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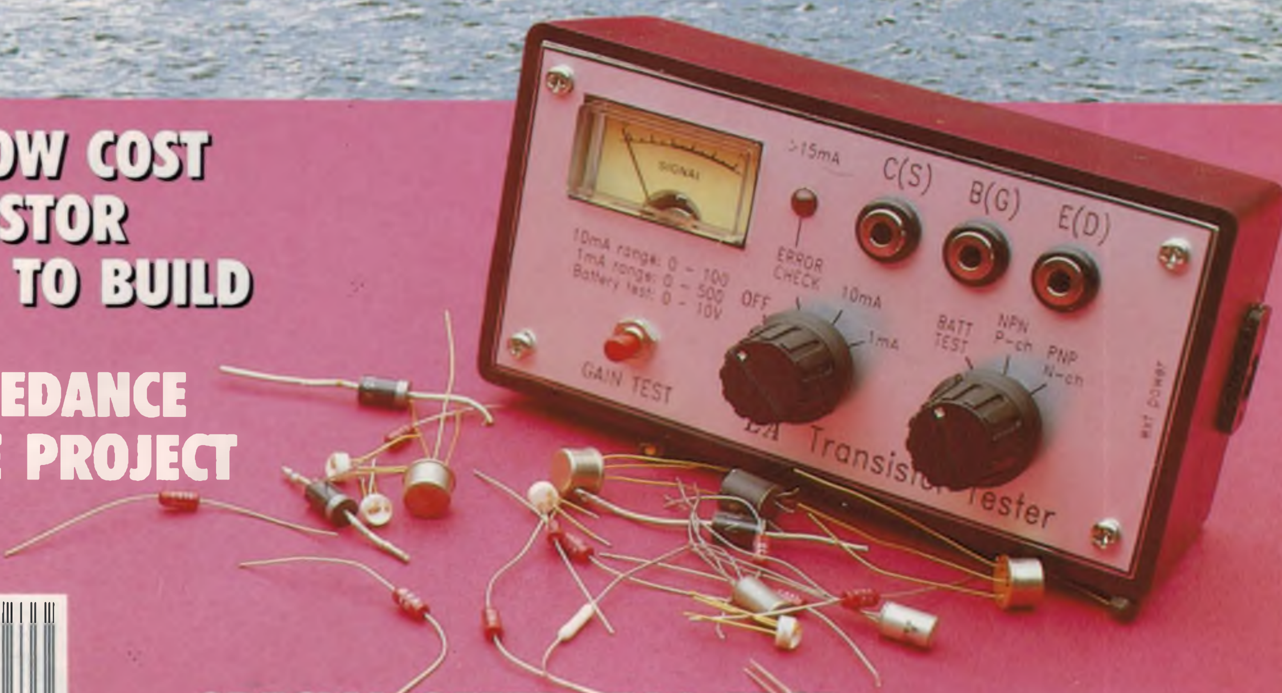

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Marconi
Instruments

Electronics Australia with ETI

Volume 52, No.12

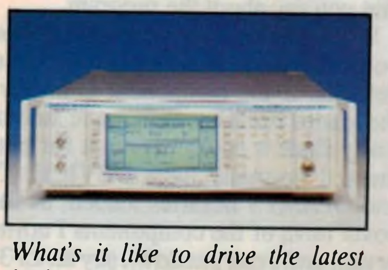
December 1990

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE – ESTABLISHED IN 1922

New low cost transistor tester

Need a simple, easy to use tester for transistors, FETs and other solid state devices? Our new design is for you – see page 86. Building it will also be especially easy for 500 lucky readers, as RCS Radio is offering that many etched and drilled PC boards – free! (page 91)

Marconi's new 2.7GHz signal generator



What's it like to drive the latest high performance, fully synthesised, computer-controlled Marconi signal generator, with all modulation modes and covering from 10kHz to 2.7GHz? Jim Rowe tells the story, starting on page 118.

On the cover

Our main picture shows International Catamaran's Seacat 'Hovercraft Great Britain', in New York earlier this year before it broke the Atlantic speed record. See our story, starting on page 140. Also shown is our new Transistor & FET Tester (Picture by John Fryz)

Entertainment Electronics

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Workstation

News and Comment

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LETTERS TO THE EDITOR

Combination lock

I am pleased to see a project on access control (August 90 Combination Lock). However there are some points that I would like to make.

The items that were called 'door lock solenoids' are electric strike releases and depending on the type of locking used, could have limitations in the security they offer. Most houses also have dead bolts fitted to their security doors and although there are types of strike to go with dead bolts, that would require two strikes for a door.

Looking at cost, now is a good time to consider options available and the security they offer. If a strike must be used, a good quality dead latch is the first consideration, then a strike that is of solid construction. Another possibility is an electric mortise lock; this offers all the advantage of a strike but normally with better security.

There are quite a few products available on the market that are Australian made and are good quality. Hardcor make the A500 and A600 strikes, Lane make the E335 and E435 mortise locks and G.W. Electronics convert a Lockwood standard backset lock. All are good quality and have service and parts available if required.

As I work with electric locking on a daily basis I felt that adding a strike and code pad would not automatically increase security and could well decrease it. The locks and strikes above are more expensive than those in the project but offer much increased security in most conditions.

Sam Wallace,
Alexandria Hills, Qld.

Help for disabled

Technical Aid to the Disabled is an organisation with separately constituted bodies in most Australian states.

TADSA is desperately in need of voluntary technical members with electronics expertise, to design and develop equipment for persons with diabilities. Technical members give their time voluntarily. The client pays for materials used and out-of-pocket expenses.

TADSA is increasingly being asked to develop various types of alarm systems and communications devices, as well as aids for the visually impaired. Requests may be complex or simple. It may be to install a switch or develop a voice synthesiser connected to a blood pressure machine, for use by a visually impaired person.

It would be greatly appreciated if you could include a note about the need for members in *Electronics Australia*.

Of interest to members is an Electronics/Communications subgroup who regularly meet to discuss projects and developments associated with equipment for persons with disabilities.

Sheelagh M. Gordon, Co-ordinator,
PO Box 112
Eastwood, SA 5063

Protel Schematic

I read with interest your review of Protel's Schematic V3.3. I have been using Protel Technology's programs for around three years now, first Protel PCB and the original Schematic, and now Easytrax and Schematic V3.3. I agree enthusiastically with all the nice things that you say about the program.

With reference to your grizzle about component placement and library defaults. If the component is in any of the loaded libraries, Schematic automatically finds it and retrieves it for placement. I normally have DEVICE, TTL and OPAMPS libraries loaded, as these cover most of the components I normally use, and I can put down say an LF356, a 7404 gate, and a npn transistor, just by typing in their names. Try it yourself, it is much faster.

Protel Schematic and Easytrax seem to have been written by programmers who are ex-technicians, or who actually LISTEN to what techs tell them. In either case a very rare breed. May they grow and prosper, and have lots of influence over future programmers.

Trevor J Stahlfest-Moller
Tech. Officer (Electronics)
James Cook University,
Townsville, Qld.

(Comment: Thanks for your comments, Trevor, I agree that Schematic can find a component if it's in any of the three loaded libraries. But what if you can't recall it's correct name? Then you have

to go through the rigmarole I grizzled about...)

Toroidal transformer

I have been reading Electronics Australia, and it's predecessors, since before the day when John Moyle joined the magazine (having applied for the position myself) and always enjoyed same.

The reason for this letter was reading the article describing the method of mounting of the toroidal transformer in the June 90 issue, and the effects of the voltage induced in the mounting bolt. My reaction was 'why not use a nylon bolt and if necessary also use nylon or plastic and plates, I have yet to see any voltage induced in nylon.

Wishing you all the best,
J.T. Self,
Macleod, Vic.

(Comment: That would certainly help in one respect, Mr. Self, but nylon also doesn't offer much shielding either. Thanks for your kind words about the magazine.

Wrong Apple

I am writing to point out an error in your August issue. The computer shown on page 59 is not an Apple IIC, but either an Apple II Plus or II Europlus. The Apple IIC is a much newer computer, which is portable and much smaller and more expensive.

Peter Fleischmann,
North Sydney, NSW.

Comment: You're quite right, Peter — was an Apple II Plus. The editorial face is now the shade of a ripe Johnathon!

Microbee spares?

Since your magazine, which I have been reading for nearly 30 years, has a wide distribution, I am writing to ask if one of your readers can help me.

I have a Microbee computer. Since the demise of the manufacturing company some years back, service facilities in North Queensland have become non-existent. I am hoping someone can put me on to a service agent or a source of parts, specifically key switches.

I would appreciate it if you could publish this letter.

Garry D. Hinspeter,
3 Undara Avenue,
Cranbrook, Qld, 4814.

DROP US A LINE!

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

EDITORIAL VIEWPOINT

Positive examples of Australian enterprise

Here we are again, at the end of another year – a year that certainly brought its share of hard work and challenges, although not without a few worthwhile achievements. I suspect a good many Australians have found 1990 rather tougher going than they'd have liked, but perhaps many of us had grown a bit too lazy and complacent, and needed this kind of 'medicine' to strengthen our characters and bring us into line with reality.

I believe you'll find quite a lot of positive, encouraging and interesting reading in this issue. One story I found particularly interesting myself was Jim Lawler's feature on the impressive new 'Seacats', developed and built by International Catamarans in Tasmania (see page 140). These are the biggest and fastest cats yet produced, you may recall, with a length of 74m and pushed along at around 35 knots by four big 5000hp engines driving massive water jet impellors. The very first one produced broke the records for crossing both the Tasman and the Atlantic, before going into service as a cross-channel ferry between England and France. Another is shortly to begin service locally on the Bass Strait run, and will carry up to 350 passengers and 84 cars across in a mere 4.5 hours.

The Seacats are pretty impressive technology, as I saw for myself when I was able to have a quick inspection of the *Hovercraft France* during its recent trip to Sydney. And as Jim Lawler explains, they're simply bristling with hi-tech electronics – much of it designed and built right here in Australia.

Another story that you'll hopefully also find interesting is my own piece describing our experiences trying out an up-market hifi system using Australian-designed and manufactured components (see *The Ozfi Experience*, page 20). Quite a few of Australia's hifi equipment designers have been quietly but steadily making their reputation, both here and in various overseas markets, and it was very interesting to try out some of their innovative new products. There's no doubt that these compare very well indeed with the best from elsewhere.

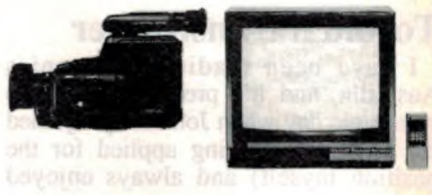
As these examples show, Australia doesn't lack for gifted, innovative designers and genuinely enterprising business people. This is surely cause for optimism for the future, despite many of the recent setbacks and debacles.

Incidentally this month's issue isn't short of reading for those with a more technical bent, either. There are plenty of construction project designs, including a new low-cost transistor and FET tester, an impedance bridge for VHF and UHF, an encoder for 'IBM' keyboards, and details of how to modify Icom BP-70 battery packs to allow transmitting while you're recharging. These, along with reviews of AT&M's new 'radio modem' kit and Marconi's very impressive new 2.7GHz signal generator should give you plenty of reading and inspiration, until next month's big annual digest issue...

In the meantime, we extend best wishes to all of our readers, advertisers and friends, for an enjoyable Christmas and New Year holiday season – from all of us here on the *Electronics Australia* team.

Jim Rowe

What's New in VIDEO and AUDIO



'Horizontal' camcorder from Akai

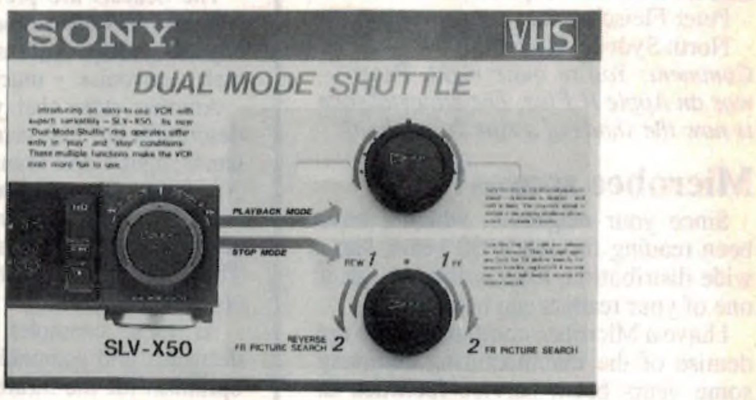
Akai has now reentered the camcorder market with the introduction of the PVS-C100E camcorder.

The PVS-C100E offers a number of innovative features, the most notable being the camera's 'horizontal' design. Akai's market research has apparently shown that two-handed operation is popular and preferred because of the stability it offers. The horizontal design of the PVS-C100E allows it to be comfortable handled and used in one hand, but two-handed operation allows full operational control without taking your eye from the viewfinder.

The unit incorporates a 420,000 pixel 0.5" CCD sensor, claimed to be one of the highest resolutions in the industry. Other features include two speed rec/playback, a high speed shutter to 1/2000th of a second, 8x power zoom, fully auto features such as auto exposure, auto focus and auto white balance. Auto operation can be overridden for manual operation with two settings for indoor and outdoor light conditions and a manual white balance. The electronic view finder can be adjusted to 90° (vertical) for low angle shooting.

The PVS-C100E is supplied complete with cassette adaptor for playback on VCR's, an AC adaptor battery charger plus one battery. It is covered by a 12 month warranty, has a recommended retail price of $1899 and is available at selected Akai dealers and department stores.

Three more VHS VCRs from Sony



Sony Australia has introduced three new VCR models with innovative features designed to offer convenience and outstanding performance.

The SLVX50, with DA Pro 4 head for high picture quality, features Sony's new dual mode shuttle ring. This gives you easy control of all major tape transport functions, and yet eliminates many of the buttons usually cluttering the front panel. In playback mode, tape speed can be adjusted from 1/5th to normal to double speed, and then search in both forward and reverse. From the stop mode, turn full left or right and release for rewind or fast forward, turn fully again and you can picture search. The centre of the shuttle ring also doubles as a play button.

The Sony SLVX50 also offers an auto head cleaner, on-screen menu system, high speed rewind plus an array of other convenient features which have already received excellent consumer acceptance.

The new line-up includes the SLVX30, which also features the dual mode shuttle ring, auto head cleaner, digital auto tracking, high speed rewind plus Sony's on-screen menu system. Functions such as clock setting and timer programming are easy with the on-screen menu system because it guides you with simple commands.

The SLVX20 features remote timer programming for the convenience of timer setting from your armchair. Other functions include frame still, frame advance, fast response picture search and blank search (which searches for the next blank point on your tape, so you can easily begin your recording on the next unrecorded section).

Sony's Super Access Mechanism, available on all its VCR's, gives fast response – in fact less than a second between pressing the play button and the picture appearing on the screen. All the models come with unified remote commanders allowing control of the VCR and your Sony Trinitron CTV from one handy unit.

These new models will be available through the Sony Dealer Network at a suggested retail price of $749 for SLVX50, $629 for SLVX30 and $579 for SLVX20. Sony will also continue with its top-end VHS hifi model, SLV757.

Metal-finish 'midi' systems from Pioneer

'Personna Plus' is the latest range of 'midi' stereo systems from Pioneer, offering a full selection of compact hifi components packaged to save living space and be unobtrusive in the home, while giving full size performance. The three hifi systems in the range have also been priced to meet the pockets of most people who wish to combine quality sound with value for money.

Complementing the presentation of the Personna Plus is a new stylishly designed cabinet, CB777, to house the systems.

The Premium member of the new range is the Z-999. Apart from the expected features of a sophisticated system – including a quality full logic twin auto-reverse cassette deck, electronic graphic equaliser, 50W/channel amplifier, quartz-PLL tuner, and three-way four speaker system and surround sound facilities – this also has some special aspects:

- CD direct, which reduces inteference and distortion by by-passing unnecessary circuitry;
- Motor-driven remote volume, which gives a clearer and smoother control compared to that of other systems;
- Sophisticated but simple to use auto-synchronised editing system. With the push of a single button, the system automatically cues the tape for recording, rewinds to just before the ending, then fades out, changes sides of tapes when recording is completed, and synchronises with the music source CD.
- A multi-program timer with one record and two wake-up timers; and
- A 'user friendly' graphic display.

The purchasers of the Personna Plus Z-999 have the flexibility to add any of the three compact disc players – either the six disc multiplay (PDZ83M), the twin CD player (PDZ73T) or single CD player (PDZ63).

The Z-999 will retail for a recommended retail price of $1799 plus CD player.

New camcorder from Panasonic

Panasonic's new compact NV-MS90 Super VHS-C camcorder can shoot continuously for 90 minutes in long play mode (using Panasonic's 45 minute tape NV-SEC45EXD) – ample time to capture an entire event such as a wedding service, graduation ceremony or football game. Its automatic focus means that even a beginner should be able to produce professional results from their first 'shoot'.

An easy-to-read panel on the side of the camera shows the remaining battery capacity, elapsed time and remaining tape available. For creative filming the digital title memory will insert titles when shooting, wiping and scrolling.

The camera's frame interline transfer (FIT) system stops smearing, so you can confidently film events such as a child blowing out the candles on a birthday cake, without fear of the candles looking blurred.

The Super-VHS facility (with a high resolution of more than 400 horizontal lines) ensures detailed textures, intricate patterns and striking colours are accurately reproduced.

The NV-MS90 has a recommended retail price of $2799.

Marantz amp delivers first 20W in class A

The new Marantz PM80 integrated amplifier produces an output of 110 watts per channel into 8 ohms, of which the first 20 watts are pure Class A. The PM80 can also be switched into pure Class A operation for the sweetest, clearest sound quality.

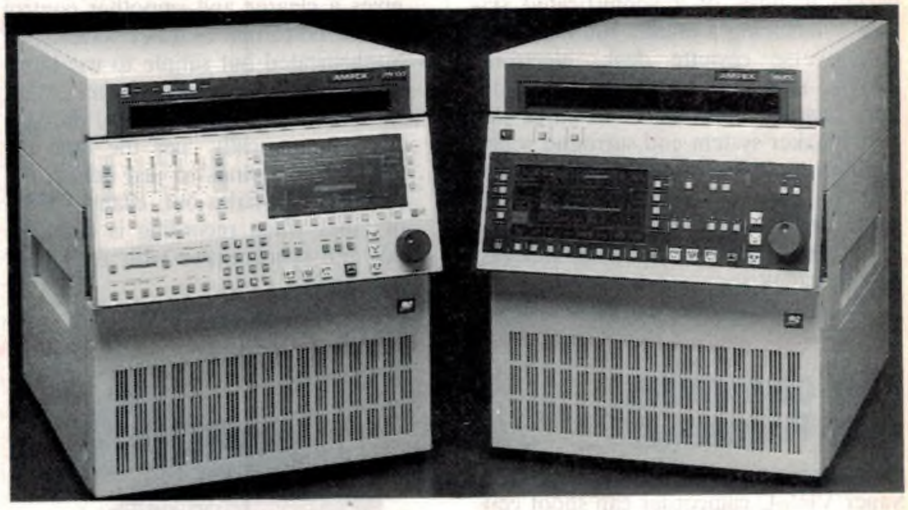
Beyond the 20 watts per channel point of Class A, the PM80 switches smoothly and automatically to Class A/B operation – the amplifier itself sensing the actual current and voltage drawn by the speakers. The amplifier also has the ability to drive the most complex loud speaker systems by delivering a massive 340 watts (RMS) into a 2-ohm load, making it ideal for today's demands of digital sound.

Input facilities include three pairs of tape inputs and outputs, CD or CDV, tuner, three auxiliaries and phone for both magnetic and moving coil cartridges – not usually found in an audiophile amplifier.

With a recommended retail price of $1299, the PM80 carries a two-year warranty. A special hotline to the company's Sydney headquarters (02) 742 8322 ensures availability of sales and product information.

VIDEO and AUDIO

Ampex unveils new professional video gear



Ampex highlighted a number of new products and enhancements at the International Broadcasters Convention (IBC), held recently in Brighton, UK. These included three D-2 format composite digital studio VTRs.

The new PAL recorders (the VPR-200, VPR-250 and VPR-350) join Ampex's established VPR-300, bringing the company's D-2 recorder complement to four – the broadest studio offering of any manufacturer. The VPR-200 (three cassette capability) and VPR-250 (two cassette capability) are optimised for broadcast and mid-market post-production applications where fast, easy operation, signal quality, cassette play length and maintainability are key. The VPR-300 (three cassette capability) and the VPR-350 (two cassette capability) are high-performance machines optimised for high-end post-production applications where signal quality, multi-generation performance and high-speed editing capabilities are paramount.

Ampex also unveiled a new audio recovery process for its D-2 composite signal VTRs. Called Accu-Mark, the process dramatically improves audio clarity at still or slow speeds, allowing precise audio editing that is superior to any digital or analog video format in use today. The Accu-Mark audio recovery process overcomes the noise which creates difficulty in accurately picking a specific location on tape when editing the digital audio tracks on all non-Ampex D-2 VTRs.

Ampex has submitted its unique Accu-Mark process for patent protection and is providing this capability exclusively on Ampex VPR-200 and VPR-300 series D-2 studio VTRs as a new standard feature. Existing system owners will receive the Accu-Mark feature free of charge as a software system update.

Another new product displayed was the new ACE 10 low-cost video editing system. The ACE 10 system offers the features most demanded by editors in broadcast news applications, as well as moderately-sized post-production and corporate facilities.

An A/B roll, three-machine edit-controller, the ACE 10 system operates on a standard computer platform. It features a simplified operations keyboard, Help Text, easy-to-read status display and list management capabilities. The new system is designed to provide practical features essential in newsroom and corporate editing environments, such as full switcher control, sequential auto assembly, and a 250-event edit decision list (EDL). List output may be in either CMS340 or SMPTE format.

Further details on the new Ampex products is available by circling 181 on our reader service coupon or by contacting Ampex Australia, 61 Talavera Road, North Ryde 2113; phone (02) 887 3333.

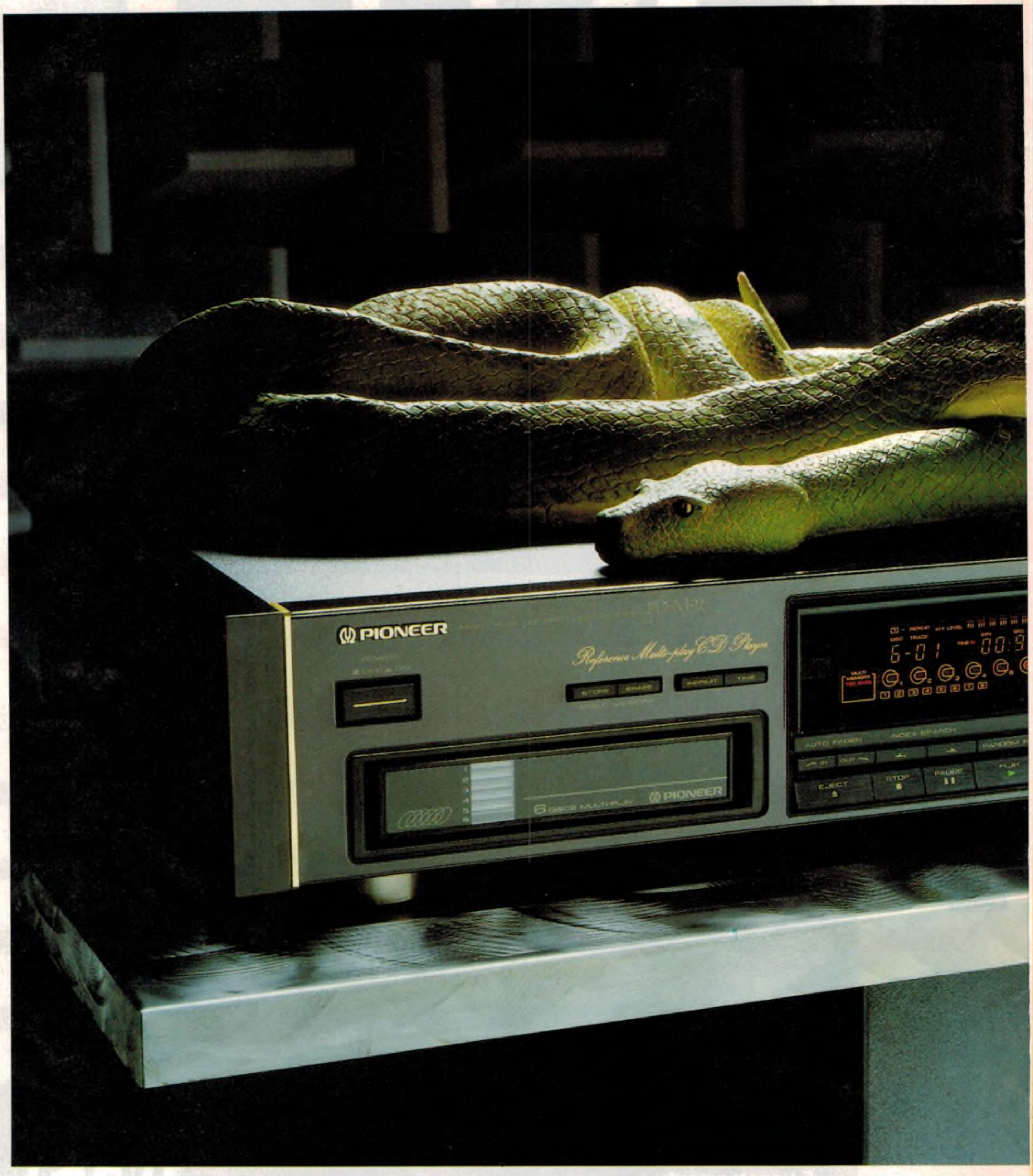
Award to Challis & Associates

EA columnist Louis Challis and his colleagues at the Sydney-based acoustical and vibration engineering consultancy Challis and Associates have been honoured with an Award of Merit by the Association of Consulting Engineers Australia (ACEA), for the development of a novel and cost-effective system to monitor and analyse the noise produced by aircraft landing and taking off from Sydney's Kingsford-Smith Airport.

The system was developed as part of the General Curfew Study for the Airport. Funding for the project did not allow the purchase of noise monitoring equipment from overseas, so Challis & Assocates designed, developed and assembled their own system with 15 computerised sound loggers. These included high precision outdoor microphones with associated field calibration and interrogation equipment.

Despite limited development time, the system worked very well and cost less than half the figure quoted for a single monitoring system from overseas.

Following the original study, the systems have been used in hundreds of subsequent noise analysis studies around Australia, and also in New Zealand.

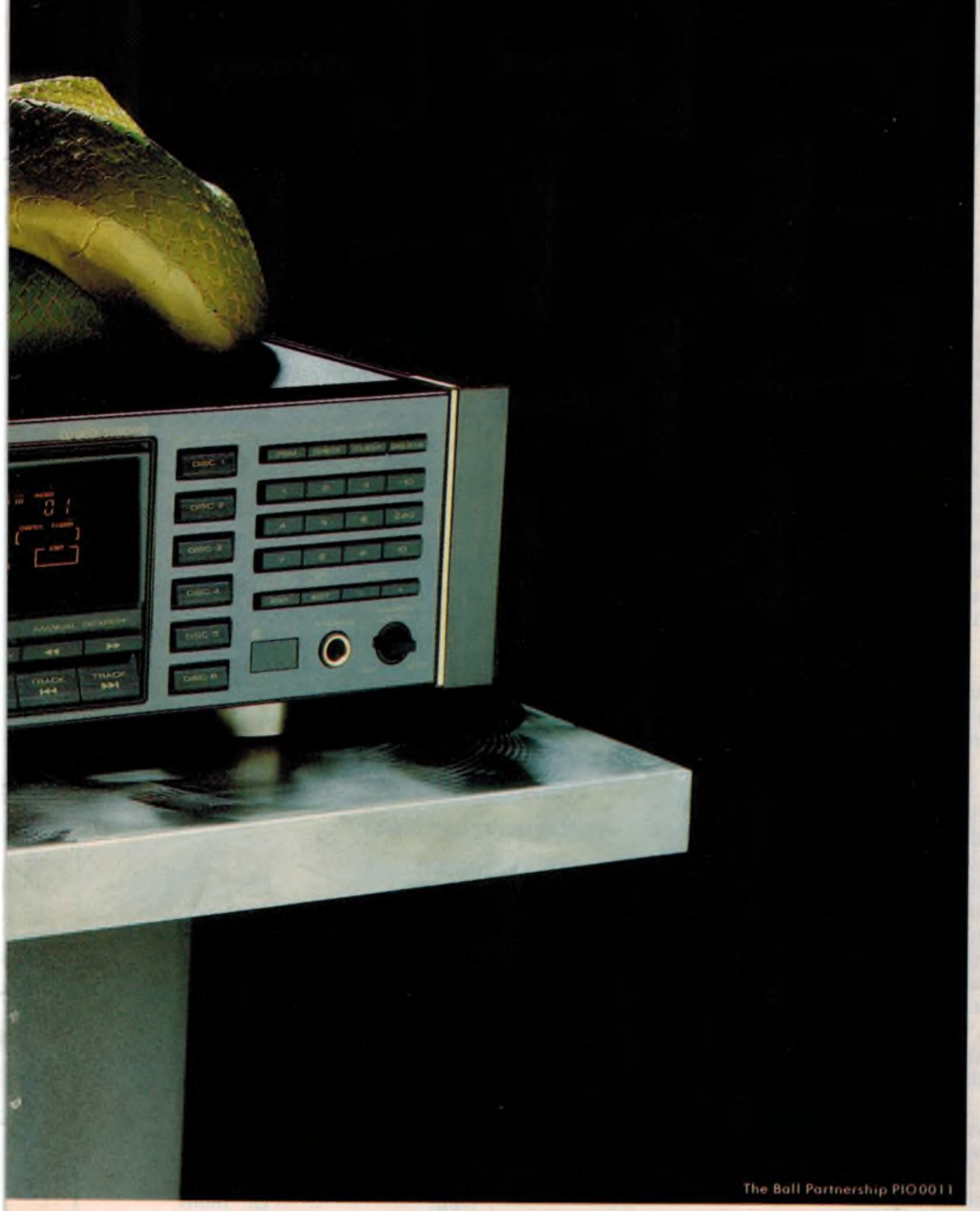


PIONEER

The Art of Entertainment

This snake is in the perfect position to judge this CD's sound quality.

(Even if he is deaf.)



The Green Tree Python like most snakes, is as deaf as Beethoven.

But like the great composer, it has managed to rise above such a deficiency and has instead evolved a sensitivity to vibrations far beyond we mere humans.

Which is exactly what puts it in an excellent position, strange as it sounds, to judge one of Pioneer's latest advances in high fidelity.

Take the case of their top-of-the-range Reference Multi Compact Disc player.

Or, rather, the base which is built to a unique honeycomb design that increases its rigidity and helps dampen resonance and vibration coming from such outside sources as footsteps or even the speakers.

Meaning perfectly accurate tracking for the laser — and ultimately, perfectly accurate sound reproduction.

Which is why you could play the heaviest metal on this unit without so much as a hiss out of this light sleeper.

And, of course, why Pioneer leads the world in sound.

READER INFO No. 3

The Challis Report:

JAMO'S COMPACT 'CONCERT II' SYSTEM

As with the larger systems in the Jamo range, the new Concert II bookshelf system provides Danish elegance and superb finish – along with technical innovation. Louis Challis reports that it gave impressive results with classical and vocal music, in particular.

Having only recently reviewed the Jamo Concert VII, which I consider to be a technically outstanding speaker system, I was more than pleased to have the opportunity to review their much smaller brothers – the Concert II's. These are quite diminutive in comparison to the Concert VII's (413 x 250 x 255mm, with a weight of 9kg each) and obviously their performance characteristics must relate to their size and their lower cost.

In the European market the main emphasis still appears to be directed towards the marketing of bookshelf speakers, as there are innumerable small flats or apartments which have minimal space for floor-mounted hardware and especially loudspeakers. Not so surprisingly, 'bookshelf' speakers outsell the rest by almost 2:1, although the monetary value of those speakers is obviously disproportionate.

The Danish approach to the manufacture of furniture and related consumer goods is to 'mass produce' and, it should be noted, invariably with a quality of finish that borders on the 'superb'. With a local and export market which is fully reconciled to producing quality furniture, Jamo have adopted the ethos of the industry and consequently even the little Concert II's are veneered on the sides and even on the back, to a higher standard than that offered by almost any of their American or Japanese competitors.

The front of the cabinet is however, injection moulded from a 'mass loaded' plastic composite material, which is visually and functionally superior to veneered timber and obviously has the added bonus of reducing the manufacturing costs.

Of course the manufacturer's blurb will tell you that this material was selected because its main attribute is that it effectively dampens spurious sound radiation and unwanted cabinet resonances, which tend to be an all too common problem with most conventional forms of cabinet construction. An equally significant advantage which results from the adoption of this plastic composite front panel is that it allows the cabinet designer to add inserts, like magnets, and simple slots into which folded cloth covered steel face panels can then be neatly and delightfully inserted.

As you must have guessed by now, these features and a number more (which were not immediately quite so obvious), have been adopted in the front panel design. These include the adoption of a carefully sculptured face panel, to reduce fresnel dispersion effects from the 30mm diameter soft dome tweeter, and an equally well contrived insert structure into which the well-engineered 140mm diameter low frequency driver is neatly inserted and cunningly retained.

Jamo engineers have taken considerable trouble to optimise the sound radiation and dispersion characteristics of both these drivers, which have above average performance over the range 90Hz to 22kHz when measured under anechoic conditions. Of course the Concert II's have not been

MEASURED PERFORMANCE OF JAMO CONCERT II LOUDSPEAKERS

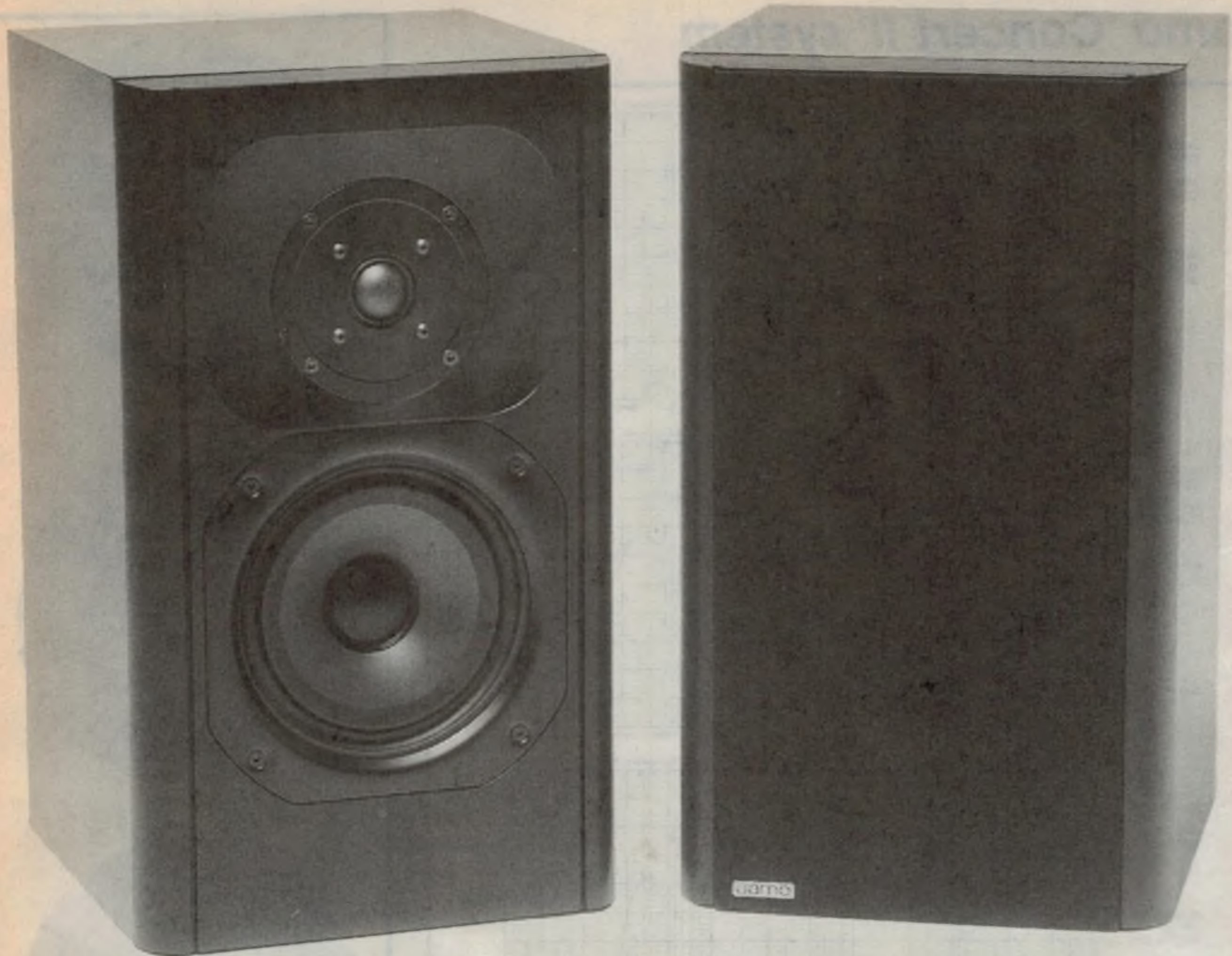
SERIAL NO. 54279697

1. **Frequency response** 90Hz to 20kHz +/–6dB
2. **Crossover frequencies** 2kHz
3. **Sensitivity**
   (for 90dB average at 2m) 10.5V RMS = 13.8 watts (nominal into 8 ohms)
4. **Harmonic Distortion**
   (for indicated levels at 1m)

	90dB 100Hz	96dB 1kHz	90dB 6.3kHz
2nd	–33.1	–57.7	–47.6dB
3rd	–38.9	–48.7	–54.0dB
4th	–56.5	–70.6	–66.2dB
5th	–58.1	–62.0	-
THD	2.5	0.40	0.46 %

6. **Input impedance** **100Hz/7kHz 4:1**

100Hz	14 ohms
1kHz	25 ohms
6.3kHz	8 ohms
Min at 4kHz	6 ohms



Compact but very solid, the Concert II's give impressive results. The front panel is plastic composite material.

designed for anechoic listening, and the design has been optimised to produce the best possible performance when mounted on a shelf or specifically in a bookcase where the low frequency response can provide appropriate loading (and reflection) for the rear loaded venting port.

As the intended market niche of these speakers was as a 'bookshelf' speaker system, or alternatively attached by brackets to a wall, it was logical to put the loading port at the back of the cabinet, so that the frequency region between 50Hz and 90Hz could then derive maximum possible benefit from this supplementary low frequency phase-additive output component. Having accepted this philosophy, one might question the designer's penchant for then veneering the back of the cabinet – which would then be unlikely to be seen by anybody other than the purchaser or their installer.

The rear of the cabinet has been neatly fabricated, with a very sensible deeply recessed moulded well for the two large gold-plated universal terminals. This deep well structure ensures that the speakers do not need to stick out too far from the wall when the speaker leads are attached, and thereby further complicate the installation, which is a problem I have observed on many other small speakers.

Each speaker's internal wiring, which inter-connects the rear terminals with the well made crossover network and the two drivers, uses unusually heavy wire interconnects. This is good design pratice for a quality speaker. Although the cabinet is small, it is well braced internally and considerable trouble has been taken to effectively dampen and reduce unwanted spurious sound emission from the outer surfaces of the cabinet.

The speakers themselves are well designed, and the long throw of the 160mm driver provides a capacity to generate significant output levels all the way down to 60Hz. The tweeter uses a ferro-fluid in the magnet's voicecoil air gap to increase its thermal dissipation capability, and I suspect to avoid the cost of a supplementary protection circuit.

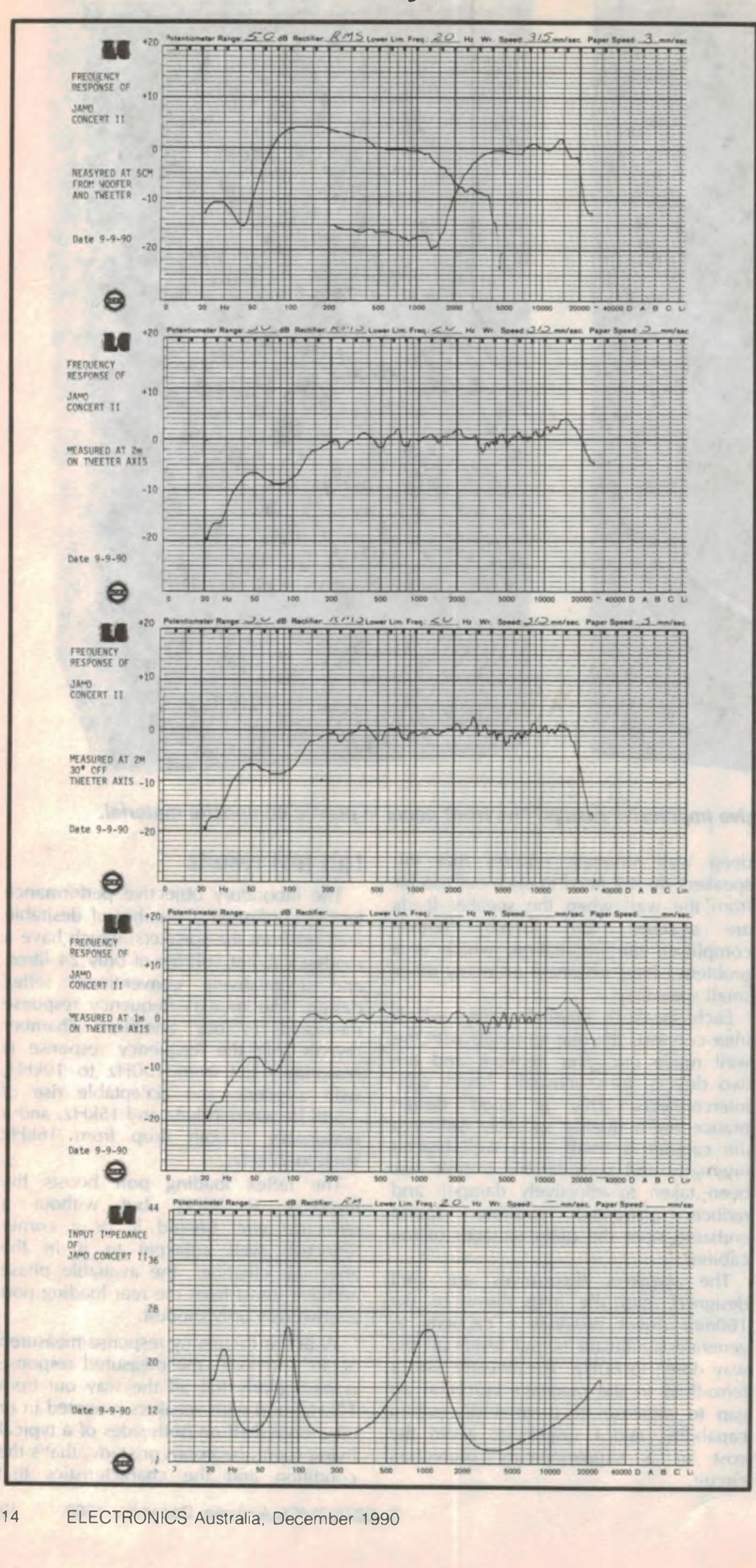
Lab test results

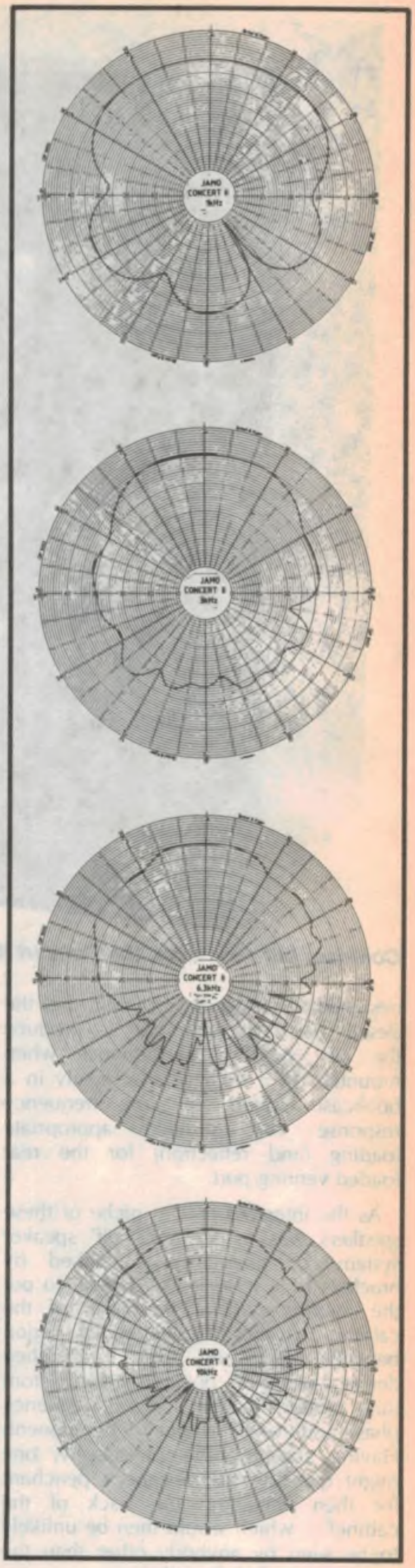
The laboratory objective performance testing confirmed a number of desirable features from the speakers, which have a modest cabinet volume of only 24 litres, and a relatively conventional reflex design. The on-axis frequency response measured in our anechoic chamber reveals that the frequency response is reasonably flat from 100Hz to 10kHz, with a gentle and acceptable rise of +5dB between 10kHz and 15kHz, and a reasonably smooth drop from 16kHz back to 22kHz.

The reflex loading port boosts the response at 50Hz, but without a reflective wall behind it, or a corner reflective wall adjacent to it in the anechoic chamber, the available phase additive boost from the rear loading port is obviously only modest.

With the frequency response measured at 30° 'off axis', the measured response is particularly flat all the way out from 17kHz, and with speakers mounted in or on a bookshelf on both sides of a typical living room, bedroom or study, that's the condition and the characteristics that

Jamo 'Concert II' system



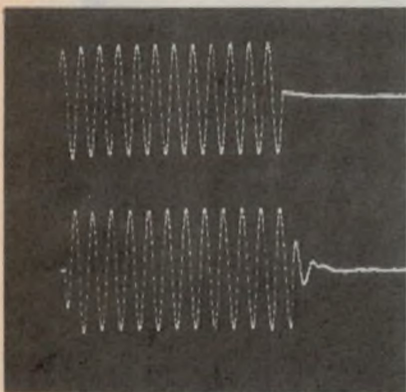


At left are the various frequency plots for the system: close-proximity, 1m and 2m responses on axis and at 30°, and the input impedance. Above are the polar plots at 1, 3, 6.3 and 10kHz.

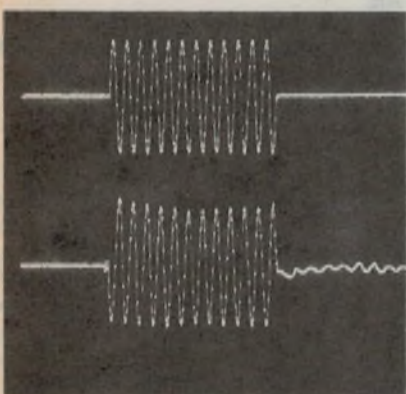
TONE BURST RESPONSE OF JAMO CONCERT II LOUDSPEAKERS

(For 90dB steady state SPL at 2m on Axis).

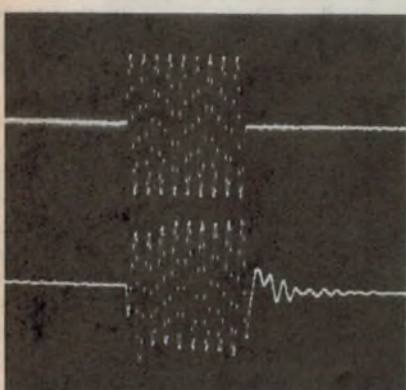
Upper trace is electrical input. Lower trace is loudspeaker output.



100Hz (20ms/div).



1kHz (2ms/div).



6.3kHz (0.5ms/div).

Above: tone-burst responses of the Concert II system at 100Hz, 1kHz and 6.3kHz. Overall the response is quite smooth, and with minimal signs of unwanted resonances from either the drivers or the enclosure.

most people would experience when listening to these speakers.

The close proximity frequency response measured at 50mm from the face of the low frequency driver and similarly 50mm from the face of the tweeter are reasonably smooth and confirm that the crossover frequency is 2kHz, with the potential for a significant notch in the crossover region.

An examination of the polar plots reveals that the off-axis responses are particularly smooth all the way up to 10kHz. At 10kHz, the response is only 3dB down at +/–30°, while at +/–60°, the response is down by only 9dB. At higher frequencies the high frequency directivity characteristics are more marked, but not unreasonably so.

One of the most important and telling investigations of a speaker's response is the quality and uniformity of its impulse response. In this particular case, the impulse response is very smooth with minimal signs of unwanted resonances from either the transducers – or more significantly from the cabinet, whose design concepts have been particularly well conceived. The tweeter response is not quite as smooth as I would like, and both the decay response and the subsequent room responses displayed a clearly defined notch round the 2kHz crossover frequency, which did not show up as clearly in the on-axis anechoic room swept frequency response measurements.

The impulse response also highlighted the presence of some low-level natural resonances, which would result in some audible colouration of the reproduced sound under normal playing conditions. These characteristics also showed up quite clearly in the high frequency tone burst measurements conducted at 6.3kHz.

The measured input impedance characteristic of the Concert II is quite bumpy, with peaks of 22 ohms at 25Hz, 25 ohms at 80Hz and 25 ohms at 100Hz. The lowest impedance is 6 ohms, over an extended band between 3kHz and 4kHz. Although the Concert II's are described as 8 ohm speakers, applying the IEC principles, it would be more appropriate if these speakers were described as being 6 ohms impedance.

The last set of measurements, of harmonic distortion, revealed the common problem of limited power handling capabilities of small speakers when driven hard at 100Hz. Under these test conditions, there is significant measurable distortion at 100Hz, but fortuitously, there is much lower harmonic distortion at higher frequencies, which is obviously a very desirable feature.

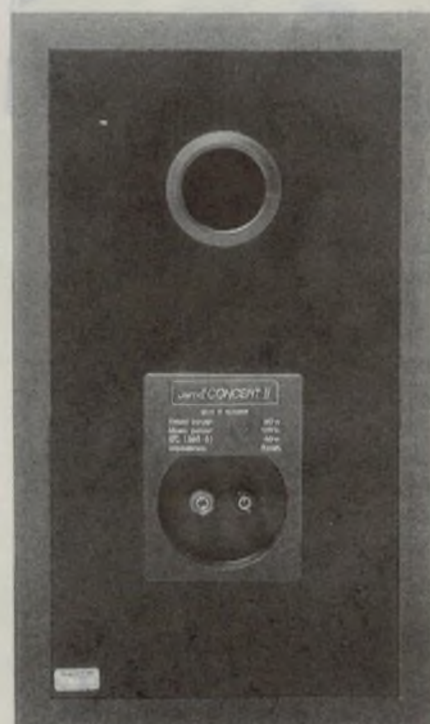
Taken overall, the objective test results are reasonably good for such a small enclosure and I was satisfied that the Concert II's should be capable of performing reasonably well when subjected to a critical subjective evaluation.

Because of their cost and the quality of finish of the cabinets, I suspect that most purchasers of the Concert II's will be classical fans, and that their preferred or most likely function will be in the reproduction of both orchestral music and focal reproduction – with a strong likelihood that the user will be seeking above average performance and most likely at high listening levels.

Listening tests

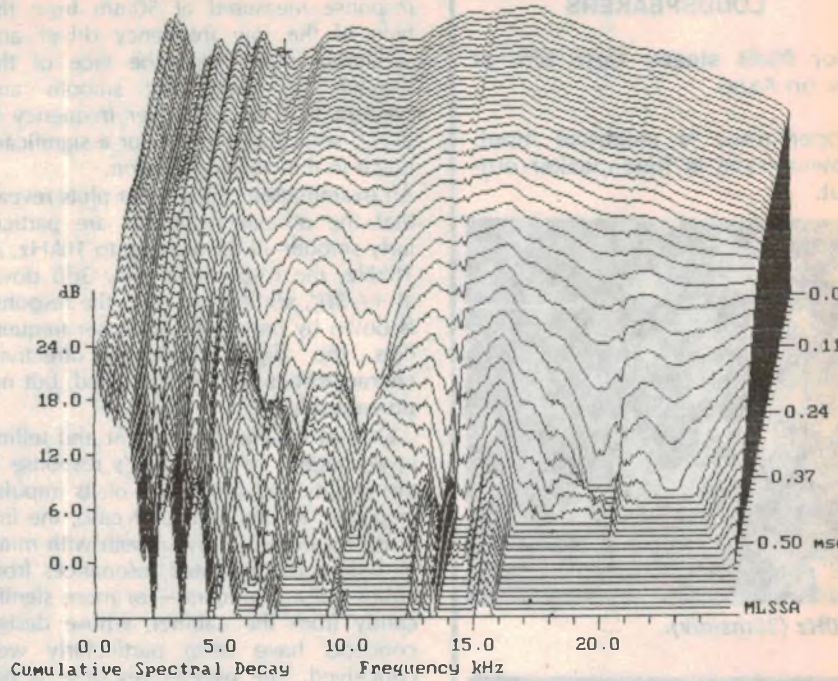
In order to put these premises to the test, I evaluated the Concert II's with this type of music. The first disc I auditioned was Donald Shanks, the notable Australian operatic bass accompanied by the organist Robert Baughen, in 'Songs & Ballads' (ABC 426803-2). The music on this particular disc was recorded in the Queensland Cultural Centre and the disc is a tribute to the quality of Australian recording techniques, which are clearly still in advance of most imported discs. This well-recorded disc provided excellent organ music, which tested the speakers, but the best feature was the well-balanced reproduction of Donald Shanks' outstanding voice.

The Concert II's provided an excellent and life-like voice reproduction, and I must acknowledge that I enjoyed the selection of songs and music, as well as



Rear view of a Concert II enclosure, showing the rearward-facing tuning port and the recessed terminal plate.

Jamo 'Concert II' system



The cumulative spectral decay plot for the Concert II system. The initial response is fairly smooth, but with a notch in the vicinity of the system's crossover at 2kHz.

the reproduction of the organ accompaniment. This was particularly good and both the disc and speakers earned top marks.

The next disc which I played was Jose Carreras singing 'Italian Opera Composer Songs' from Bellini, Donizetti, Rossini and Verdi – Sony Classical SK 45863.

This disc was recorded after Carreras recovered from a serious operation in 1988. The song selection features beautiful love songs from the late 1800's, which in almost all cases the composers deigned to include in their major operas.

Whilst the 20-bit technology works quite well on this disc, the recording engineer's choice of microphone positions does not really favour the direct signal to quite the degree that I would like for a truly perfect recording. The spatial separation of the microphones results in a trifle too much emphasis on the room's reverberant signal, and this de-personalises the intimacy of the singer and his singing. The Concert II's functioned very well and Jose Carreras, the piano and the Jamo speakers got a four star rating – but the recording technique would only get a three star rating.

The third disc I used for my primary assessment was a trifle different from what I would normally use, and featured the Sydney String Quartet playing 'Australian String Quartets', with pieces composed by Don Barks, Andrew Ford, Alfred Hill and Wilfred Lehman.

This disc contains 'avant garde' Australian music, which is well played, extremely well recorded, but is frankly not the sort of music which will necessarily please, nor attract a large following. The Concert II's provided a wonderful response and it should be noted at true chamber music recital listening levels.

I played the music at levels of up to 105dB at my seated position, and although the distortion was starting to be audible at the low frequencies, the high frequency performance was still reasonably smooth and particularly clean.

After three weeks of auditioning the Concert II's, I am satisfied that these speakers are reasonably well suited for the primary task of classical music reproduction, that they will provide above average quality of reproduction of singers, and offer fair but not outstanding reproduction of organ music. However, they are not well suited to the reproduction of rock music, or other music which contains dominant bass characteristics.

At a recommended selling price of $1090 they offer a good performance in small rooms and in situations which do not lend themselves to the adoption (or purchase) of larger speakers.

Further information on the Jamo Concert II system is available from distributor Scan Audio, of 52 Crown Street, Richmond 3121 or phone (03) 429 2199. EA

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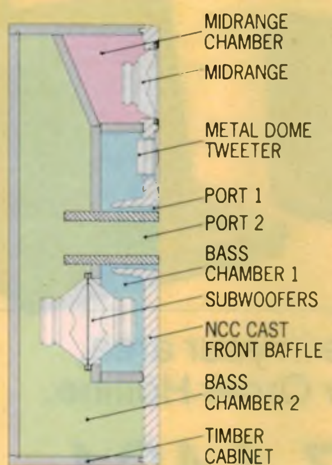

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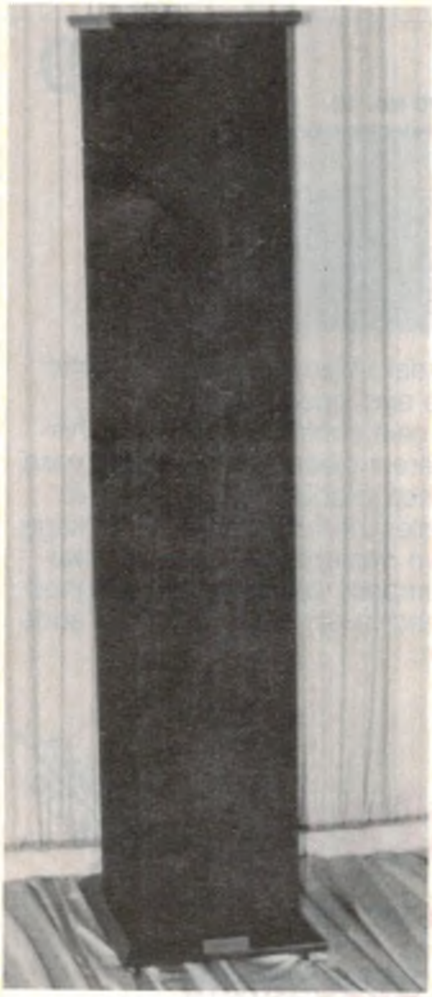
THE OZFI EXPERIENCE

ozfi

Following on from our discussion of esoteric hifi cables in 'Forum', we were contacted by representatives of 'Ozfi' – the group dedicated to raising market awareness of Australia's own hifi manufacturing industry. Would we care to try out an impressive system based on locally designed and manufactured components? Indeed we did, and here's our report.

by JIM ROWE

A few days after the phone call from Ozfi representative Trevor Wilson, an impressive set of gear was delivered with the message: "Keep them for as long as you need – make sure you get a good *feel* for the level of performance and sound quality that this level of system can provide."



Actually the Ozfi people also wanted to install the system for us, just to make sure everything was set up correctly. However we elected to do this part ourselves, to get a better feel for the equipment as well. They weren't overly happy about our doing so, presumably because installation is part of the normal service; but they went along with us.

The system consisted initially of an ME 850 power amp and ME 25 preamp combination, from ME Sound; a pair of Audio Definition 'Silhouette' tower speakers, by courtesy of Audio Definition and Pirimai HiFi and Video; a Sound Research CD-IV compact disc player, by courtesy of Trevor Wilson himself; and a set of Cardas 'Hexlink Five Series' interconnecting and speaker cables, by courtesy of importers The Audio Connection. (All address information is given at the end of this story, by the way.)

After a couple of weeks, the Sound Research CD player was replaced with a high performance Harman-Kardon HD7500 single-bit player. Similarly the Audio Definition speakers were needed for a demonstration to an important client, so these were replaced with a pair of 'Dolomite' enclosures from Orpheus Loudspeakers.

Overall then, the experience gave us an excellent opportunity to carry out 'driving tests' of some impressive high-end hifi gear, from Australian designers and manufacturers. But before we report on our reactions, this is probably a good time to give you some background on the Australian manufacturers concerned, and the products themselves.

The firms...

ME Sound is a small company based in rural Dyers Crossing, about 30km south of Taree on NSW's northern Central Coast. Its driving force is director Peter Stein, who is also the firm's chief designer. Peter has been designing and building high-end amplifiers since 1976, based on his own somewhat distinctive philosophy – acquiring in the process a growing national, and indeed international, reputation for his 'no compromise' dedication to sound quality.

ME has produced over 3000 of its amplifiers and preamps to date, and currently produces some six different power amplifier models, two preamps and a speaker control unit.

Audio Definition is a manufacturer of high-end loudspeaker systems, and is also based on the NSW Central Coast – in this case, at Port Macquarie. The driving force is a lady called Lia Galante, who is again the firm's chief designer. In fact she is by repute Australia's only female designer of audio gear, with a steadily growing reputation for combining acoustic performance, very solid construction and excellent cabinet finish.

Although established for only three years, Audio Definition has launched some five different systems to date. Already these have made a significant impact on the high-end market. All A-D systems are based on extensive computer-aided design techniques, and verification of driver and crossover filter optimisation.

Orpheus Loudspeakers is also a maker of high quality speaker systems, based in the Sydney suburb of Lilyfield. Here the designs all emanate from Brad Serhan, who also hand-assembles and thoroughly tests all systems personally. Brad also goes to great lengths to remove cabinet resonances, and his enclosures are characterised by their particularly solid construction, bracing and internal damping panels.

I probably don't need to point out that Sound Research, Harman-Kardon and Cardas are all imported products, and were essentially provided with the Australian components to provide a suitable level of system support. Those who are readers of Forum will already be familiar with the cable design philosophy of George Cardas, as we reproduced a letter from the man himself in the September issue. Whether or not one agrees with his philosophy, his cables certainly have a reputation for high performance in making both system interconnections and the important power amp-loudspeaker links.

The Sound Research and Harman-Kardon CD players are also of undoubted high quality, making them well suited for demonstrating the capabilities of the Australian-made gear.

...and their gear

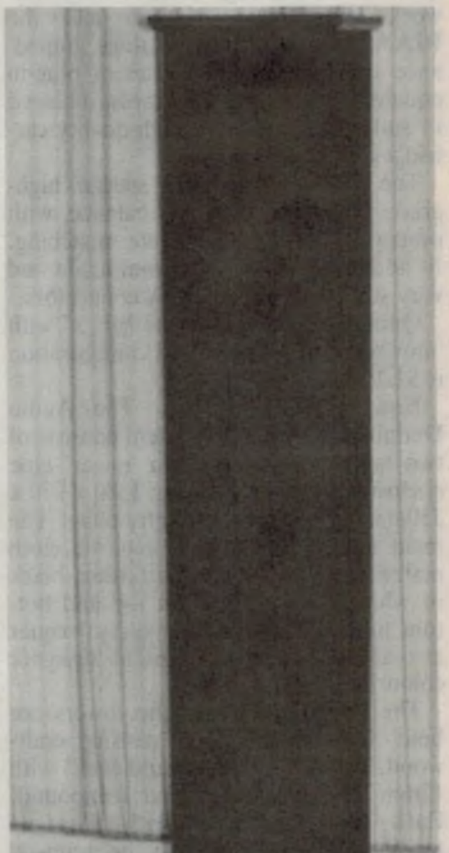
ME Sound's model 850 power amp is a relatively recent addition to the firm's range, with a power capability placing it in about the middle of the range. My understanding is that it's a 'beefed-up' version of the previous model ME 750, which was itself an upgraded version of Peter Stein's original model ME 75 (which was reviewed back in March 1984 by Louis Challis, in *ETI*).

As with the other models in ME's range, the 850 firmly embodies various aspects of Peter Stein's rather distinctive design philosophy — which is apparently based in part on the somewhat controversial work of Matti Otala. There isn't space here to go into Peter's philosophy in detail, but here are some of the more salient points in summary form:

1. **No loop negative feedback**. None of the ME amplifiers employs a negative feedback loop around the output stages. There is a negative feedback loop around the input voltage amplifier section, but the output, driver and predriver stages are fitted only with local emitter degeneration. This is to prevent any possibility of speaker EMF's entering the amplifier and degrading its transient or other behaviour, via the negative feedback loop. However the output stages use many power transistors in parallel, to provide suitably low impedance, and great care is taken to select accurately matched active devices and other components. The output stages use bipolar transistors, and are also operated in class A at low levels, for maximum linearity.
2. **High output current capability**. In addition, the output stages are each designed to be able to deliver up to 70 amps peak (20% duty cycle) into the load. This is to ensure that the amplifier can faithfully handle the peaks of large signals.
3. **Large power supply, with distributed reservoir C's**. To allow the amplifier to deliver such peak current levels, its power supply uses a particularly large and husky (read 'heavy') transformer. Separate secondaries and supplies are used for the two channels, to minimise crosstalk, with each supply using an unusual array or 'matrix' of many smaller reservoir capacitors in parallel, rather than one or two high-value units. The latter is to provide much lower series inductance and resistance, and hence again increase the transient current capability.
4. **Elevated output stage temperature**. Whereas other designers attempt to keep their output stages as cool as possible, in Peter Stein's designs a special thermostatic fan system is used to maintain them at a relatively elevated temperature — 60°C, in fact. This is done to improved the gain, bandwidth and transient distortion performance of the output stage devices, and also to ensure that current swings due to large music transients cannot have have any significant 'modulating' effect on device junction temperature — and hence transient performance.
5. **Symmetrical balanced topology, rounded clipping**. ME amplifiers use a balanced topology with matched positive- and negative-going slew rates and settling times, again to minimise transient distortion. They also employ circuitry to ensure that when clipping is finally reached, it takes place in a 'rounded' fashion, with low-order and hence less audible harmonic content.
6. **DC servo to maintain low output DC**. To avoid the need for output coupling capacitors, ME amplifiers employ a separate 'DC servo' control amplifier to maintain the output stage DC voltage level to within a millivolt or so of zero.
7. **Modular construction**. Unlike most other brands, ME's amplifiers are designed with modular construction, to allow key sections to be replaced with later versions if significant improvements are made to the technology. In fact ME has a policy of offering upgrades to existing users, when such improvements occur.

As an illustration of these points, the ME 850 uses a total of 16 carefully matched high speed 140V bipolar transistors in its output stages, each rated at 250W dissipation and 20A current rating. The power transformer is a massive 2kVA unit, with quadrifilar secondaries and separate rectifiers feeding a 'matrix' of some 52 reservoir capacitors, for a total of 245,000uF (245mF). Each amplifier channel has a rated power output of 120W into 8 ohms, with class A operation up to 8W and a current capability of 70 amps. Power output into 4 ohms is rated at 200W, while the corresponding figures for 2-ohm and 1-ohm (!) loads are 350W and 500W respectively. These figures are for both channels driven, and with the amp connected to a regulated 240V AC supply.

Rated frequency response is DC-150kHz (+/-2dB), with no measureable phase shifts or anomalies in the audible spectrum. Rated risetime is 1 microsec-



Ozfi Experience

ond, while the damping factor is quoted as 160 over the range DC-20kHz (presumably for an 8-ohm load). Hum and noise are quoted as 100dB below rated output, while THD and IMD are described as 'less than 0.1%'.

The 850 measures 435 x 440 x 170mm, and weighs a substantial 30kg – not a unit that you'd want to carry far, without assistance. Quoted current retail price is $3880.

ME's matching model 25 preamp incorporates many of the same design philosophies as the power amplifiers, as you'd expect – except that they're adapted for a much lower power level. It has similar open-loop class-A output stages, designed in this case to drive interconnecting cables of almost unlimited length (and to prevent transients due to cable dynamics from influencing preamp performance).

Other points of interest are an absence of tone controls, in line with the 'minimal signal degradation' school of thought; buffered phono input stages, to isolate the cartridge from RIAA network impedance variations and the RIAA network from cartridge impedance variations; and a series of plug-in equalisation/gain/loading cards, tailored to suit specific popular high-quality cartridges.

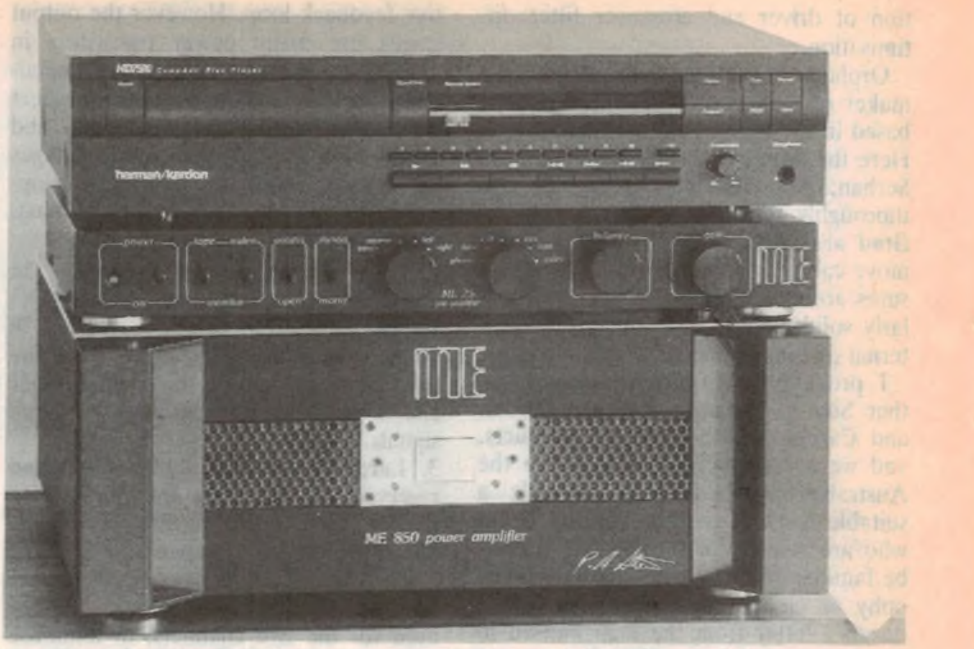
The ME 25 also uses special high-grade pots for volume and balance, with precise curves and accurate matching. In addition it features custom-made and very solid gold-plated RCA connectors.

Quoted retail price of the ME 25 with 'moving magnet' front-end configuration is $1295.

Now for the speakers. The Audio Definition 'Silhouette' system consists of two tall but relatively slim 'tower' type enclosures, each measuring 1580 x 270 x 350mm and weighing a hefty 60kg. The main body is covered in acoustic cloth material on all four sides (either black or white), with plinths on top and bottom finished in high-gloss spray lacquer available in any of 22 different 'designer colours'.

The enclosures inside the towers are built from 25mm high density craftwood, rigidly reinforced and lined with 12mm energy-absorbing tar compound. Each enclosure comes with a set of three 'spikes', which may be screwed into the lower plinth in tripod configuration, to provide firm and stable mechanical contact with the floor – and also prevent 'squashing' of your carpet.

Inside each enclosure are symmetrical configurations of five drivers: a pair of 200mm woofers, with one at the top and the other at the bottom; a 25mm metal dome tweeter in the centre; and a pair of 75mm dome mid-range units positioned at the intermediate positions. The woofers are in a bass reflex system, tuned for 35Hz.



The heart of the Ozfi system used for our listening tests. The 'foundation' is ME Sound's ME 850 power amplifier, coupled with matching ME 25 preamp. A Harman-Kardon HD 7500 CD player provided the signals.

The Silhouette crossover system uses first-order filtering, and employs high-grade polypropylene capacitors and air-cored inductors for maximum linearity. A phase filter is used for the two mid-range drivers, to match them to the woofer phase. Also an 'impedance correction' (conjugate matching?) circuit is used to maintain a steady, defined loading impedance so that the filter functions remain as defined.

Each Silhouette enclosure has two pairs of gold-plated terminals – one pair for the tweeter and mid-range drivers, and the other for the woofers – to allow bi-amping. Removeable bridges allow them to be used with single amplifier systems.

Power handling capability of each Silhouette enclosure is rated at 200W RMS or 1000W for 10ms transients. The nominal impedance is 4 ohms, with a sensitivity of 90dB/1W/1m. For maximum enjoyment, Audio Definition recommend the use of an amplifier capable of delivering at least 80W RMS on a continuous basis. Rated frequency response of the Silhouette system is 30Hz-20kHz, +/-3dB.

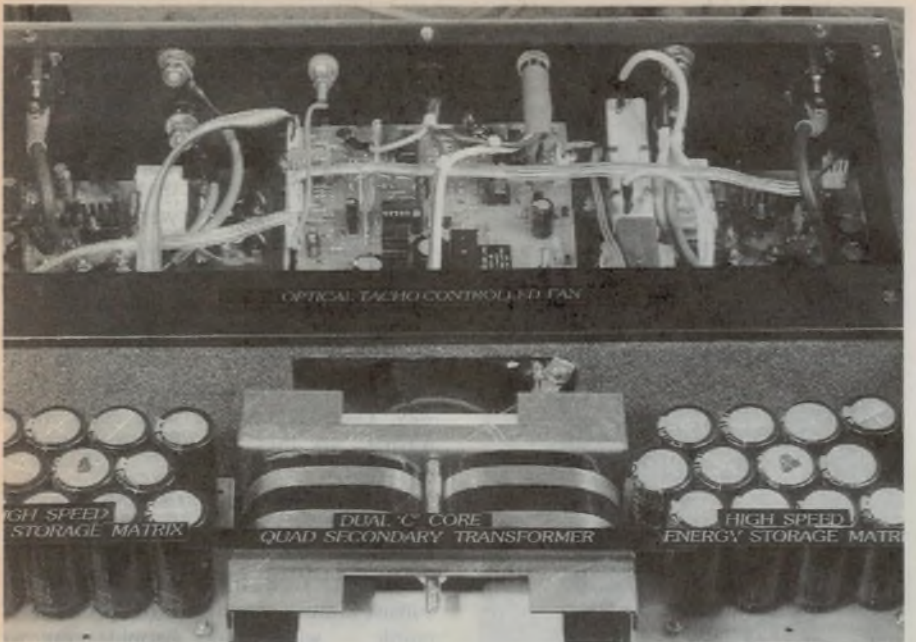
Quoted retail price for the Silhouette system is $3990, incidentally.

The Orpheus Loudspeakers 'Dolomite' system which came later in the tests is a somewhat more compact one, designed for less spacious listening rooms. It consists of a pair of rather more conventional looking enclosures, each measuring 611 x 290 x 325mm and with an enclosed volume of 38 litres. However you only have to pick one up to realise that at 18kg each, they're considerably more solid than most similar units. They're made from 19mm high density craftwood, with heavy internal bracing and extensively damped using 10mm tar pads. Normal finish is a high quality Queensland Walnut veneer, but other finishes are available to order.

The two enclosures are designed to mount on stands 400mm high, and Orpheus recommends the sturdy metal stands produced by Audio Furniture, as shown in the photo.

Each enclosure is a two-way system using a 200mm polypropylene-cone woofer/mid-range driver in a 'QB_3' bass reflex configuration, and a 25mm aluminium dome tweeter with ferrofluid cooling and soft polyamide surround. Rated power handling capability is 30-150W RMS, with a sensitivity of 90dB/1W/1m. The impedance is 8 ohms nominal, and the frequency response rated at 38Hz-20kHz +/-3dB.

As you'd expect, the Dolomite crossover networks use high grade metallised polypropylene capacitors and air-cored inductors for high linearity. The bass/mid-range drivers use special 'progressive' spider suspensions, and also silver-



The demo ME 850 was fitted with a perspex top, to allow this look at the innards. Note the massive quadrifilar-secondary transformer, the array of reservoir electros and the tacho-controlled fan.

plated lead wires for lower resistance and greater flexibility.

Quoted RRP for the standard Dolomite system is $1850, but there's also a 'High Performance' version featuring bi-amp wiring, even more rigid internal bracing and improved internal cabling. This sells for $2075.

How they went

As noted earlier, the whole idea of the 'Ozfi Experience' was to get a good impression of the kind of listening performance provided by a representative system of high-level domestic components. Bearing this in in mind, we placed our main emphasis on listening tests in a typical domestic environment, rather than instrument measurements in the lab.

In any case, one can argue that instrument measurements become rather less relevant at this level of equipment, as virtually all components meet all normal performance and quality criteria. The differences between them tend to boil down to more subtle things, often only evident to the trained ear – and even then subject to differences in subjective evaluation, in many cases.

First of all, we set up the initial system with ME 850 and 25, Audio Dimension Silhouette enclosures and Sound Research CD player, with Cardas 'Hexlink' cables for both the interconnections and speaker leads. Using a low-distortion audio generator we then gave it a preliminary checkout, just to see if we could find any obvious 'bumps', 'dips', 'buzzes' or 'rattles'. Needless to say there weren't any – it all sounded very smooth indeed.

Out of curiosity we checked to see if we could spot the bass resonance point of the Silhouette systems, by listening and looking for wind effects at the cones or ports. These were well controlled, but evident at around the quoted frequency of 35Hz.

So far, so good. Then we settled down to give it an extended series of careful listening tests, with some familiar and known high-quality DDD compact discs. These went on over a couple of weeks, as we could spare the time – an hour here, a couple of hours there, and so on.

Overall, we were left with the impression that the system was exceptionally 'smooth' and 'clean' in reproduction. There were simply no nasty resonances or colourations – yet at the same time, the sound was certainly not 'colourless' in the sense that it sounded 'dead' or 'dull' and uninteresting. In fact it was particularly lifelike, convincing and enjoyable; crisp and clearly defined, but without any harshness or 'edge'. One had the impression that here was a system capable of extracting just about every detail recorded on the discs, yet without any added colouration of its own.

We still had virtually the same reaction when the Harman-Kardon HD 7500 was substituted for the Sound Research CD player, and also when Brad Serhan's Dolomite system was brought in to replace the urgently-needed Silhouette enclosures. There really isn't a great deal to choose between modern top-end CD players, in terms of performance, nor indeed between speaker systems at the level of the Silhouette and Dolomite.

Of course the Dolomite system is very much more compact than the Silhouette, and perhaps more conventional in styling. It's certainly more suited for those with less space to spare, or who want the speakers to be a bit less obtrusive. Nominally it also has a lower power handling capability, although in our listening room it gave a very good account of itself, and seemed equally capable of taking anything that the ME 850 could deliver – without any hint of embarrassment.

Frankly at times the sound with all of this gear was little short of *electrifying* – even with tracks on the discs that we've heard many times before on other (and considerably cheaper) systems. This in itself suggests (a) that high-level components may indeed provide a subtle 'something extra' in terms of performance, to justify their considerably higher price tags; and (b) that Australian makers like ME Sound, Audio Definition and Orpheus are well able to meet the challenge of providing this order of performance.

We do have a couple of relatively minor niggles, though.

One is with regard to the connection screws and linking straps used on the Silhouette enclosures. We found these rather frustrating, when we went to hook everything up.

The straps linking each pair of terminals are made from gold-plated strip, with holes so that they mount under the knurled heads of the fastening screws. These are fine if the screws can be tightened right down, to establish a good contact between strap and pillar – but this can only occur if you *don't* have the usual fairly stout connecting cable conductor, inside the pillar's transverse hole. When the screw is tightened on such a conductor, its head is necessarily unable to bear down firmly on the strap...

Actually with some cables fitted with spade lugs, it might be possible to tuck the lugs underneath the screw heads along with the straps, instead of in the transverse holes. This would be OK, allowing them to be tightened up together. But unfortunately it wasn't possible with the Cardas cables supplied, because the slots in their spade lugs were too small to fit around the thread of the screws. Murphy's Law!

Ozfi Experience

With the sample system, we got around the problem by using some lengths of very heavy pure copper wire, tucked into the pillar holes along with the main cable conductors and connected between the pillars to bypass the straps and ensure good low impedance connections. But a little re-design may be indicated here, Ms Galante – it's the one frustrating aspect of your otherwise very impressive enclosures, but a pretty basic one. The other point is not so much a criticism, but more a comment in passing, with regard to the warmup characteristics of ME amplifiers. It's something we've noticed during a previous series of listening sessions with other ME models, and actually applies to a lesser extent with the new model 850 (and also to some of the other current models, we gather).

Because of the way Peter Stein designs his amplifiers without any loop negative feedback around the output stages, and also to give their best performance when they're running at 60°C, they tend to sound rather less than optimum when they're first turned on. In fact the earlier models tended to sound pretty awful for the first 20 minutes or so, and only reached their full 'sweetness' when everything reached its correct operating temperature.

Unfortunately this seems to be one of the penalties of using the design approach concerned, and I gather there's no easy way around it. Owners who want the benefits of this kind of amplifier simply have to develop the habit of turning it on 30 minutes or an hour before they want to actually sit down and do some serious listening...

Actually with later models like the 850, Peter seems to have shortened this warmup time, reducing it to somewhere between five and 10 minutes. And for most of that time, the amplifier's thermostat circuitry simply won't let you actually play any music; it holds the amp muted, in 'standby' mode. It only unlocks the muting when the circuitry has warmed up to a reasonable point, allowing acceptable performance. A small LED on the front panel indicates when this point is reached.

So even with the 850, you have to have a certain amount of patience. ME amplifiers are not designed for those who demand instant gratification; in fact if you want the cleanest sound, it's still best to wait at least 30 minutes before playing any music, after switching on from cold.

One of the Orpheus Loudspeakers 'Dolomite' system enclosures, which we tried out after parting with the Audio Definition 'Silhouette' system shown on pages 20-21.

Quick test

Actually we couldn't resist doing some quick tests on the ME850/25 combination with the instruments, because we were intrigued. They sounded so 'sweet' in the listening tests – rather like one of the classic valve amplifier systems of the past; yet we knew the 850 didn't have any loop negative feedback around the output stages. Would the usual instrument measurements bear out the reaction of our ears?

Not really, we have to confess. We couldn't match the quoted power output levels, although these weren't far away. The figures for continuous and IHF output were virtually identical, though, testifying to the 850's massive power supply capability.

We found it difficult to measure the power bandwidth, as the 850's protection circuitry tends to shut it down at higher output levels for high frequencies. Signal to noise ratio was better than the quoted figure, at more than 100dB below 80W into 8 ohms. The square wave response was also very good, with only minor overshoot at 1kHz, short risetime and only very minor changes due to loading.

But when it came to distortion measurements, the results were somewhat mystifying. The figures for both THD and IMD were significantly higher than those for most other current-model amplifiers we've tested, particularly at higher power levels (but still below the rated figures, and before clipping). This was even when the 850 had fully warmed up; they were higher again before that...

How is it that the 850 sounds so clean and sweet, when the instruments reveal what seems to be a significant level of distortion? Well, the distortion seems to consist almost completely of second harmonic – which most people seem to find quite pleasant, as compared to higher-order harmonics. In fact there is a very low level of higher-order harmonics, even when the 850 moves into the 'clipping' region.

Apart from that, all we can suggest is that perhaps THD and IMD aren't in reality quite as important as we engineers tend to think. And on the other hand, perhaps some of the performance parameters that Peter Stein's design approach tends to favour – balanced slew rates, high current capability, and freedom from transient distortion caused by negative feedback delay and load circuit impedance changes – may be *more* important than we've thought.

One thing's certain: our ears liked the end result, whatever the instruments say. Food for thought, isn't it?

Supplier details

As promised, here are the address details for the Australian manufacturers and suppliers mentioned in this article:

Audio Definition, PO Box 464, Port Macquarie 2444. Phone (065) 81 0452, 84 9623; fax (065) 81 0949.

ME Sound Pty Ltd, PO Box 50, Dyers Crossing 2429. Phone (065) 50 2254; fax (065) 50 2341.

Orpheus Loudspeakers, 7 Ainsworth Street, Lilyfield 2040. Phone (02) 569 9352.

Pirimai HiFi & Video, Shop 54, Westfield Shopping Town, Burwood Road, Burwood 2134. Phone (02) 747 2533.

The Audio Connection, Shop 44, Old Town Centre Plaza, Bankstown 2200. Phone (02) 708 4388.

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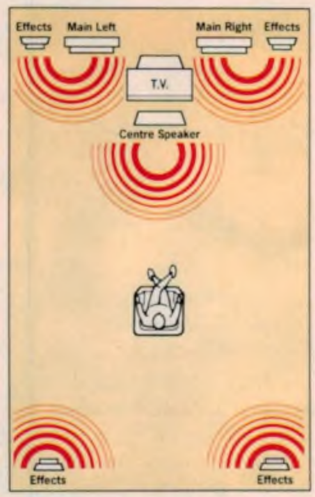

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Editing with Sony's home Video-8 system

Professional video gear provides extremely flexible editing facilities, but until recently the same has not been true of domestic video. The latest generation of camcorders and decks is rather more friendly, though, as Jon Fairall has found from his experiences with the Sony CCD-V900E camcorder and EV-S1000E deck.

In the bad old days, when you needed totally improbable biceps to lift a video editing machine, and recorders used 2" wide tape and were taller than the people who ran them, Super-8mm cine film was king of the amateur roost. It was serious stuff. There were even Super 8 artists who, rumour had it, were looking for a job 'in the industry'.

And why not? Certainly the little 8mm camera, loaded with five minutes' worth of film, was appealing to more ordinary people, but it also attracted people with a more serious hobby interest in film making as a craft. Most of the techniques available to professional film makers in 16, 35 or 70mm were available to the amateur in scaled-down form, with the exception, perhaps, of some largely irrelevant fancy laboratory film processes.

Magazines like this one were filled with articles on how to put down professional quality soundtracks, and projects for sync generators and such like esotery. Editing benches, scaled down versions of the real thing, could be had for a few hundred dollars. Viewers, projectors – all the paraphernalia of a real film house could be purchased and installed in the bedroom.

No more. Sadly, the arrival of cheap video killed most of the interest in the hobby. Video was so much easier and more flexible. Pictures could be viewed instantly, and even if they had neither the resolution nor the dynamic range of film images, they were certainly more convenient.

Editing

There is, however, one disadvantage. It is almost impossible to edit video tape using the kind of tools an ordinary hobbyist has available. Does it matter? Why bother to edit your tape? The answer is painfully apparent as soon as you look at someone else's video recording. Why is home video so dull? Endless shots of the baby, of Aunt Flossy's wedding, of the Trip Down the Nile soon pall. I suspect that even the people who own video cameras only look at the results once or twice.

Sony's EV-S1000E and CCD-V900E: a flexible combination.

The truth is that a well made little film, even if it is only you and the family going on a picnic, will give you pleasure for years to come. It doesn't need to be long – just a few minutes – but it will give you all the images you need to keep memories alive.

And if happy snaps aren't your bag, then editing opens up video as an art form. Whether you're telling a story or just juxtaposing images for effect, you need to be able to edit.

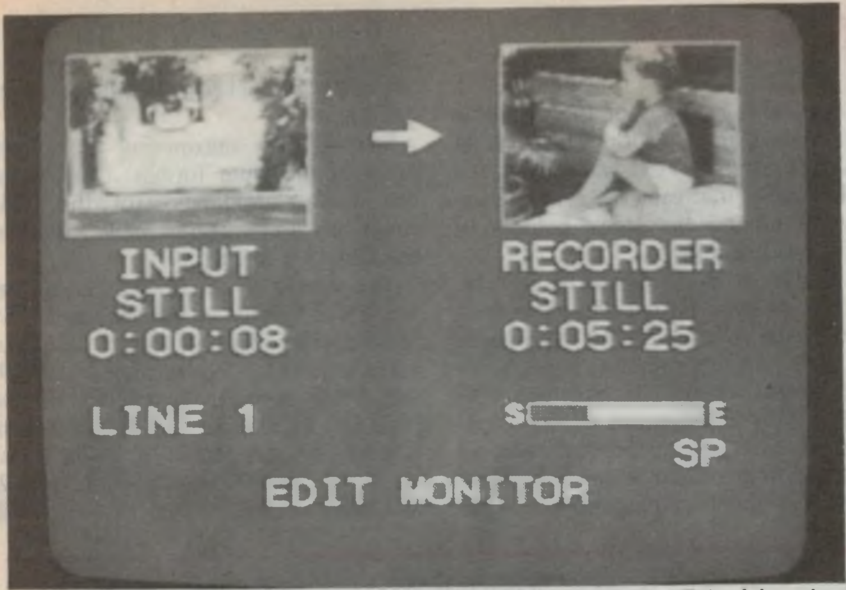
Currently, most people in the market for this sort of thing rent time on professional or semi-professional gear on the bigger formats. Professional gear, even when suitable for the emerging domestic formats, is far too expensive to buy. But now, 8mm video is starting to make it happen at the cheap end of the market.

Hi8 video

Sony launched the new decade with an update of their five year old 8mm video format. There have been three releases during the first half of 1990 – a tiny camera, the TR-55; a larger, more fully featured model, the CCD-V900E; and a tape deck, the EV-S1000E.

The Hi8 format is substantially compatible with standard video 8. The Hi8 cameras can record in either Hi8 or ordinary 8; the Hi8 tape can be used in both, and Hi8 machines can play back both formats. Needless to say, conventional Video-8 machines can't play back or record Hi8.

Technically, the principal difference between the two formats is a move in the position of the luminance carrier



To simplify editing, the EV-S1000E displays small digital 'stills' of input and tape video on the screen, in 'paused playback' mode.

and its deviation (it's an FM system), up from 1.2MHz at 4.8MHz to 2.0MHz at 6.7NHz. This is alleged to give superior quality, although I certainly can't see the difference. It has, according to Sony publicity, more than 400 lines of vertical definition. Suffice to say, Video-8 of whatever flavour gives playback performance as good as you will get from off-air programs.

In both systems, 8mm uses a helical scan video head that lays down tracks at an angle across the tape. PCM sound is recorded at one edge, and standard FM sound along the track.

The requirements

The essential problem for video is that it's difficult to make the cut from one shot to another smoothly. In film making, and professional video for that matter, it's possible to control the position of the tape on a frame-by-frame basis. You can define exactly where you want a cut, make it, and the film will flow perfectly.

This has always been a problem with video. It's difficult to synchronise the pictures so that the two pictures will butt together without affecting the TV signal. What tends to happen is that the TV monitor loses sync for a few seconds, rolls and shudders and then settles down again.

Also editing has been physically difficult because of the problem of synchronising two machines so that they can both be cued correctly, and started and stopped together. Having two separate machines connected merely by a wire carrying the signal, also implies a need for two monitors – adding to the cost, space and confusion.

Sony has not solved all of these problems completely, but they have gone a long way towards it. The editing architecture of the EV-S1000E (see the box) effectively solves all the problems about controlling two units. Using the LANC control, it is possible to put one unit on the other side of the room and forget about it.

They have not completely solved the

Sony's EV-S1000E VCR

As befits its function, the EV-S1000E has a quasi-professional look to it. Finished in brushed aluminium, it has most of its front panel controls hidden behind closed doors, so that the unit is dominated by a control display and the shuttle control.

Much of the functioning of the system is fairly routine, although it is controlled from an innovative system of menus displayed on the TV screen. Using these, you can set up the tuner, the picture sharpness and so on.

Not so routine is the small matrix of knobs over the right, dominated by the shuttle. This is the editing control system. Two VCRs can be connected together by the proprietary LANC terminals and one of the video/audio systems available. (LANC is a Sony remote control standard). Both systems can now be controlled from this panel. Two small lighted buttons at the top marked Player and Recorder decide which unit is affected by the control.

Upon activation, the player goes into Paused/Playback mode and the recorder into Paused/Record mode. Output from both units is displayed together on the TV as two small screens, with status information below them. These small displays are good enough for one to identify the scene, and the place in it. However, they can't be used to make judgements about the individual shots, because the definition is just not good enough. Moving the shuttle control activates either unit, either at one-fifth normal speed, normal speed or fast forward. Also rewind and fast rewind are available.

Operation of the shuttle control is very straightforward. However there is a certain time lag between moving the control and things happening, which you need to get used too. Also, the lack of a slow rewind facility is a problem.

When both units are cued to the appropriate place, the Synchro Edit button starts the recording from one unit to the other. Pushing Synchro Edit again stops recording and places both units in the pause mode again. It's also possible to define the end point of the edit by using the counter. When it reaches zero, the edit finishes.

Many of the functions on the unit can only be accomplished from the Remote controller. These include access to the control menus, time setting, timed recordings off air, placing index marks on the tape, generating a subsidiary picture within the main picture for monitoring other channels, and so on.

So whatever you do, don't lose the controller!

Sony's home Video-8 system

problem of making clean cuts every time. The relationship between the two incoming signals is still completely random, so the result of switching from one to the other cannot be guaranteed. It seems that in the worst case condition, it can take four frames for the recorder to resync itself after a cut. This is not a long time, but it is still quite noticeable. However, many times it does better than that.

Market

Sony executives say that the home video camera market is one of the fastest expanding sections of the domestic electronics market. With saturation in TVs, hifi systems, VCRs and so on, it's small wonder that cameras generate excitement among the stock holders of companies like Sony.

If this is so, Sony should be well favoured. Its 8mm format will allow it to develop the smallest, most convenient and most portable cameras. Equally, its development of VTR's like the EV-S1000E with an advanced editing capability should make it popular with all those for whom video is more than just 'point and shoot.' Apparently, a semi-professional version of the Hi8 VCR is due out late this year which will have this problem licked. It will be worth getting.

Sony is busy maximising the advantages of the 8mm format. Considering the market dominance of the VHS camp, it's a courageous move, but one that deserves to succeed.

You should be able to see and try out the CCD-V900E camcorder and EV-S1000E video deck at any of the better video stockists. They're priced at $3699 and $3149 respectively (RRP). If you have any difficulties, the best idea is to contact Sony (Australia) at 33-39 Talavera Road, North Ryde 2113; phone (02) 887 6666.

Sony's CCD V900E Camcorder

The latest development in 8mm camcorder technology is the CCD-V900E. As the name suggests, it's based around a CCD image sensor. The sensor is fed by a fast (f1.4) 8x power zoom lens that can sweep from 11 to 88mm. It also contains a microphone and amplifier, and of course, a video recorder.

It turns out to be a superb little unit to use – light to carry, well balanced for hand operation, with all the major controls easily accessible. It is fully automatic, so usable results are obtainable under virtually any conditions. Its low light performance needs to be seen to be believed. Roughly; if you can see it, you can film it.

However the automatic controls are by no means foolproof, and after a few hours of playing around with it, I found I was using it in manual mode almost all the time. Confronted by a moving target, automatic control of focus means that the unit is constantly hunting for best results. It's also slow a lot of the time, particularly in circumstances lacking horizontal lines or bright spots. I found it better to do the job myself.

The auto focus works by trying to maximise the contrast in the central portion of the screen. I experienced trouble with flat surfaces and bright lights, and the manual warns you to expect problems with fine patterns, horizontal stripes, frosted glass and fluorescent lights.

In any event, focusing manually is not much trouble – especially if you remember to wind the zoom out first.

Automatic iris control can also be a problem under mildly unusual lighting conditions. For instance, if the subject is darker than the surroundings you can expect trouble. Also, if you pan through areas of light and shade, you can see the iris opening and closing, a somewhat annoying thing on the screen. Since you can see the effect of opening and closing the iris in the viewfinder, this seemed to be a preferred option under any slightly unusual circumstance.

The unit also allows manual or automatic control of the white balance and shutter speed. I didn't have any problem with the automatic function of either of them, but their manual operation seemed quite straightforward. Under funny lighting conditions manual adjustment of the white balance might be quite a plus.

Likewise, shutter speed might need adjusting if you are looking at fast action. The unit will operate as fast as 1/10,000 of a second, although there is the normal trade-off in sensitivity – so the low light performance suffers.

The microphone, indeed the whole acoustic system, works well. We had no trouble recording conversation in a car, even with the windows down. There is an effective wind filter that cuts down on low frequency rumble.

There are a number of rather nice 'bells and whistles' on the unit. It has an automatic titling facility. You can film a title, then superimpose it on a picture. You can also scroll and change colour, just like the professionals do. It will automatically record the date and time as well as the tape duration onto the tape, if required.

There is also a rather useful facility by which you can lay down an 'index' signal during recording. This allows you to rapidly find a piece of film again if you need it. You can fade into or out of either white or black.

The tape is controlled by a simple VTR control configuration. Tape can be rewound, cued, paused and so on, as well as viewed through the viewfinder.

The CCD V900E supports a variety of playback modes, either from the camera or the VTR. It comes with a modulator, so that you can plug it straight into the antenna input of a TV or VCR. Alternatively there is a composite video with a separate audio connector, and a S-video connector. It's also possible to support a 21-pin SCART Euroconnector, common on European TVs.

It's possible to use the camera as a conventional, albeit expensive, VTR; you can record off-air or from another VCR using any of these connection systems. The only thing it lacks is a timer.

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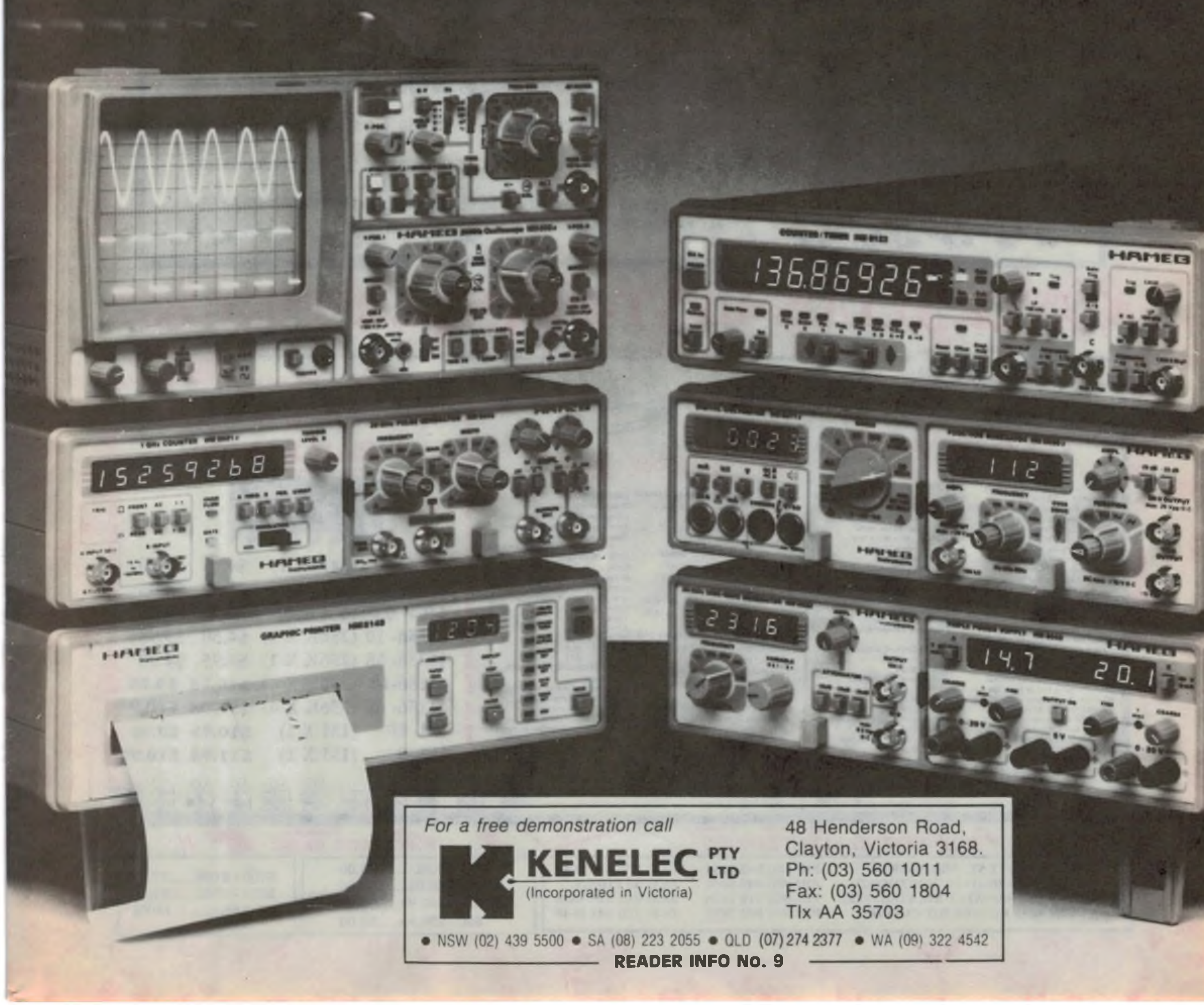

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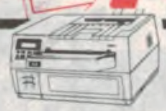

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C22063.. $2,695

24 PIN MICROLINE 391

The OKI Microline 391 is a result of a combination of the very latest technology and OKI's many years of experience. The OKI 391 provides exceptional paper handling and professional quality print whilst being extreamly quiet.

The foil-covered touch keys on the control panel are clearly lit to avoid confusion.

The OKI 391 can print up to 270 characters a second and 90 characters a second at letter quality. The OKI 391 also has enormous paper handling ve-sitility.

The bidire. onal push tractor is standard in the OKI 391, as is automatic single sheet feed. The paper handling features are numerous making this primter one of the capable on the market.

SPECIFICATIONS:
PRINTER MECHANISM:
Printer method: Dot matrix
Print head: 24 pins (diameter 0.2)
Head operating life: 200 Million characters
PRINTER SPEED:
Data: 270 cps (12cpi)
processing: 225 cps (10cpi)
Letter: 90 cps (12cpi)
quality: 75 cps (10cpi)
Characters per line:
10 cpi 136
12 cpi 163
15 cpi 204
17.1 cpi 233
20 cpi 272
PRINTER CHARACTERISTICS:
Typefaces
Standard: Courier, High Speed
Insert Cards: Letter Gothic, Prestige Elite
Software input: up to 256 characters as required
Fonts: 18 national fonts, IBM I and II, Epson, Semi- Graphic.
Buffer: 4C K Bytes.

C22152..$995

EXPANDED DYNAMIC RAM RANGE

4164- 10	(64K X 1)	$4.95	$4.50
4464- 10	(4 X 64K)	$5.50	$4.95
4464- 08	(4 X 64K)	$5.95	$5.50
41256- 10	(256K X 1)	$4.50	$3.95
41256- 08	(256K X 1)	$4.95	$4.50
44256-10	(256K X 4)	$10.95	$9.95
44256- 08	(256K X 4)	$11.95	$10.95
1M- 10	(1M X 1)	$10.95	$9.95
1M- 08	(1M X 1)	$11.95	$10.95

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MAIL ORDER: 56 RENVER RD, CLAYTON PH: (03) 543 7877 FAX: (03) 543 2648

POSTAGE RATES

$1 - $9.99..........$3.00
$10 - 24.00........$3.50
$25 - $49.99......$4.50
$50 - $99.99......$6.00
$100 - $199.......$7.00
$200 - $500.......FREE
$500 Plus.........FREE

QUALITY COMPONENTS

BNC PLUGS AND SOCKETS

BNC MALE PLUG

	1-9	10-99	100+
P10514	$2.50	$2.25	$1.50

BNC PANEL SOCKET

	1-9	10-99	100+
P10516	$2.50	$2.25	$1.50

BNC CRIMP PLUG

	1-9	10-99	100+
P10530	$2.95	$2.75	$2.00

BNC SOLDERLESS TWIST ON PLUG

	1-9	10-99	100+
P10531	$2.50	$2.25	$2.00

CANNON PLUGS AND SOCKETS

CANNON TYPE 3 PIN CHASSIS MALE

	1-9	10+	100+
P10962	$3.50	$2.95	$2.50

CANNON TYPE 3 PIN LINE FEMALE

	1-9	10+	100+
P10964	$3.95	$3.50	$2.90

CANNON TYPE 3 PIN CHASSIS FEMALE

	1-9	10+	100+
P10966	$4.95	$4.50	$3.50

CANNON TYPE 3 PIN LINE MALE

	1-9	10+	100+
P10960	$4.50	$3.50	$2.50

COMPUTER CABLES

- Six conductor shielded computer interface cable
- m = metre

	1-9 m	10+ m	100+ m
W12670 · CIC6	$1.30m	$1.10m	$1.00m
W12672 · CIC9	$1.60m	$1.50m	$1.20m
W12674 · CIC12	$2.50m	$2.20m	$1.90m
W12676 · CIC16	$3.50m	$3.20m	$2.50m
W12678 · CIC25	$3.90m	$3.40m	$3.00m

WIRELESS MICROPHONE

A10450..........$24.95

HEATSINK COMPOUND

Heatsink compound is applied to the base and mounting studs of transistors and diodes. It maintains a positive heatsink seal that improves heat transfer from the device to the heatsink, thus increasing overall efficiency.

H11800 .10g......$2.00
H11810 .150g....$14.95

ULTRASONIC TRANDUCERS

Designed to transmit at 40kHz (L 19990) and recieve at 40 kHz (L 19991) with up to 20V I/P on the transmitter. These units can't be heard so are ideal for TV remote control's, water level detectors, burglar alarms, motion detectors and information carriers as they can be either pulsed or used in a continuos wave mode.

	1-9	10+
Transmitter L19990	$3.95	$2.95
Receiver L19991	$3.95	$2.95

PCB MOUNTING SCREW TERMINALS

(INTERLOCKING ENDS)

These terminals feature interlocking ends to form any number of conections. Standard 5mm spacing pins

	1-9	10+	100+
P10520 2 way	$0.60	$0.50	$0.40
P10521 3way	$0.80	$0.70	$0.60

9 PIN TO 25 PIN CONNECTOR ADAPTORS

The perfect solution! Features gold plated pins

X15668 DB9 Plug to DB25 Socket
X15669 DB9 Socket to DB25 Plug

each $8.95

UTILITY BOXES

Plastic boxes with plastic tops and available in 5 sizes. Very popular fro projects & very economical

	1-9	10+
150 x 90 x 50mm H10111	$4.95	$4.75
185 x 113 x 60mm H10112	$5.75	$5.25
130 x 68 x 41mm H10113	$2.95	$2.50
83 x 54 x 28mm H10115	$2.25	$1.95
120 x 65 x 38mm H10120	$2.95	$2.50

IC SOCKETS

LOW PROFILE IC SOCKETS

Save a small fortune on these "Direct Import" low profile ic sockets! PCB mounting solder tail. All tin plated phosphor bronze or berryllium and dual wipe for reliability.

Cat No	Description	1-9	10-99	100+
P10550	8 pin	15¢	12¢	10¢
P10560	14 pin	20¢	18¢	15¢
P10565	16 pin	20¢	18¢	16¢
P10567	18 pin	30¢	25¢	22¢
P10568	20 pin	35¢	30¢	25¢
P10569	22 pin	35¢	30¢	26¢
P10570	24 pin	35¢	30¢	26¢
P10572	28 pin	45¢	35¢	30¢
P10575	40 pin	45¢	40¢	35¢

WIRE WRAP IC SOCKETS

These quality 3 level wire wrap sockets are tin-plated phosphor bronze.

		1-9	10+
P10579	8 pin	1.50	1.40
P10580	14 pin	1.85	1.70
P10585	16 pin	1.95	1.80
P10587	18 pin	1.95	1.80
P10590	20 pin	2.95	2.75
P10592	22pin	2.95	2.70
P10594	24 pin	3.95	3.50
P10596	28 pin	3.95	3.50
P10598	40 pin	4.95	4.50

IDC PLUGS AND SOCKETS

D TYPE IDC PLUGS

	1-9	10+	100+
DE9P 9 pin plug P12166	$2.95	$2.50	$2.00
DA15P 15 pin plug P12168	$3.50	$3.00	$2.50
DB25P 25 pin plug P12170	$4.50	$3.95	$3.50

D TYPE IDC SOCKETS

	1-9	10+	100+
DE9S 9 pin socket P12167	$2.95	$2.50	$2.00
DA15S 15 pin socket P12169	$3.50	$3.00	$2.50
DB25S 25 pin socket P12171	$4.50	$3.95	$3.50

IDC CENTRONICS 36 WAY PLUG & SOCKET

	1-9	10+	100+
Plug P12200	$3.95	$3.00	$2.95
Socket P12201	$3.95	$3.00	$2.95

ELECTRET MIC INSERTS

(With pins for easy board insertion) Cat C10170

1-9	10+	100
$1.20	$1.00	$0.90

CRYSTAL LOCKED WIRELESS MICROPHONE & RECIEVER

MICROPHONE SPECS
Transmitting Frequency: 37.1MHz
Transmitting system: Crystal oscillation
Microphone: Electret condenser
Power supply 9V battery
Range: 300 feet in open field
RECIEVER SPECS:
Receiver freq: 37.1MHz
Output level: 37mV(max)
Receiving sys: Super crystal oscillation
Power sup: 9V battery
Volume control: Tuning Led
Dimmensions:115x32x44mm
Weight: 220grams

A10452..............$99

DATA TRANSFER SWITCHES

If you have 2 or 4 compatable devices that need to share a third or fifth, then these inexpencivedata tranfer will save youthe time and hassle of constantly changing cables and leads around.

- No power required
- Speed and code tranparent
- Two or four position rotary switch on front panel
- Switch comes standard with female connector

RS232- 2 way..........$39
RS232- 4 way..........$59
RS232- X over..........$69
RS232- 2 way auto..........$69
Centronics- 2 way..........$49
Centronics- 4 way..........$69
Centronics- X over..........$69
Centronics- 2 way auto..........$79

ECONOMY TRANSFORMERS

MAMMOTH PRICE REDUCTIONS!!!

	1-9	10+
2155 240V 6-15V 1A Cat M12155	$8.95	$7.95
2156 240V 6-15V A2 Cat M12156	$13.95	$12.95
2840 240V 9VCT Cat M12840	$4.95	$3.95
2851 240V 12-6V CT 250mA Cat M12851	$4.95	$4.50
2860 240 V 15VCT 250m A Cat M 12860	$4.95	$4.50
6672 240V 15 30vc 1A tapped Cat M16672	$12.95	$11.95

12V DC FANS

80 x 80 x 25.4mm
12V DC 1.7 Watt 0.14 Amps
T12469..............$12.95
10+ fans only $11.95 each

FANS

Quality fans for use in power amps, computers, hotspot cooling etc. Anywhere you need plenty of air

240V 4.5" T12461 $12.95
115V 4.5" T12463 $12.95
240V 3.5" T12465 $12.95
115V 3.5" T12467 $12.95
10+ fans (mixed) only $10.95 each

LEDS

QUALITY 3MM LEDS

	1-9	10-99	100+
Z10140(R)	$0.15	$0.12	$0.10
Z10141(G)	$0.20	$0.25	$0.12
Z10143(Y)	$0.20	$0.15	$0.12
Z10145(O)	$0.20	$0.15	$0.12

QUALITY 5MM LEDS

	1-9	10-99	100+
Z10150(R)	$0.15	$0.10	$0.10
Z10151(G)	$0.20	$0.15	$0.12
Z10152(Y)	$0.20	$0.15	$0.12

FLASHING LEDS

	1-9	10+
red 5mm Z10159	$1.10	$1.00

RECTANGULAR LEDS

	1-9	10-99	100+
RED	20c	15c	12c
GREEN	20c	15c	12c
YELLOW	20c	15c	12c
ORANGE	20c	15c	12c

PANEL METERS GALORE

We have a great range of panel meters at great prices!

Q10500	MU45 0-1m A	$12.50
Q10502	MU45 50-50uA	$12.50
Q10504	MU45 0-100uA	$12.50
Q10510	MU45 0-5A	$12.50
Q10518	MU45 0-1A	$12.50
Q10520	MU45 0-1A	$12.50
Q10525	MU45 0-20V	$12.50
Q10530	MU52E 0-1A	$14.50
Q10533	MU52E 0-5A	$14.95
Q10535	MU45 VUP	$14.95
Q10538	MU65 0-50uA	$16.95
Q10540	MU65 0-1mA	$16.95
Q10550	MU65 0-100uA	$16.95
Q10560	MU650-20V	$16.95

MOSFET SPECIALS

	1-9	10+
2SJ49	$7.50	$7.00
2SJ56	$10.00	$9.50
2SK134	$6.90	$6.50
2SK176	$9.50	$8.90

VOLTAGE REGULATORS BARGAINS

Description	1-9	10+
7805UC	$0.50	$0.45
7812UC	$0.50	$0.45
7815UC	$0.50	$0.45
7905UC	$0.60	$0.55
7912UC	$0.60	$0.55
7915UC	$0.60	$0.55
78L05	$0.40	$0.30
78L12	$0.40	$0.30
LM324	$1.00	$0.90
555	$0.40	$0.38
741	$0.50	$0.45

DB25 CONNECTOR SPECIALS

		1-9	10+
P10885	DE9S	$1.00	$0.70
P10890	DA15P	$1.00	$0.70
P10891	DA15S	$1.00	$0.70
P10892	DA15C	$1.00	$0.80
P10890	DA15P	$1.00	$0.80
P10895	DA15S	$1.00	$0.80
P10902	DB25C	$1.00	$0.80
P10905	DB25P	$1.00	$0.80
P10905	DB25S	$1.00	$0.80
P10880	DE9P	$1.00	$0.80

8087 CHIPS

8087-3	(4.77MHZ)	$175
8087-2	(8MHZ)	$265
8087-1	(10MHZ)	$395
80287-6	(6MHZ)	$295
80287-8	(8MHZ)	$395
80287-10	(10MHZ)	$495
80387-16	(16MHZ)	$795
80387-20	(20MHZ)	$895
80387-25	(25MHZ)	$1,095
808387 33		$1,495

TOGGLE SWITCHES

		1-9	10-99
S11010	D.P.D.T	$0.90	$0.80
S11020	D.P.D.T	$1.10	$1.00

NICADS

Save a fortune on expensive throw away batteries with these quality Nicads and Rechargers!

Size	Desc.	1-9	10+	100+
AA	450mAH	$1.95	$1.75	$1.50
C	1.2 A H	$9.95	$9.50	$8.95
D	1.2 A H	$9.95	$9.50	$8.95

HORNS

SUPER HORN TWEETER

Requires no crossover and handles up to 100 Watts
Sensitivity: 100dB 0.5 m
Frequency response: 3kHz-3-0kHz
Independence: 8 ohms
Size 96 m diameter
Normally..........$12.95
ONLY..........$9.95

10W HORN SPEAKERS

White durable plastic. 8 ohms
Cat. C12010 Normally $11.95
$9.95

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P.O. Box 620, Clayton, 3168
Order Hotline: 008 33 5757
(Toll Free Strictly orders only)

POSTAGE RATES

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$100 - $199........$7.00
$200 - $500.......FREE
$500 Plus.........FREE

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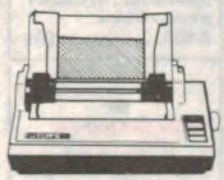
ROD IRVING MAKES YOUR CHRISTMAS EVEN MERRIER WITH THESE EPSON PRICES!

EPSON LX-850 PRINTER

- NLQ Mode
- 180 C.P.S. & 25 C.P.S.
- Tractor or friction feed
- Proportional printing
- Convenient push button control panel
- Standard Parallel interface

C22057..............$399.95

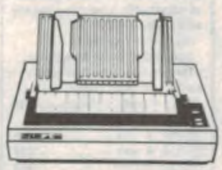
EPSON LX-400 PRINTER



- Epson 9-pin dot matrix printer
- 180 caps in draft mode
- 25 caps in NLQ mode
- Convenient push button control panel

C22054.............$299

EPSON LQ 400 PRINTER



- 80 Column 24-pin dot matrix printer with tractor and sheet feeder
- 180 caps in draft mode
- 60 caps in LQ mode

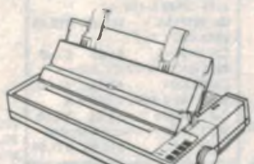
C22070..............$495

EPSON LQ-850 PRINTER

- 24 Pin Dot matrix printer
- Advanced paper handling
- Fast printing, up to 300 CPS
- 2 built-in Letter Quality fonts
- Short tear-off feature saves paper
- Direct selection control panel

C22072.............$995

EPSON LQ-1050 PRINTER



- 24 pin dot matrix printer
- Advanced paper handling
- Fast printing, up to 300 CPS
- 2 built-in Letter Quality fonts
- Short tear-off feature saves paper
- Direct selection control panel
- Micro-adjustment feature allows accurate paper feed.
- Handles a wide range of paper types

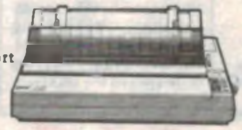
C22066.............$1,295

EPSON LQ-550 PRINTER

- 80 Column-24 pin dot matrix printer
- 180 CPS in draft mode - 60 CPS in LQ
- Advanced paper handling capabilities
- 2 Letter Quality fonts built-in
- Standard parallel port/optional serial port
- Optional multi-font module

C22068.............$620

EPSON LQ - 1010 PRINTER



- 136 Column-24 pin dot matrix printer
- 180 CPS in draft mode - 60 CPS in LQ
- Advanced paper handling capabilities
- 2 Letter Quality fonts built-in
- Standard parallel port /optional serial port
- Optioal multi-font module

C22065.............$895

NEW IBM PRINTERS

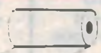
IBM 5537 Printer

Outstanding Near Letter Quality performance from this 9-pin dot matrix printer. Printing an execptional 120 x 72 dpi, the 5537 also offers a choice of 4 resident fonts at 37 cps while drafts can be printed out at a quick 150 cps at 10 cpi.
The fonts, DP, Courier, NLQ, San-serif NLQ, Orator NLQ, suit most print requirements. The 5537 also has a paper parking feature enabling single sheets to be fed while retaining tractor feed.
..............................$359

IBM 5538 Printer

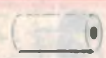
Outstanding Near Letter Quality performance from this 24-pin dot matrix printer. Printing an execptional 180 x 180 dpi, the 5538 also offers a choice of 4 resident fonts at 50 cps while drafts can be printed out at a quick 150 cps at 10 cpi.
The fonts, Courier, Prestige, Orator and Script, suit most print requirements. The 5538 also has a paper parking feature enabling single sheets to be fed while retaining tractor feed.
..............................$695

DID YOU KNOW THAT WE NOW SELL FAX ROLLS!



	1-9	10+
C20092	$8.95	$8.50

SIZE: 210mm x 11.5mm x 30 M



	1-9	10+
C20098	$9.95	$9.50

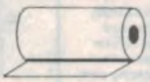
SIZE: 216mm x 25.4mm x 30 M

	1-9	10+
C20094	$9.95	$9.50

SIZE: 210mm x 24.5mm x 50 M

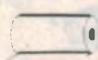
	1-9	10+
C20100	$11.95	$11.50

SIZE: 216mm x 25.4mm x 50 M



	1-9	10+
C20096	$17.95	$16.95

SIZE: 210mm x 25.4mm x 100 M



	1-9	10+
C20102	$8.95	$8.50

SIZE: 210 mm x 25.4mm x 30 M

LOOK! NEW PRODUCTS FOR THE NEW YEAR!

LIGHT SENSOR SWITCH

Designed to automatically switch lights on at night and off during the day which makes them ideal for both domestic and security use. A single unit can be used to control the porch or the driveway. Several can be used to control the porch or the driveway. Several can be used together to give the impression the house is occupied.

- Turn lights off at 120 lux & on at 20 lux
- Waterproof for use under eaves and verandahs.
- Operates on 240VAC/50Hz

A15596................$11.95

MOBILE BABY MONITORING SYSTEM

Fully portable two station audio monitoring system that enables you to move around the house without any cords and keep an "ear" on your baby, the kids, the aged or sick.

- No installation required. Simply plud the transmitter into any 240 volt AC mains power point and switch on.
- Portable battery powered receiver is carried around with you for constant monitoring
- Squelch control for reducing background noise.
- Transmitter frequency: 49.830MHz
- Power: Transmitter - 240 volt AC operated; Receiver - 2 x UM3 penlight batteries

A15505...............$89.95

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NEWS HIGHLIGHTS

AUDIOSOUND WINS DESIGN AWARD

Sydney loudspeaker system manufacturer Audiosound Laboratories has received a prestigious Australian Design Award, for its range of eight speaker systems. The systems vary in price from $600 to $4000, and the Award was granted to all models submitted. The citation read:

All aspects of the design have been considered, with the intention of obtaining the best audio performance. The cabinets are of solid construction, with the joinery and timber finish to a very high standard. The press-fit front grille is easy to remove and replace, and requires no clips or fixing devices that could become loose or break.

Audiosound Labs is the first loudspeaker manufacturer to receive an Australian Design Award for its products. The picture shows Audiosound's Ron Cooper (R) receiving the Award from NSW Minister for Business and Consumer Affairs, Hon. Gerry Peacocke.

MMT TESTS WIDEBAND F-O LINK

Victorian-based communications specialist MMT Australia has performed successful laboratory tests of a new wideband fibre-optic cable link, operating at 1310nm. In the tests 12 standard AM/PAL television signals (7MHz wide), eight FM broadcast television signals (16MHz wide) and 10 stereo FM radio signals were combined and sent successfully over a single 50km length of single mode optical fibre.

MMT's manufacturing company Transbeam Communications was expecting to begin manufacture of the new link in mid-November. Joint venture partners in Canada have already placed orders for 30 links, which will represent over $1 million in export sales for the first year. MMT believes that the product has a good potential market in both the USA and Europe.

INTERESTING PICS FROM HUBBLE

Despite its mirror problems, NASA's Hubble Space Telescope has provided what is described as 'a dramatic new look' at the remnants of the great supernova of 1987. Observations made with the European Space Agency's Faint Object Camera on the HST have provided an intriguing view of the supernova and its surrounding shell of stellar material, with 'unprecedented sharpness and clarity' – down to 0.1 arc second.

The image, taken in visible light, reveals the details of the circumstellar shell, whose characteristics previously had been suggested by ground-based observations and data from the International Ultraviolet Explorer satellite. The visible image clearly shows an elliptical, luminescent ring of gas about 1.3 light-years across, surrounding the still-glowing centre of the 1987 explosion.

The Wide Field and Planetary Camera on HST has also provided a 'remarkably detailed view' of the core of galaxy NGC 7457, located some 40 million light-years away from our own.

NGC 7457 is a quiescent galaxy, picked for its 'normalcy' as an early target for assessing the performance of HST. However the resulting images show, to the surprise of astronomers, that an exceptionally bright and compact core is embedded in the diffuse background of the rest of the galaxy. The stars in this nucleus appear to be crowded together at least 30,000 times more densely than those in our own 'galactic neighborhood'. Previous ground-based observations had suggested a density 400 times smaller.

MOTOROLA ELIMINATES CFC'S

Motorola Australia has totally eliminated the use of chloroflurocarbons (CFC's) at its complex at Mulgrave in Melbourne.

Chloroflurocarbons had been used in various production processes, particularly in the electronics field, for cleaning printed circuit boards.

In early 1988, Motorola research found the boards could be cleaned to a high quality level by the use of aqueous washing. The process involved washing the boards with a detergent and water mixture, and then putting them through a drying cycle. A locally designed and manufactured aqueous washing system was introduced for cleaning of the circuit boards in November 1988 and the usage of CFC's fell by over 300%.

Motorola's elimination of CFC usage puts it at the forefront of progressive companies looking to improve the environment and quality of life, while increasing production and standard of manufacturing.

PHILIPS DEVELOPING DIGITAL CASSETTE SYSTEM

Philips Consumer Electronics has confirmed that it is developing a Digital Compact Cassette (DCC) system, with the active involvement of a number of major companies from the music and hardware industry.

The system is apparently based on a new and revolutionary coding technique. This coding technique, in combination with the existing well-proven compact cassette technology and standard tape, is claimed to offer the consumer a sound quality equivalent to that of compact disc.

The new system will allow consumers to play attractive, specially designed digital compact cassettes, as well as their traditional, analog compact cassettes on DCC-players designed for home, portable and in-car use.

The DCC product range is expected to be introduced at the beginning of 1992.

EXICOM BUYS SILICON VALLEY FIRM

Australian firm Exicom Limited has announced its successful acquisition of 100% of the Silicon Valley-based manufacturer Vantronic Corporation. Exicom took an initial 27% shareholding in October 1989. The company has been renamed Exicom Technology Inc.

Managing Director of Exicom Limited, Mr John Harrison said "The advanced manufacturing techniques developed by Exicom Technologies complement the innovative robotic plant developed at Exicom Australia for high volume production. This acquisition will give Exicom Australia access to state-of-the-art manufacturing techniques in surface mount technologies – and offer an excellent opportunity to expand our manufacturing in the huge USA market for Exicom and thirty party products."

HARDWARE EMULATOR FOR ASICS

Local ASIC specialists Australian Silicon Structures (AS2) has launched an innovative emulation system which allows designers of electrical equipment to confirm the functionality of their ASIC designs before committing to fabrication.

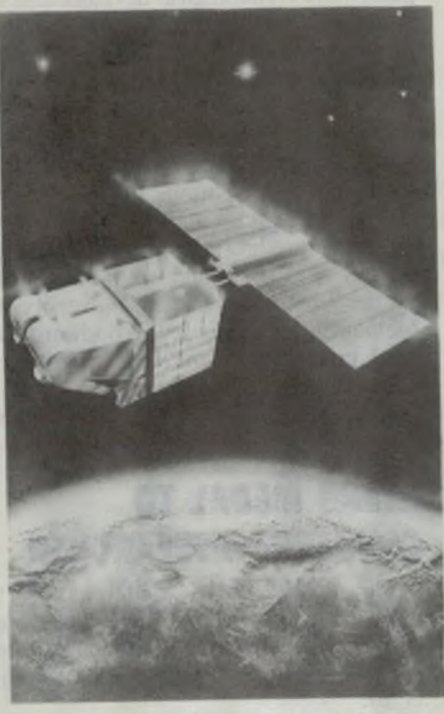
The AS2 Personal Prototyping Machine is a hardware emulator for Application Specific Integrated Circuits (ASICs) and related logic devices and performs as a reconfigurable electrical breadboard, allowing equipment designers to above a virtual ASIC at the end of a cable.

According to AS2's Managing Director Toby Cross, "circuit emulation is not a new idea; however being able to emulate ASIC devices in real time is a major breakthrough. This results in significant technical and financial gains in that prototype systems can be verified immediately and demonstrated sooner, and software developed without the delay of waiting for fabricated devices."

An important feature of the PPM is that it supports multiple ASIC vendors with a range of cell libraries and netlist translators available including LSI Logic, Texas Instruments, VLSI Technology, Fujitsu, Hitachi, NEC, ES2 and Plessey Semiconductors. This allows the selection of appropriate ASIC vendors on the basis of technical or commercial criteria. The entry level PPM supports up to 8000 gates at 30MHz, and can be upgraded to 20,000 gates.

CSA WINS $9.9M ACRES CONTRACT

The Department of Administrative Services has outsourced the operation and maintenance of the Australian Centre for Remote Sensing's (ACRES) data acquisition, processing and distribution facilities to Computer Sciences of Australia. The $9.9 million contract will initially run for three years.



Some 38 production, engineering, photographic, marketing, support and administration staff will become CSA employees. They will continue to be located at the Data Acquisition Facility at Alice Springs and in the Data Processing Facility at Fernhill Park in Canberra.

A unit of the Australian Surveying and Land Information Group within the Department of Administrative Services, ACRES is Australia's major remote sensing organisation. It captures data transmitted from the US Landsat and NOAA and the French Spot satellites and processes it into photographic and digital images.

The images are used in minerals and oil exploration; research into agricultural crop yields; urban mapping; surveying; and monitoring land degration, the salinity of rivers, pasture improvement programs, bush fires and floods.

ATERB AWARDS FOR RESEARCH

Postgraduate awards of $9000 per year tax-free will enable research students to supplement their other scholarships and receive over $25,000 tax-free while studying. The Australian Telecommunications and Electronics Research Board (ATERB) is offering these postgraduate awards as it believes it is critically important for Australia to increase the number of researchers and future academics in its areas of interest.

Made up of Telecom, CSIRO, OTC, Defence and with representatives from universities, ATERB has a long history of support of research and training in telecommunications. Its current Chairman, Professor Trevor Cole from Sydney University said, "Australia is entering a period of massive shortage of skilled engineers in telecommunications and electronics. Recent detailed surveys project that by the end of this decade Australia will have to produce between three and five times its current rate of graduation of electronic engineers and information specialists. This huge number of engineers are needed to support the hundreds of millions of dollars of R&D commitments made by the information industries as well as the billions of dollars of production also committed."

AUSSAT ASSISTS AMATEUR TV TESTS

For some time, the Gladesville Amateur Radio Club has conducted a series of test transmissions each week in Sydney using UHF TV channel 35. These tests came to the attention of AUSSAT executives, who approached the Club to find out more. AUSSAT then offered Gladesville the use of a transponder to conduct the tests over a wider coverage.

Arising from this, a test transmission was planned for November 14, a joint operation between the Gladesville Amateur Radio Club and the NSW Division of the WIA. The satellite to be used was AUSSAT-2 – the most westerly of the three AUSSATs – on transponder 5, using an unencoded PAL mode of transmission. The footprint was expected to cover at least south-eastern Australia, including the State capitals Brisbane, Sydney, Canberra, Melbourne, Hobart and Adelaide; not forgetting of course all the country regions of south-east Australia.

NEWS

NSW LAUNCHES SERVICING CODE

Mr Gerry Peacocke, NSW Minister for Business and Consumer Affairs, has launched a draft code of conduct for the television and electronic goods repair industry.

"In most of the domestic service and repair industries, we have a very high complaint level from consumers. The main areas of concern include faulty servicing and repair of television sets, video cassette recorders and sound equipment," Mr Peacocke said.

"The code covers such things as the price of service calls, industry qualifications, service calls, and repairers keeping appointment."

"The industry has supported the development of the code because as I am, they are concerned about the level of consumer complaints and I commend them for their willingness to address the problem," Mr Peacocke said.

"The effectiveness of the Code will be monitored by the Business and Consumer Affairs Agency and the industry for an initial period of 18 months. A review of the code will then be conducted which will evaluate its success and need for any changes."

HP SCHOLARSHIPS FOR WOMEN

In 1991, there will be an added incentive for women and girls to train in the computer and electronics fields, thanks to Hewlett Packard Australia. The company is offering five scholarships of $800 each, to selected women and girls who undertake an Associate Diploma in Electronics or Computer Systems at Victoria's Box Hill College of TAFE.

"It's exciting that a company like Hewlett Packard is concerned about the under-representation of women in the electronics industry and is prepared to do something about it," said Don Sweeney, Head of Electronics Engineering at Box Hill TAFE.

"These scholarships are a positive way of assisting women financially with their training and encouraging them to enter this field."

The scholarships not only include the $800 grant, but also the chance to undertake paid work experience with Hewlett Packard at Blackburn.

TELECOM RESEARCHER WINS KERNOT MEDAL

A Melbourne man who nurtured and guided the technological development of Australia's telecommunications industry for nearly 40 years has been bestowed one of engineering's highest awards.

Mr Harry Stewart Wragge, the head of Telecom Research Laboratories, has been awarded the esteemed Kernot Medal for contributions to telecommunictions research, and to professional engineering education in Australia. Mr Wragge was presented with the Medal by the Chancellor of the University of Melbourne, Sir Edward Woodward, at the University's Wilson Hall on the evening of Tuesday 2nd October.

Since its inception in 1925, the Kernot Medal has been awarded to Australia's most distinguished and eminent engineers. The list of past recipients includes household Australian names such as Sir John Monash, Brian Loton and Sir Arvi Parbo.

ATERB MEDAL TO CANBERRA RESEARCHER

The 1990 ATERB Medal has been awarded to Dr Mary O'Kane, Professor and Head of Information Sciences and Engineering of the University of Canberra.

The award, consisting of a silver medal and a prize of $2500, recognises outstanding contributions in the fields of telecommunications and electronics by a young Australian researcher. It is awarded jointly by the Australian Telecommunications and Electronics Research Board (ATERB) and the Australian Academy of Technological Sciences and Engineering. ATERB, established in 1927 as the Radio Research Board, encourages and sponsors research with funding from its sponsors, Telecom Australia, CSIRO, OTC Ltd and the Department of Defence.

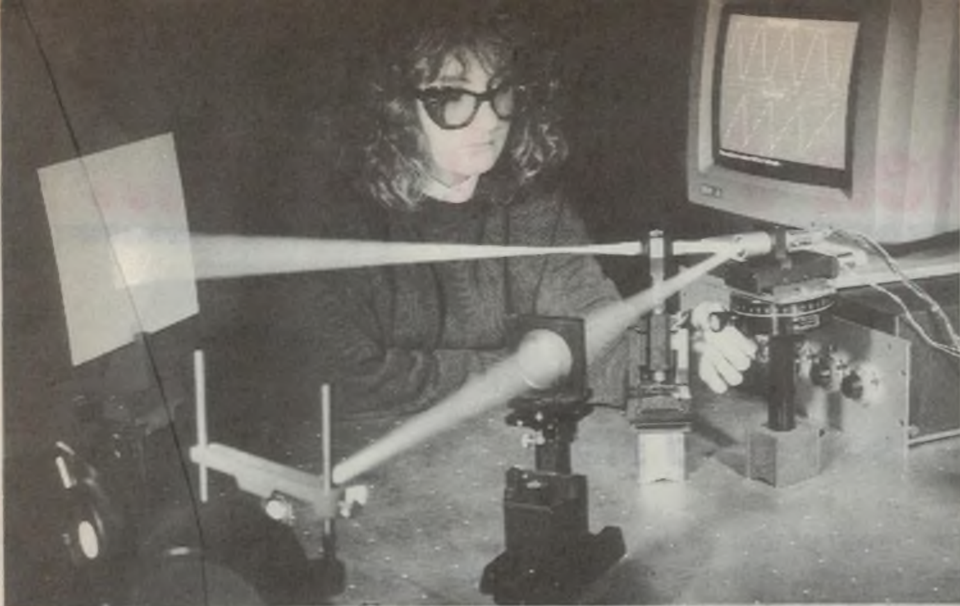
Professor O'Kane received the Medal from the ATERB Chairman, Professor T W Cole, at the annual oration of the Academy on October 3 in Melbourne.

Professor O'Kane is distinguished for her research and development work in the computer recognition of continuous speech, in contrast with other approaches which deal only with isolated words. She has designed general program architecture and algorithms for this important problem.

Her work has attracted considerable attention from industry because of its commercial potential. Wang was an early backer of the SPRITE project. Other industry groups that are linked to this work include Logica, Computer Power, Telecom and Schlumberger.

NEWS BRIEFS

- Sydney-based PC enhancement board builder ***Hypertec*** is opening an office in Brussels, next month. The new office will be headed by David Evans, Hypertec's Commercial Director and one of its founders, and is intended to allow further development of European export markets.
- Audio and video equipment maker ***Akai*** has appointed Peter Biziorek as its State Manager in Queensland. Anthony Birtles and Jayne Lilli have also been appointed as NSW sales consultants.
- ***Cooper Tools*** has appointed a new Managing Director: Peter Reynoldson, who was previously Finance and Administration Manager. Mr Reynoldson replaces 19-year veteran MD George Richards, who is leaving to join the Mitre 10 Group as chief executive, Southern Region.
- Hong Kong's most comprehensive annual electronics exhibition, ***EIE'91***, is scheduled to be held from June 21-25, 1991 at the Hong Kong Convention and Exhibition Centre, 1 Harbour Road, Wanchai. Details are available from Business and Industrial Trade Fairs, 28/F Harbour Centre, 25 Harbour Road.
- Australian telecomm equipment manufacturer ***Alcatel STC*** has won two significant contracts to supply equipment to communications authorities in Singapore and Hong Kong. The contract with Singapore Telecom is to supply 48V/800A telephone exchange power supplies, valued at $200,000, while that with the Hong



Researchers at Edinburgh's Heriot-Watt University are working on a new kind of spatial light modulator, using a non-linear interference filter instead of an LCD light valve. The new SLM can process up to 10,000 images per second, making it suitable for optical computing.

AWAM APPOINTS CIMA AS ASIC TECH CENTRE

Sydney-based AWA Microelectronics (AWAM) has appointed CIMA Electronics of Oakleigh, Victoria as an ASIC Technology Centre (ATC). This means that companies will have access, at CIMA's design lab, to all of AWAM's ASIC design processes, and the resulting design data can then be sent to AWAM for manufacture.

Dr Bob McCluskey, General Manager of AWAM, said that in appointing CIMA as an ATC his company took into consideration CIMA's excellent design facilities and pool of design staff, together with their market and customer service orientation.

An example of the AWAM-CIMA relationship is the recent development

of an ASIC by the Aeronautical Research Laboratory (ARL), as reported last month. ARL found it a better commercial proposition to design their own ASIC, using CIMA's facilities, and have it manufactured by AWAM rather than compromise their project results and security with an off-the-shelf alternative.

Kong Telephone Company is to supply Buck-Boost power supplies worth $2.3 million.

- Australian professional audio and loudspeaker system manufacturer ***ARX Systems*** has appointed distributors for Hong Kong, Macau and the People's Republic of China (Chainford Technology), Taiwan (Prosound Inc.), South Africa (Prosound Pty Ltd) and France (Etelac).
- ***Audio Insight***, the Australian distributor for Onkyo, Beyerdynamic and Tannoy, has appointed Perry Sampson as its State Manager in Victoria. Mr Sampson previously managed his own audio retail business in Melbourne.
- Sydney-based ***RF Devices*** has signed an agreement with UK power supply maker Powertran, to manufacture that firm's switchmode power supplies under licence. RF Devices has also appointed M. Keskin as Digital Product Manager.
- ***Greater Union Village Technology***, formed by the merger of Greater Union Theatre Supplies and Village Roadshow Technology, has formed a Professional Audio Products Division. The new division is based in new 1200 square metre premises in Camperdown, Sydney.
- An Australian consortium has been formed by ***Pacific Dunlop Ltd, Exicom Ltd, the AMP Society and Racal Telecom PLC***, to pursue the opportunities presented by the Government's proposed telecommunications reforms.

1987A SUPERNOVA NOW RADIO SOURCE

Sydney University astronomers Dr Tony Turtle and Mr Duncan Campbell-Wilson, together with astronomers at the Australia Telescope National Facility, have announced the reappearance of supernova 1987A as a radio source.

"The reappearance of the exploded supernova 1987A as a radio source is an event of great astronomical significance," says Professor Lawrence Cram of the School of Physics (Astrophysics). "The emission may result from an extremely violent collision between the ejecta from the supernova and material in the general neighbourhood of the exploded star."

"The ejecta left the supernova with a speed exceeding 20,000 kilometres per second, and would now fill a sphere a few light-months in diameter. If this is the source of the radiation, astronomers will have a unique opportunity to study the very earliest phases of the formation of a supernova remnant. Several hundred other remnants are known, but all are at least several centuries old. Their main significance lies in the fact that they are the results of extremely violent explosions which energise the interstellar gas in galaxies, and fill it with the wide range elements synthesised by nuclear reactions in stars."

First indications of the new fireworks appeared in a routine monitoring observation on 5 July last, made with the University's Molonglo Observatory Sysnthesis Telescope. Astronomers at the Australia Telescope National Facility then used the new and powerful Australia Telescope Compact Array to confirm the detection and determine the spectrum of the radio emission on 15 and 16 August. Molonglo observations imply that the radio source is brightening at a rate of about 2% per day.

Philips' Australian designed and manufactured PRM80 VHF/UHF mobile radio has won a 'Gute Industrie Form' (IF) award, at the recent Hanover Fair. The PRM80 uses the latest surface mount technology, and can be made for PMR bands from 68MHz to 520MHz.

When I Think Back...

by Neville Williams

From sparks and arcs to solid state - 3

In this third article looking at the development of techniques to allow direct transmission of speech and music via radio waves, we look at the so-called 'RF alternators' which found favour early this century. From here we look at early modulation systems, and finally the development of valve oscillators and transmitters.

Goldsmith also devotes a complete chapter to 'Alternators of Radio Frequency' – the design of which posed a state-of-the-art challenge to specialists in rotating electrical equipment.

As a measure of the basic problem, Goldsmith calculated that a 100,000-cycle alternator, with a 60cm diameter rotor spinning at 2500rpm, would require an impractical 48,000 poles and a pole pitch of 0.4mm!

Alternatively, if a designer opted for a rotational speed of 20,000rpm, 600 poles would be required with a pitch of 3.0mm – plus an ability to withstand enormous centrifugal force.

As an example of then-current technology, Goldsmith surveys three quite different alternator systems, each of which is capable of generating output currents to around 50,000Hz (cycles per second) or a wavelength of 6000m at power levels to 100kW or more.

Two of the systems involve frequency multiplication – one internal, the other external to the alternator – while the third relies on direct generation. In this present article, it is possible to outline the systems only in very broad terms. Readers wanting to study the technology in detail will have to refer to the original or other suitable texts.

The so-called 'Goldschmidt' alternator illustrated in Fig.6, relies on the fact that (and I quote) 'an oscillatory movement of frequency 'n' taking place on a system rotating with frequency 'n' is equivalent relative to fixed external points to an oscillation of half the amplitude or width and of double frequency'.

This is tantamount to frequency multiplication, which is 'internal' to the alternator.

To set up the required condition, the Goldschmidt alternator provides external means of resonating the rotor system, overall, at the fundamental frequency of the system, and the stator, overall, at twice that frequency.

The interaction of the harmonically related resonant modes, plus the original fixed and rotational fields, can be made to substantially cancel the 'n' and

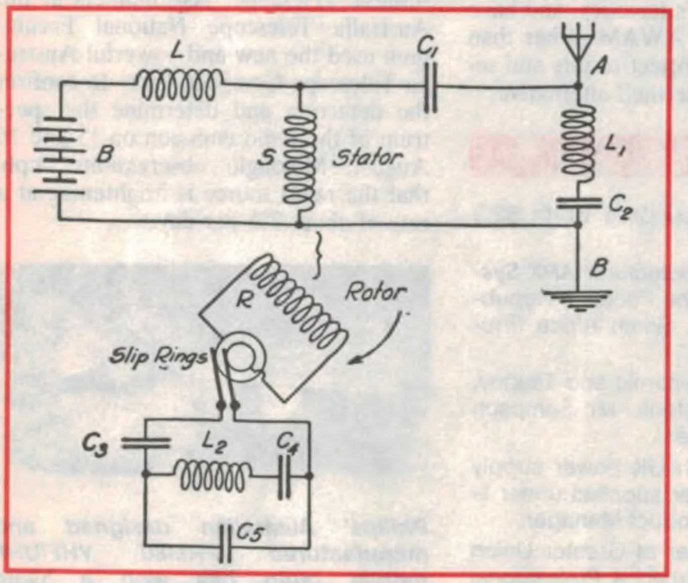


Fig.6: Illustrating the basic principle of a Goldschmidt alternator. By resonating the rotor at a frequency related to the rotational speed, the stator acquired an AC component resulting in an output at double or quadruple the natural figure.

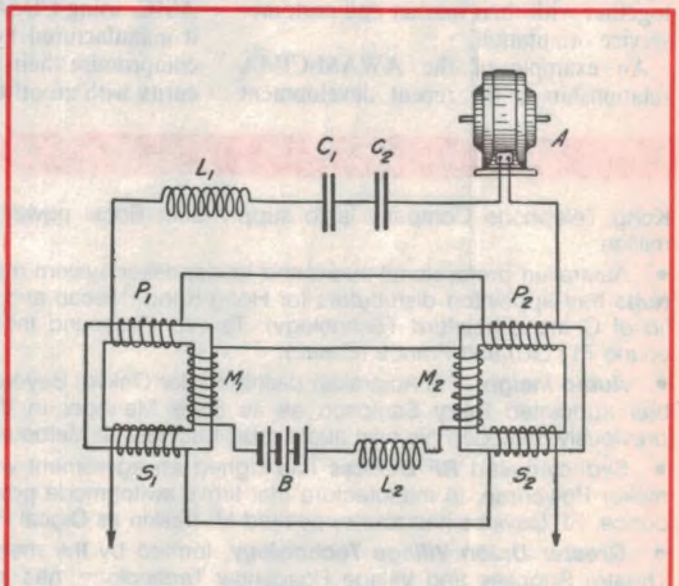


Fig.7: A system favoured by Telefunken to double or triple the frequency from an RF alternator. Transformers with saturated cores suppressed the respective half cycles of the input waveform.

'2n' components, yielding a resultant '4n' current in the stator at four times the fundamental alternator frequency. By design, that segment of the total stator system involving the antenna can be resonant at the quadrupled frequency, which therefore becomes the dominant output signal.

Inductor L prevents the RF energy from being diverted into the DC source, but special care was necessary in what were quite bulky motor/alternator installations to ensure that busbars to the pre-settable external resonating components did not compromise the wanted signal by stray L/C leakage effects.

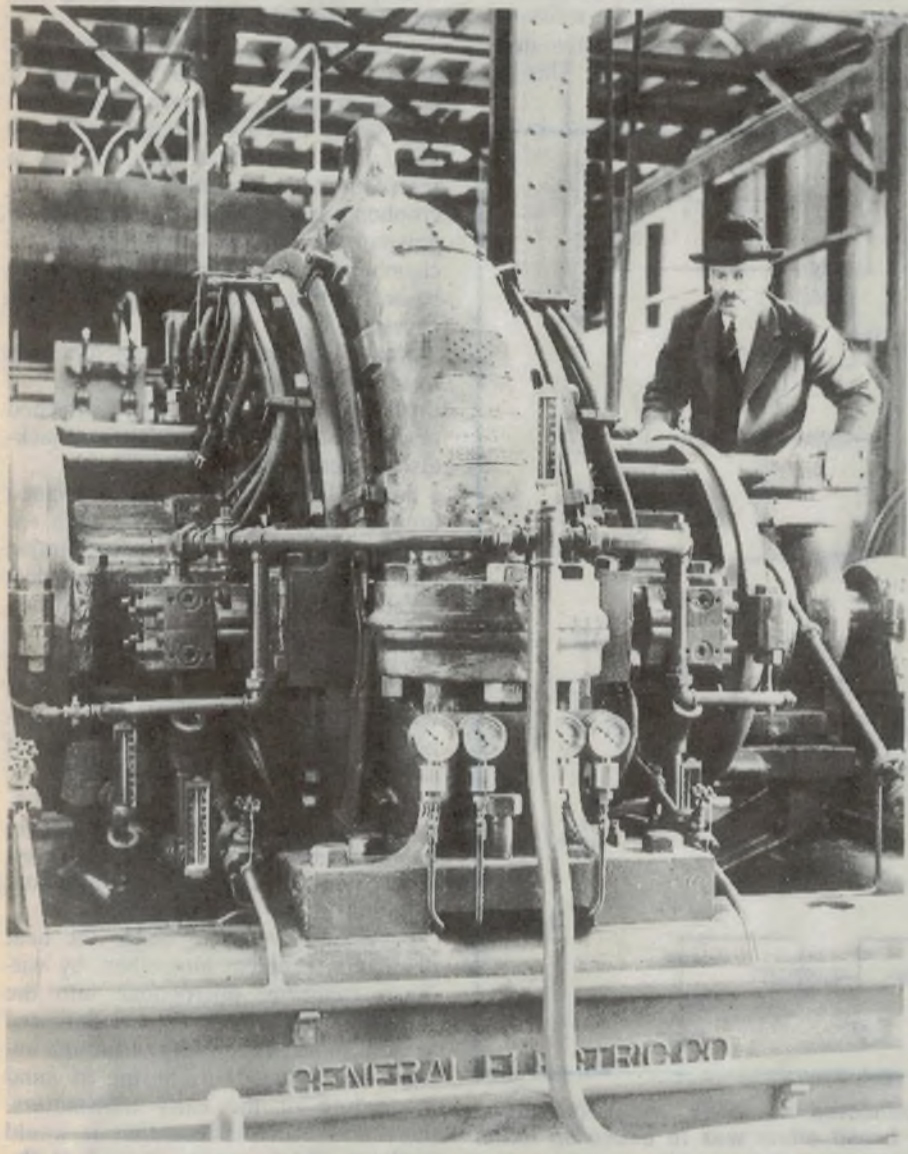
External multiplier

Fig.7, also from the Goldsmith book, shows a system favoured by Telefunken, which involves an inductor type alternator A and a pair of saturable transformers operating as a frequency multiplier. L1, C1 and C2 serve to bring the total input circuit to resonance at the fundamental alternator frequency.

In operation, the transformer cores are brought close to saturation by a current from DC supply B though the respective windings M1 and M2. Inductor L2 passes the direct current but inhibits alternating current from circulating around the DC loop.

Because of core saturation, the respective transformers can each transfer only one half-cycle of the input frequency, the other half being effectively suppressed. The windings are so arranged, however, that they operate out of phase, such that windings on transformer 2 preserve and invert the half-cycles suppressed by transformer 1.

In the simplest situation, the half-cycles interleave to provide a waveform which is predominantly a second harmonic of the original input – or double the frequency. Goldsmith says, however, that, by reversing the phase of one secondary, the output waveform becomes preminantly a third harmonic, so that the system can be set up fairly readily to operate either as a doubler or tripler, feeding a suitably resonant aerial system.



GE pioneer Dr Ernst Alexanderson pictured in 1922 with one of his high speed 'RF' alternators. They were typically fitted with 600 or 800 poles!

Alexanderson/GE system

The third type of RF alternator was researched in part by the National Electric Signalling Co, working in conjunction with R.A. Fessenden. At his suggestion, it was taken up by E.F.W. Alexanderson of GE, who produced a practical design in 1908, rated to deliver a direct signal of 100kHz at a power level of around 2kW.

The Alexanderson alternator was also of the inductor type, typically using a 300 to 600-slot field and a spinning disc of chrome nickel steel, which was thick at the hub and thin at the periphery to equalise the radial tension on the metal throughout the whole unit.

Radial slots were milled through the outer extreme of the disc and subsequently filled with phosphor bronze, firmly rivetted into the slots, then ground and polished to cope with air drag and a centifugal force of 37kg on each each individual filler at a typical operating speed of 20,000rpm.

For efficient operation, the Alexandersen alternator called for the utmost precision, with the outer edge of the disc spinning at a peripheral speed of about 20km/minute in a stator gap adjusted down to a clearance on each side of about 0.4mm.

Driven by a DC motor with a belt and/or gear train, or directly by a steam turbine, Alexandersen alternators were normally provided with pressure-fed lubrication and protected by an automatic cut-out sensitive to oil flow.

Goldsmith pictures a 50kW, 50kHz Alexanderson/GE installation that had been operating with a high degree of reliability up to the time his book was published. He notes that Alexanderson alternators were, of necessity, low impedance devices, requiring a step-up matching transformer to couple them to the antenna system.

At the time of publication the highest known frequency that had been achieved directly by a rotating machine was produced by an 800-slot Alexanderson alternator: namely 200kHz or 1500 metres. Obviously enough, while the signal may have been well suited for speech modulation, the technology was limited to the low end of the radio frequency spectrum.

Significantly, perhaps, the *Admiralty Handbook* makes only passing reference to RF alternators. It concedes that they produced a very pure wave, were easy to key, well suited for telephony and for high power working. Against that, the first cost was high, they required expert supervision and maintenance, they were suitable only for low frequencies, and frequency changing was more of a problem than with other systems. The Royal Navy simply did not use them.

Speech modulation

If the generation of stable continuous radio waves posed a problem for the pioneers of radio telephony, so also did the task of modulating those same RF carriers with speech and/or music waveforms. Radio valves had been invented, but their routine use as oscillators, amplifiers and modulators was still somewhere in the future.

If a transmitter had to be modulated with speech, it had to be achieved more or less directly with a microphone – with or without the dubious assistance of a magnetic relay.

What's more, with the type of transmitting equipment discussed thus far, there was little option but to connect the microphone into the arc, alternator or aerial circuit in such a way that it would vary the efficiency of the circuit and therefore the instantaneous amplitude of the RF output.

While Fig.8 indicates some of the circuit options available, it also suggests that the levels of current and/or voltage involved in the majority of circuit situations might be much higher than could be tolerated by ordinary microphones.

According to Goldsmith, carbon microphones of the period had a resistance of 50 to 100 ohms and an effective dissipation rating of about 2 watts. This implied a maximum permissible voltage of around 10 and current in the range 0.1 to 0.2A. Excessive current could typically cause an objectionable 'frying' noise, heat damage to the granules and a tendency for them to 'pack' or 'cake' and lose sensitivity.

The resulting incompatibility prompted would-be solutions that ranged from ingenious to bizarre!

Believe it or not

According to Goldsmith, Dr Lee de Forest resorted to attaching a buzzer to one of his microphones so that the operator could 'de-cake' it from time to time by pressing a button.

A certain Lieutenant Ditcham opted for four pairs of series-connected microphones, mounted on a rotatable table-top stand. Every two minutes he would click the stand around to bring two new microphones into circuit, leaving the others to cool down!

J.B.Marzi, an Italian designer hit upon the idea of a moving stream of carbon granules, so finely divided that they would flow like a liquid and carry away their own heat. Loaded into a reservoir at the top of a table-top microphone assembly, the granules would gravitate steadily through the diaphragm chamber into a container underneath, to be be emptied back into the reservoir as necessary.

More conventionally, microphones were cooled by integral fans, by oil thermo-cycled through an attached reservoir, or provided with water jackets connected to an external supply.

Some microphones were designed around carborundum powder with asbestos spacing washers – more durable than normal carbon granules, but electrically less convenient than a carbon and felt design.

'Hydraulic' microphones, devised by Chambers, Vannui, Majorana and others, dispensed with granules altogether, exposing columns or globules of slightly acidic water or other conductive liquids to sound waves and taking advantage of variations in their instantaneous resistance. From all appearances, they could hardly have been mechanically stable.

Fessenden sought to dodge the heat dissipation problem altogether, by wiring a *capacitive* microphone into the resonant aerial circuit. It was supposed to 'spill some of the energy from the antenna to ground' but, having in mind the nature of the early transmitters, there was every chance that it would modulate the frequency as well as the amplitude of the radiated carrier!

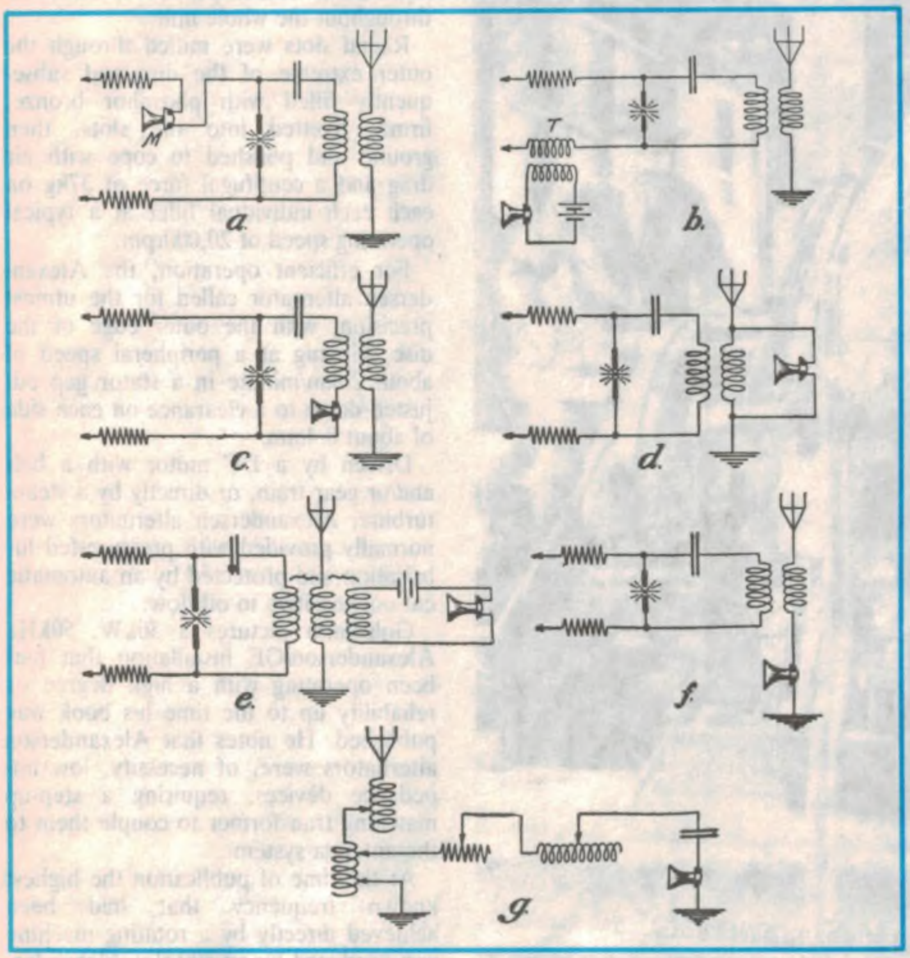


***Fig.8:** Carbon microphones were connected to early radio telephony transmitters in a variety of ways. Their broad effect was to cause an initial loss of efficiency, which was then varied up and down with instantaneous changes in microphone resistance.*

Back to the granular types, an accepted way of achieving high dissipation was by operating several microphones in parallel.

A noteworthy design by Egner and Holmstron of Stockholm contained 16 low resistance high-current cartridges arranged in groups of four, to share four separate diaphragms. All 16 were mounted in a rectangular metal housing with external cooling flanges and filled with a non-conductive cooling oil. Provision was also made to periodically displace the air in the microphone chambers with hydrogen or a gas containing hydrogen. Terminals at the rear allowed the microphones to be connected in series and/or parallel to provide a choice of resistance and current rating.

Fig.9 shows an alternative method of achieving a similar end result, with acoustic tubes branching from a single mouthpiece feeding multiple cartridges. Using only three microphones, the one illustrated in Fig.9 would be appropriate only for a low-power or short-range transmitter. More typically, a Berliner/-Poulsen ship radiophone installation pictured by Goldsmith uses six cartridges, while a Lorenz multiple microphone uses no less than 25 Berliner cartridges fed by tubes from a common speaking trumpet!

The valve era

With the adoption of valve-based technology, transmitter design became much more elegant and purposeful.

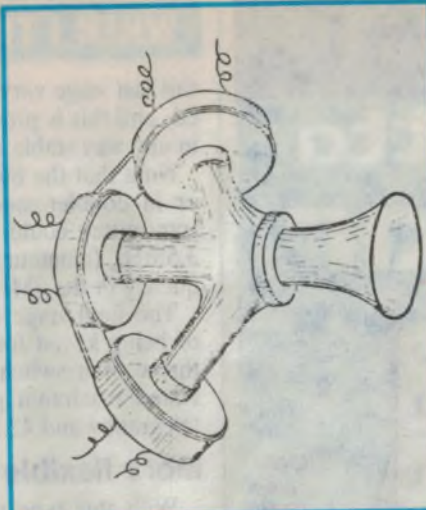


Fig.9: An effective if cumbersome way of providing a high current microphone, as illustrated in Gernback's Wireless Telephone – published in 1911.

Fig.10 shows a typical, relatively simple circuit published by the A.W. Valve Co in the mid 1930's, in a booklet entitled *Radiotron Circuits for Experimenters*. It should serve to illustrate the thinking behind valve transmitter design.

The first stage (top left) is an oscillator, designed to generate the basic signal. This is amplified and/or processed in the following stages and ultimately radiated at a precise frequency specified by the administrative authority or, in the case of experimenters, within strictly defined frequency bands.

In the early 1920s, the basic oscillator frequency was commonly determined by a ruggedly assembled tuned circuit, which the operator was required to adjust with the aid of an approved wavemeter.

(In 1923, to assist experimenters in the Sydney area, pioneer experimenter Charles Maclurcan (2CM) was authorised to measure the frequency of other experimental stations, on request, on behalf of the State Radio Inspector, Mr W.T.S. Crawford; this was to a potential accuracy of about 1.0%).

In later years, the tuneable L/C circuit was commonly replaced by a quartz crystal, as depicted in Fig.10, which oscillated in piezo-electric mode at the particular frequency for which it had been ground. Far more stable than a conventional tuned circuit, it became possible to generate a 'rock-steady' signal within 0.005% or better of the specified frequency.

Oscillator stages were normally operated at a modest power level, to limit valve heating and mechanical stress on the vibrating crystal. Depending on the tuning of the anode circuit, the oscillator could deliver an output signal at the same frequency as the crystal or, in 'doubler' mode, at twice the crystal frequency.

The second stage in Fig.10 is a 'buffer' amplifier, so called because it serves to isolate the oscillator from the RF output stage, which feeds the antenna. The dynamic operating conditions of

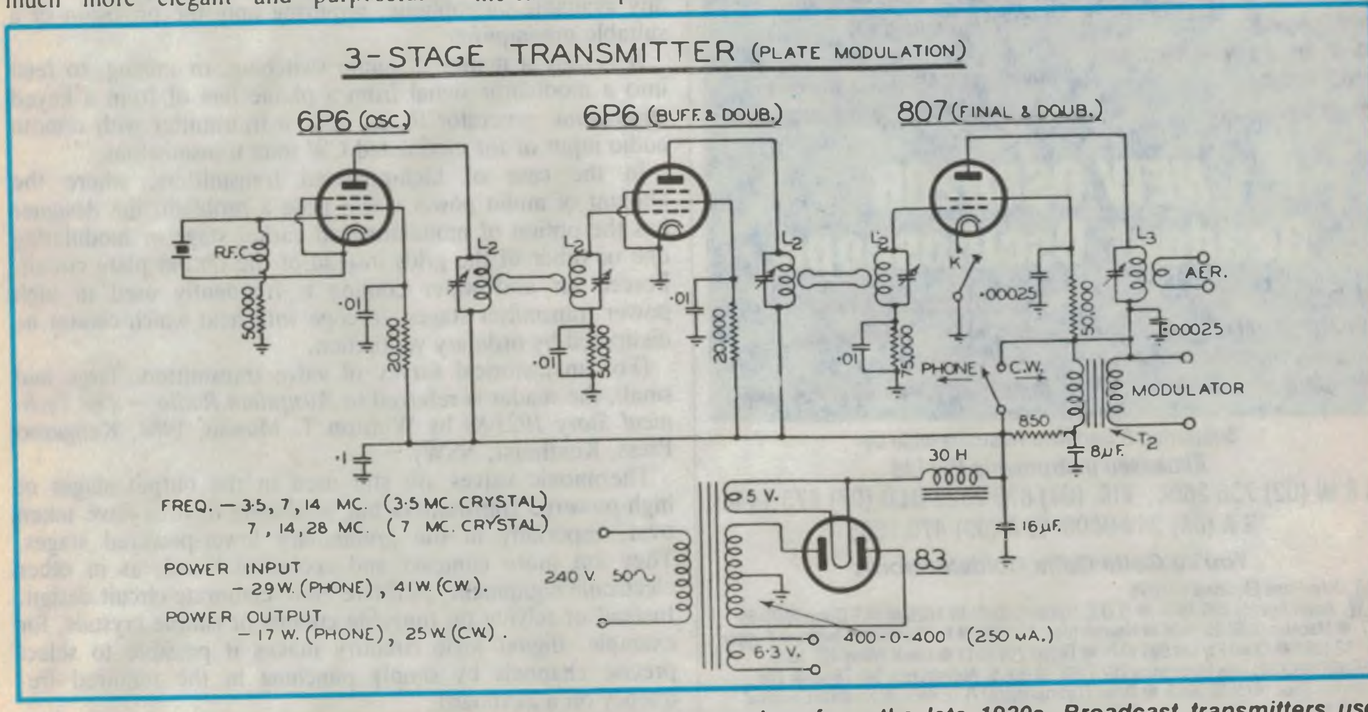


Fig.10: A typical valve type transmitter used by amateur operators from the late 1930s. Broadcast transmitters used similar basic principles, but at a far higher power level.

this last stage vary greatly when it is being keyed or modulated, and this is prevented by the buffer stage from prejudicing in any way stable operation of the oscillator.

Note that the buffer also can operate as a straight amplifier or in doubler mode such that, with a 3.5MHz crystal, the transmitter could operate at the original frequency in the 3.5MHz (amateur) band or at double or quadruple the frequency in the 7MHz or 14MHz bands.

The final stage used an 807 beam power tetrode, capable of being keyed for CW Morse code transmissions or, at the throw of a switch, modulated with voice or music signals. Rated maximum power output from the 807 was 50W for telegraphy and 42.5W for telephony.

More flexible design

With this type of transmitter, the aerial system plays no part in determining the exact frequency of the generated signal and it can be designed quite independently to meet the operator's requirements. It may conceivably be a large installation or something confined by available space. It may be a single-band or multi-band design, directional or non-directional; the radiation pattern will be affected but not the transmission frequency.

Similarly, there would be no awkward limitations on the choice of microphone or the depth and linearity of modulation.

The 'modulator' on which this depends is an audio power amplifier, essentially little different to a domestic music or public address system, except that it must be capable of delivering the requisite power to the transmitter through a suitably designed modulation transformer T2.

With Fig.10, using plate modulation of the final stage, and a plate power input of about 60W, the required modulation power would be about 30W RMS – a fairly routine figure for an audio system. The audio input signal – speech or music – could be derived from any ordinary input source or any available microphone, requiring only the provision of a suitable preamplifier.

It is only a matter of audio switching, or mixing, to feed into a modulator signal from a phone line of from a keyed audio tone generator to use such a transmitter with remote audio input or for modulated CW tone transmissions.

In the case of high-powered transmitters, where the amount of audio power might pose a problem, the designer has the option of modulating an earlier stage or modulating one or other of the grids instead of the output plate circuit. Forced air and water cooling is frequently used in high power transmitter stages, to cope with heat which cannot be dissipated by ordinary ventilation.

(For an historical survey of valve transmitters, large and small, the reader is referred to *Australian Radio – The Technical Story 1923-83* by Winston T. Muscio, 1984, Kangaroo Press, Kenthurst, NSW).

Thermionic valves are still used in the output stages of high-powered transmitters but solid-state devices have taken over, especially in the preliminary lower-powered stages. They are more compact and economical and, as in other electronic equipment, facilitate more elaborate circuit design. Instead of relying on tuneable circuits or simple crystals, for example, digital logic circuitry makes it possible to select precise channels by simply punching in the required frequency on a keyboard.

But I'm no longer thinking back. I've caught up with the present!

Silicon Valley NEWSLETTER

Cypress to launch first Soviet chip

Remember the 'red carpet treatment' the usually penny-pinching T.J. Rodgers accorded the delegation of Soviet semiconductor scientists during the Silicon Summit? There were promises of Cypress making and selling advanced Soviet chip designs for HDTV and other graphics applications.

It seems that both parties still remain serious about the unusual East-West chip alliance. In fact, Cypress has signed chip licencing agreements with three Soviet companies and will begin marketing the first devices made under the agreement as early as this month.

One chip involves an advanced three-nanosecond ECL custom memory. Other Soviet devices Cypress plan to put on the market include a DSP part, a systolic gate array and a correlator.

Hi-tech eye on Iraq

Look up, Mr Saddam, and say 'cheese'. Mr Bush is taking your picture with two of his new cameras; the huge KH-11 spy satellite and a new – almost toy-like – unmanned drone.

Until now, the existence of the KH-11 spy satellite has never been admitted publicly by the Pentagon. But at least two of them are apparently in orbit, and at least one is putting crisp pictures of Iraqi troop movements on President Bush's desk every morning.

Usually the Pentagon does not reveal the top performance capabilities of its equipment, but in describing the performance of the KH-11, the Pentagon said the spy satellite is capable of recognising objects as small as a grapefruit from 200 miles out. And unlike the previous generation of spy satellites, the KH-11 can produce impressive-looking pictures at night as well.

The Pentagon hopes the publicity regarding the KH-11 and its role in crisis, will help it convince Congress not to cut off funds to put a globe-spanning network of KH-11's in orbit.

Meanwhile, the 82nd Airborne Division which was sent off to Saud Arabia took with it a number of still experimental unmanned 'Pointer' drones developed by AeroVironment in Los Angeles.

The small plane is battery powered and can fly around for more than one hour within a radius of three miles. It can be remotely controlled or fly a pre-programmed route. On-board cameras provide battlefield commanders a clear 360° view of nearby enemy positions and movements.

"It is like making a 500-foot-tall man with a pair of binoculars. If he has his eyes up there, he can look over the hill and around the curve. Obviously, he has a great advantage" said Ray Coleman, who directs the Point deployment program.

The Point was first used in battlefield exercises in June and the Army has rated the performance as 'outstanding,' promoting the decision to take the drones along to Saudi Arabia – despite the short time they have been on duty.

The Goupil Golf is a very compact new personal computer from Newbury Park-based Computer Peripherals Inc. Using the new 386SX processor running at 16MHz, it features a fold-up 10" backlit LCD screen plus 1.44MB 3.5" floppy drive and a 20MB, 40MB or 100MB hard disk.

Signetics workers spared Philips axe

The 6000 or so Silicon Valley based employees of Signetics were able to breathe with relief, after learning that the massive restructuring plans announced by the company's Holland-based NV Philips parent would not affect them.

Most of the 4000 people Philips will

lay off as part of the program are located in Europe. As part of the program Philips will consolidate its custom chip business and drop out of the SRAM memory market. With the restructuring Philips has joined the ongoing exodus from the SRAM memory market by a number of non-Japanese chip makers in recent months.

Earlier this year, Advanced Micro Devices sold its SRAM operations to Sony. Now both National Semiconductor and VLSI Research have abandoned the SRAM field after suffering substantial losses and being unable to make the necessary huge investments to keep up with the Japanese in developing next-generation products fast enough.

Gulf crisis boon for computer makers

The Gulf crisis has already provided a badly needed boost for struggling high-tech defence firms in Silicon Valley, which have come under severe pressure during a year of budget cutting by the Pentagon.

Because the US has been sending many of its most sophisticated weapon systems to Saudi Arabia, many Silicon Valley firms are reporting a rush of new Defence Department orders and requests for speed up deliveries on existing contracts.

The Middle-East crisis is providing a strong shot in the arm for makers of computers that are built to endure the hazards of Middle East battlefield conditions including sand storms and blistering heat.

Being shipped out to the Saudi front line are hundreds of a recently introduced new model of the Grid Systems laptop computer. Grid, a Tandy subsidiary, said the Pentagon has asked the firm to speed up deliveries of the computer. While the use of the sleek black Grid computers is classified, they are reportedly being used aboard mobile command centres and on trucks and trailers where they are used to type messages that are transmitted by means of special radio signals.

Also found in the Saudi desert are scores of Macintosh laptops, ruggedised by Rugged Digital Systems. The Mac's advanced graphics display is used for mapping and other graphics-oriented applications.

A number of soldiers have reportedly taken along a compact machine made by Magellan Systems in Los Angeles. The US$3500 computer uses satellite signals to show the user the exact location he or she is, anywhere on earth and accurate to within a few feet. According to a Magellan spokesman, many servicemen placed orders for the machine while on their way to Saudi Arabia, and charged the cost to their credit cards.

Nippon Steel enters laptop market

Following a recent trend among major Japanese industrial companies to diversify into the high-tech area, Nippon Steel, the world's largest steel mill, announced plans to enter the fast-growing laptop computer business. The company has set up a well-financed subsidiary in Silicon Valley to develop and build the machine.

The new company is called Librex Computer Systems. Company officials said the system it is developing will be aimed at the US market. The first two models in the series were expected to be ready for shipment as early as November, with manufacturing contracted out to local computer manufacturing companies.

Although a number of Japanese firms have entered the high-tech field in recent years, including farm equipment maker Kubota, Nippon Steel is the first to do so without an American partner with existing marketing and distribution networks in place.

Probably, Nippon's decision to develop a computer business on its own has a lot to do with its ability to afford such a move. Last year, the firm reported pre-tax profits of $1.3billion. Besides personal computers, Nippon Steel has also invested into such diverse areas as theme parks and biotechnology.

National sacks 2000, closes key plants

In what many industry observers termed a stunning blow, National Semiconductor has decided to shut down a state-of-the-art chip plant it inherited with the Fairchild acquisition. Any such move would cast an even greater doubt over the firm's future, industry analysts said.

In addition, National said it would be laying off another 2000 workers over the next couple of months, in a last-ditch effort to return to profitability by cutting operating expenses and closing unprofitable product lines.

Most shocking in the announcement is the decision to close the Washington plant, which specialises in BICMOS-based products and also produces a large share of National's top-of-the-line ECL high-speed logic circuits that are used in many military systems, supercomputer and other high-end systems. The plant and its technologies are so advanced and critical to the US supercomputer industry and many Pentagon programs that it served as the main incentive for the Reagan Administration to block the sale of Fairchild to Fujitsu.

"We have really faced up to some problems. But we were not making the progress we had hoped, and it impacted our ability to pursue our main businesses. This is painful but consistent with where we want to go," said National president Charlie Sporck.

As part of the latest reorganisation, National will leave the market for one megabit SRAM memory chips, products which are made at the Puyallup facility in Washington. Sporck said the company is considering selling the plant. The facility was already loaded with state-of-the-art equipment when National took it over and the firm has invested at least US$50 million more.

Sporck said National will also pull out some of its gate array business and close a military assembly and test facility in Arizona.

TV makers say dumping via Mexico

In 1988, the US Commerce Department imposed anti-dumping duties on colour television sets imported from Japan and Korea, after it found those products were being sold in the US below their manufacturing cost. A few weeks ago, the Committee to Protect American Colour Television, a group that represents a handful of US tube producers, announced it is seeking similar dumping penalties against sets imported from Mexico.

According to COMPACT, which also filed the original dumping complaint, the Korean and Japanese firms have found an effective way to get around the dumping duties by shipping their tubes and other parts to 'screwdriver plants' in Mexico. There, the sets are assembled in highly automated factories and shipped to the US. Coming from Mexico, the sets are not subject to the dumping charges.

According to the US group, imports of Mexican-made TVs have increased a whopping 140% since the dumping duties went into effect. And the sets are being sold at virtually the same dumping level prices as they were before the Commerce department action.

Wafer shortage takes hold

Shortage of certain types of silicon wafers, first mentioned during the Semicon West Show in May, appears to have become a reality as lead times for 5" and 6" wafers now stretch up to 20 weeks.

According to new figures released by Dataquest, lead times have more than doubled in the past several months and prices for most wafers, particularly 6" ones, have increased another 10-20% since June.

A possible shortage of wafers during the second half of this year was first mentioned in May by Bill Reed, president of the Semiconductor Materials & Equipment International trade group. Reed's statement at the opening of his group's annual show, surprised many because wafers have historically been in abundance. But the prolonged periods of low profit margins during much of the past two decades have caused wafer manufacturers to be overly cautious in investing in new 5" and 6" lines. Demand for such wafers has picked up dramatically in the past six months, after new 6" chip fabs have come online in Korea and elsewhere.

A shortage of wafers, of course, could trigger another crisis in the semiconductor components market. If Dataquest's analysis of the situation proves correct however, chip makers may have to contend with wafer shortages for some time.

"We are really looking to 1992 before the American market gets new wafer production capacity and the situation eases," said Dataquest's Mark Fitzgerald.

The shortage would be most painful for the smaller chip makers, because the major vendors all have long-term supply contracts that insulate them from shortages.

VSLI to leave SRAM business too

A second major US supplier of SRAM memory chips has announced it is leaving the business. Within a week of National Semiconductor's announcement that it would withdraw from the SRAM business, VLSI Technology in San Jose shocked analysts with similar news.

VLSI said as a result of the decision, the company will have to take a one-time charge of about US$13 million against earnings in the third quarter, ended on September 30. The charge will cover costs associated with closing the product line and providing severance pay for the 100 or so VLSI workers who will be laid off in the process.

Because VLSI said it would also report an operating loss on a decline in sales, analysts said the third quarter loss could well top US$20 million.

VLSI said it is leaving the SRAM business, which accounts for about 5% of total sales, because of the highly competitive nature of that market, resulting in low profit margins. Coupled with relatively high research and development costs, the product lines has been a major source of red ink for the company.

Valley Police nab colour fax pioneer

The next generation of fax machines will feature colour capabilities. Claiming to be ahead of its time, Starsignal of Campbell has claimed to have developed the first such machine. But recently, Silicon Valley authorities raided Starsignal's facilities and put its president behind bars, allegedly before he could escape out of the US with millions of dollars in venture capital.

To be sure, Starsignal did develop an IBM PC-based colour fax system, and had sold 17 of the US$25,000 units since its introduction several months ago, but according to police records, Starsignal lied in its prospectus to investors. The prospectus claims the company is close to finishing a US$83 million deal with authorities in Spain. But a former vice president told police the talks were only in a preliminary stage and the dollar figure had simply been "extracted from the air".

In an unusual move, Starsignal president Robert Wildergren was arrested and jailed without bail. A Santa Clara police spokesman said they had decided to keep Wildergren confined because of statements he had made to associates regarding the possibilities of fleeing the US if authorities moved against him. In preparation of such an event, Wildergren is alleged to have already transferred US$6 million in bank loans and lines of credit to an account in the South American nation of Belize.

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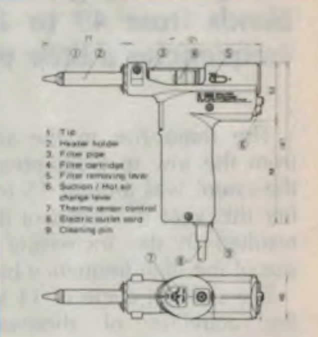

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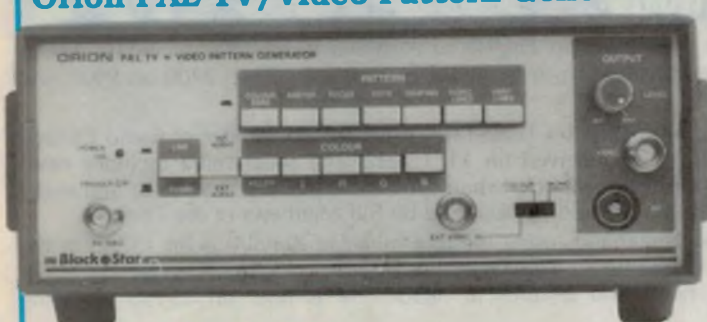

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SHORTWAVE LISTENING

by Arthur Cushen

High sunspot activity brings better overall reception

The present high sunspot count means that shortwave listeners find the signals spread across the bands from 49 to 11 metres and this, to some degree, makes the problem of finding clearer frequencies a little easier.

The rapid rise in the sunspot count from the low in September 1986 when the count was around 15 to a peak earlier this year in March of over 160, has resulted in the increasing activity and use of the high frequency bands.

The sunspot cycle of 11 years governs the activities of shortwave stations. When the count is low, they move to the lower frequency bands. Listeners will no doubt be aware that the 49-metre band was over-crowded with signals in 1986, as stations tried to use the lower frequencies for optimum reception.

The high frequency bands of 11 and 13 metres are now being widely used. The sunspot count will gradually decline and in another seven years should reach its minimum count.

Sunspot activity

The 11-year cycle of sunspot activity primarily determines the propagation conditions of shortwave radio communication. The sunspot activity determines the intensity of ultra violet and X-ray radiation from the sun and this in turn determines the degree of ionisation of the ionosphere around the Earth. It is this ionosphere that reflects the sky waves of shortwave transmissions thus making long distance broadcasting possible.

The first regular records of solar activity were made in the 17th century. Scientists regularly recorded the maximum and minimum number of sunspots as early as 1611. In the last century a Swiss astronomer, who was head of the Zurich Observatory from 1849, systematised the previous results and introduced the relative sunspot number, which is still in use today. The actual numbers of sunspot cycles began in 1760, when the maximum was 86. The year of the maximum is always given as the number of the sunspot cycle. The last sunspot maximum was in 1979, while we are again this year facing the present maximum count.

The sunspot count for October was 133, and predictions for the following three months were November 131, December 129 and January 127. Although there will be periods of high and low solar activity through to 1992, the past sunspot cycle has been the most prolific on record, in terms of generating strong proton particle events which usually cause periods of radio blackouts for signals crossing the polar caps.

ZLXA on 3935kHz

The deregulation of radio in New Zealand has not only meant the opening of new stations on AM and FM, but the availability of the shortwave bands for new broadcasting services. As a result Print Disabled Radio is now operating on 3935kHz.

Established in Levin in May 1987, Print Disabled Radio first commenced broadcasting on 1602kHz with low power and has recently increased to 1kW. Broadcasting Sunday, Monday, Wednesday, Thursday from 0530-0900UTC, the station carries a reading service for sight impaired listeners and others with reading disability or who are unable to hold a newspaper. Broadcasting with a 1000 watt transmitter on 3935kHz in the 75-metre band, the shortwave service will relay medium-wave 2XA 1602 and will have the call sign ZLXA. With the use of a V-beam, the station is heard throughout New Zealand during the hours of darkness.

Allen Little QSM who founded the station and is visually handicapped himself, has a team of volunteers who read ex-

AROUND THE WORLD

BELGIUM: Brussels broadcasts in English to Australia 0630-0700 on 6035, 11695 and 13675kHz. The transmission to North America is now 2330-2400 on 9925 and 13675.

KOREA: KBS Seoul has English on 1030-1100 using the transmitter of Radio Canada International, Sackville and received on 11715kHz. The programme includes news and on Sunday 'Shortwave Feedback' when listeners letters are answered, and every second week some DX information is supplied by Bill Matthews of the USA.

NEDERLAND: Radio Nederland, using the transmitter at Bonaire is on 15560 to the South Pacific at 0730-0825UTC. The alternative frequency is 9630kHz for this transmission, while the news and features at 0830-0850 is now on 15190 replacing 9770kHz.

SAIPAN: KHBI operated by the Christian Science Monitor has its transmission to Australia 0800-0955 on 15610; 1200-1355 on 9895; 1800-1955 9455; 2000-2155 13625. The programme includes news, features and in the second hour 'Letterbox' is heard at 30 minutes past the hour.

SWITZERLAND: Swiss Radio International is using 9650kHz from 0100-0500 with English at 0200 and 0400 and these 30-minute programmes are also available on 9885 and 12035. The transmission in English to Australia 0830-0900 is on 9560, 13685, 17670 and 21695kHz. On Saturday at 0845 'Swiss Merry Go Round' is broadcast in which the 'Two Bobs' answer technical questions from listeners.

tracts from NZ newspapers, and also have the role of teaching people to read. New Zealand's Print Disabled Radio is affiliated with the Radio for the Print Handicapped Stations in Australia, which are operating from Canberra, Sydney, Melbourne, Brisbane and Hobart.

Middle East news

Shortwave listeners are right at the forefront of news and can hear broadcasts from many Middle East countries, all at fair to good strength. Naturally Baghdad is the centre of interest, with the best reception 2000-2200 on 13660kHz. A second English broadcast 0130-0330 is on 11810 and 18830kHz. Transmissions from Dubai are well received at 0530-0600 on 21700kHz while Damascus, Syria uses 12085 and 15095kHz for their English programme from 2005UTC.

A service of interest to those in the Middle East is the British Forces Broadcasting Service, and their transmissions 0200-0230 can be received on 13745kHz, while other broadcasts at 0930 and 1300UTC use 17695 and 21735kHz. There are special programmes to the area from Radio Australia 1300-1500UTC on 17630 and 21775, while Radio Japan, Radio Thailand and Radio Sweden have all announced extended services to the Middle East.

Radio Canada International has introduced Arabic into its programme 0430-0440UTC and is part of the English transmission on 15275kHz, which is operating 0400-0500UTC. The BBC World Service broadcasts 24 hours on three long established frequencies 9410, 12095 and 15070kHz.

Allen Little, Station Manager of the new shortwave service ZLXA.

This column is contributed by Arthur Cushen, 212 Earn St, Invercargill, New Zealand, who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT), which is 10 hours behind Australian Eastern Standard Time.

FORUM

Conducted by Jim Rowe

More about ELCBs, electrical safety — and those green pens for CDs...

As promised last month, we're again looking at some more of the letters and information that arrived in response to the discussion of earth-leakage or 'residual current' circuit breakers, and electrical safety in the bathroom. I also have the results of some more tests we conducted, to try and gauge the effectiveness of those green pens which are claimed to improve the sound from compact discs.

You may recall that at the end of last month's column, I noted the arrival of another letter in response to the August discussion of ELCB operation and bathroom safety. The letter came too late for inclusion in the November column, but as it raised a number of points that hadn't been commented upon by others, there was no doubt that it deserved an airing.

The letter concerned came from Mr Peter Foley of Gerard Industries, one of the Australian firms which manufactures ELCBs. His letter is quite long, and a couple of the points he makes are very similar to those made by others. However I'll reproduce most of the rest, as I think you'll find it quite interesting:

I feel compelled to take both you and your correspondent, Jeff Thomas, to task on some inaccuracies in your article on ELCBs. (To be pedantic, the correct terminology these days is Residual Current Devices, or RCDs.)

1. RCDs are NOT promoted as the 'universal panacea' by marketing people from this company or from our major competitor. We are both very careful to point out that safety switches are NOT the be-all and end-all of electrical safety, and that all normal safety procedures be retained. But you cannot argue with the statistics — that 89% of people electrocuted in domestic situations, between 1983 and 1987, would NOT have been killed had an operative RCD been installed in the circuit.

2. Mr Thomas asserts that 'the impetus for the current wave of publicity for ELCBs was the electrocution of a five-year-old in the bath, due to a hair dryer...' This is totally incorrect. Those with a better memory will recall that this particular tragic event occurred when a Government promotional campaign was already well under way. In fact, some were concerned that the ad which showed a hair dryer falling into a bath might have contributed to this tragedy.

Those more fully informed would be aware that the plans to introduce compulsory RCDs in domestic situations relate to the periodic review of AS3000, the Australian Standard on electrical wiring. This review has been in progress for several years and will come into effect Australia wide in late 1991. All that has happened in NSW is that the Minister has brought those changes forward for new dwellings.

Degree of risk

Mr Foley then goes on to discuss the matter we looked at last month, in some depth: the extent to which someone in an unearthed bath is at risk from an appliance such as a hair dryer, dropped into the water, and whether or not the inability of an ELCB/RCD to respond to this situation is a real shortcoming. Like other correspondents, he believes that there is little risk of serious shock in an unearthed bath — this can occur only if the bather can come into contact with earth, via a water tap or similar object. And then, of course, an ELCB/RCD can offer some protection — provided you have one fitted and operational.

Just to round off this section, he advises as follows:

The wisest action to take under the circumstances we are discussing (even if you have an RCD) is to stay as calm as possible, sit still and call for someone to come and turn off the appliance and remove it. If modesty or solitude prevents that course of action, carefully stand up and, without touching anything else, grasp the appliance by the still dry section of the flex, and remove it from the bath.

He then goes on to make the following further points:

4. As for the decorative chain, certainly if an earth potential is available in the body of water when an appliance is immersed in it, sufficient current to trip the RCD will usually flow. But if you don't have an operative safety switch, it's a DEFINITE minus.

Additionally, it would be very important to ensure that the source of the earth potential (in Mr Thomas's case, a tap) is effectively bonded to the earthing system of the installation, or further complications could arise. I personally would prefer to have a completely isolated vessel.

5. As for the typical domestic bath being 'the most likely of all places for shocks to occur', while I don't have any local statistics of this nature to hand, I'm particularly doubtful of the truth of this statement. The figure for Europe is about 20% of domestic fatalities.

6. As for RCDs only detecting 'sudden' changes in current balance between active and neutral — wrong again. They detect ANY out-of-balance current, and disconnect the power if and when that residual current rises to the preset threshold of the device.

Gerard Industries has been involved with residual current devices for almost a decade. During that time we have consulted closely with Professor Gottfried Biegelmeier, a pioneer of and an acknowledged world authority on RCD technology. I am enclosing two papers on this subject given by Prof Biegelmeier, which you may find of interest.

Thanks for your comments, Mr Foley; I hope that others find them as interesting as I have. I certainly take your point about the two main makers of ELCBs/RCDs taking care not to claim that they solve all problems, and that the move towards fitting these devices in domestic installations is one of long-term planning rather than simple reaction to a particular tragedy.

I believe your points about the risk of shock in a bath, and the protection afforded by an ELCB/RCD were discussed with reasonable objectivity last month. Similarly I think you'll agree that the

pro's and con's of using Mr Thomas's suggested earthing chain were also given due discussion. There's certainly no argument that if you *don't* have an ELCB/RCD fitted, providing the bath with an earthing chain would be asking for trouble. From what we learned last month, it might even be unwise if you *do* have an ELCB/RCD fitted!

Perhaps you're right that the domestic bath situation isn't as dangerous as I suggested; I agree that the statistics for Europe given in Professor Biegelmeier's paper seem to bear this out. And as for my suggestion that an ELCB/RCD responded only to a 'sudden' change in the active/neutral current, I'm happy to stand corrected. In fact I was well aware that the ELCB/RCD would normally respond to *any* imbalance; it was really a case of expressing myself badly. My use of the word 'sudden' was really meant to imply that in the case of an appliance dropped into a bath, there would be (assuming an earth path) a sudden imbalance created — to which the ELCB/RCD would respond.

I certainly didn't intend to imply that an ELCB/RCD would *only* respond to such a sudden change.

By the way, I must thank Mr Foley for sending in copies of the papers by Professor Biegelmeier; they are most interesting, although rather too detailed and lengthy to reproduce here.

It isn't easy to summarise the information, either, because of the many variables involved and qualifications which need to be applied. But broadly speaking, Professor Biegelmeier's work seems to support the idea that in a completely unearthed bath situation, the risk of fatal shock from an appliance like a hair dryer dropped into the water is quite small.

Professor's findings

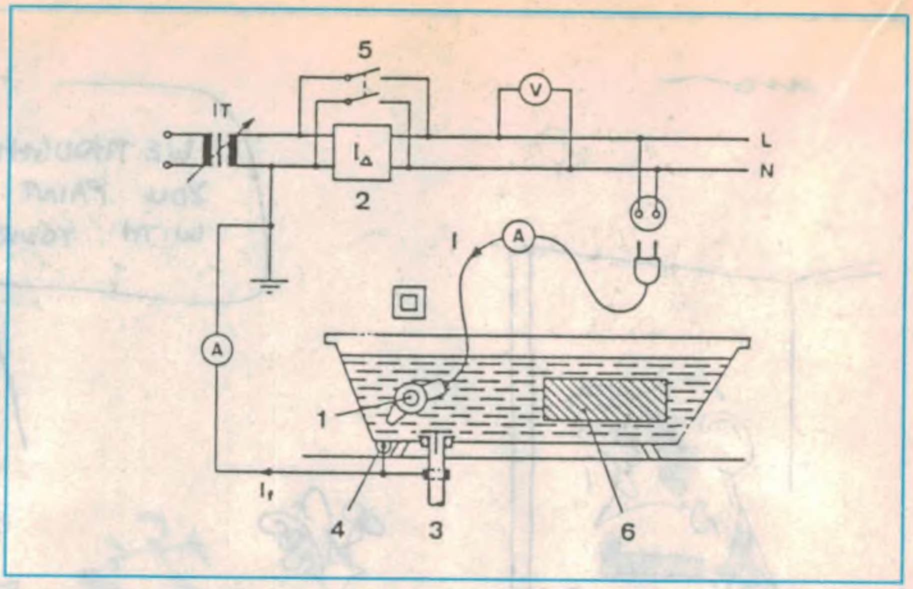
Prof Biegelmeier has gone to considerable lengths to measure typical values for the resistance of various human body paths, when wet, and also for the bulk resistance of various paths through the bathwater — including the likely path to earth via the waste pipe. He has also measured the 'constriction resistance' of appliances like hair dryers — that is, the resistance between the live internal wiring and the outer vicinity, when it is immersed in water. In fact he realised that this would vary depending upon which end of the hair dryer's heating element was connected to line active, and whether or not the dryer's switch was set to 'on' or 'off' — so he measured all four possibilities.

Following on from these measurements, he has then calculated the likely worst-case current levels through a person sitting in the bath, with the appliance immersed in various locations in relation to the person and the waste pipe. He has even calculated the likely current that would flow through the person if they should touch an earthed water tap.

The figures he has produced are approximately 600 ohms for hair dryer constriction resistance, 200 ohms for waste pipe path resistance, and 100 ohms for the typical average bulk resistance of the water between the two. Corresponding values for the resistance of the trunk and legs of a person sitting in the bath are about 200 ohms, and for the additional resistance of an arm (as a path to an earthed tap, etc) of about 500 ohms.

From these values he ends up with a figure of approximately 250mA for total fault current flowing to earth via the waste pipe, when the hair dryer becomes immersed. Of this only about 35mA are likely to flow through the person, assuming they don't touch an earthed water tap; a figure regarded as being unlikely to produce a fatal shock.

Of course if the person should happen to touch an earthed tap, the Professor calculates that the current through their body would be likely to increase to around 90mA — and it would now be flowing not just through the lower trunk and legs, but through an arm via the upper trunk and heart. As he says in his paper, *Such an accident would lead immediately to contraction of the muscles, and within a few seconds to ventricular fibrillation and therefore to death.*



Professor Biegelmeier's experiment to test the validity of his calculations. 1 is a hair dryer, 2 an RCD (ELCB), 3 and 4 are earthing connections, 5 is a switch to bypass the RCD, and 6 is the subject — the Professor himself, in fact!

Didn't stop there...

Perhaps surprisingly, Professor Biegelmeier doesn't stop at these measurements and calculations. As he goes on to say,

All theoretical considerations and measurements on models cannot provide information on which currents are really flowing in the human body, and what physiological reactions result when the human body is exposed in the bathtub to various situations occurring in electrical accidents. For this reason the author has carried out self experiments, in which the measuring circuit shown in the diagram was used. Some experiments were carried out with a residual current device inserted in the circuit, with a rated operating current of 30mA.

The rest of the paper concerned describes various experiments, in which he sat in a bathtub partially filled with water, and both measured currents and noted his physiological responses when a hair dryer was immersed with him, in various locations and with various applied voltages ('IT' in the diagram is an adjustable isolation transformer) — both with the RCD in circuit, and without!

One really has to take one's metaphorical hat off to him, don't you think? Not many people would be prepared to carry their scientific curiosity and objectivity quite this far, I'm sure.

Anyway, the results of these experiments seem to support his measurements and calculations quite closely. With no direct bodily contact to either the earthed waste pipe or a tap, and also none to the immersed appliance, the body current levels were quite low and little more than a 'tingle' could be felt even when the voltage was raised to full mains potential, and with the RCD disabled.

However if one of his feet touched the waste pipe, or his hand touched the exterior of the immersed appliance, or he touched an earthed tap, the body current levels were quite high even for relatively low voltages - and he also began to experience much more unpleasant levels of shock. Needless to say he didn't have his assistants increase the voltage beyond this level, in these situations...

Incidentally most of his experiments were carried out using plain tap water, with a resistivity of around 30-50 ohm-metres. However he also tried the effect of adding bath salts to the water, in typical concentrations. These had the effect of reducing the resistivity by over 10 times, down to around 2 ohm-metres, with a corresponding increase in the total fault current levels — and in some cases, the body current levels if he was also in direct contact with earthed metalwork.

So if you're going to be sitting in a bath when a hair dryer or similar appliance is dropped in, it would be a good deal less worrying if you have NOT added bath salts to the water! Or if you *have* added salts, it's even more important not to touch any earthed metalwork.

In his summary, Professor Biegelmeier notes that because of the crucial aspect of an earth path in determining the degree of danger in the 'hair dryer in the bath' situation, an RCD (ELCB) can play a significant role in preventing tragedies. He also points out, however, that it is essential for the RCD to have a rated operating residual current level of less than 30mA, and that if the appliance that has fallen into the tub is of Class II (i.e., double insulated), the RCD should be capable of disconnecting the supply 'practically immediately'.

Actually he also makes the following very interesting observation:

It seems a paradox that double insulation of the appliances for such kinds of accidents proves to be of a certain disadvantage. Appliances of Class I, i.e., with protective conductors, have the external conductive parts earthed, and these remain earthed even if under water. Fault currents are therefore mainly flowing between those earthed parts and the active parts. The proportion of the fault current flowing to the water outlet remains therefore small. For this reason earthed parts inside the appliance which are connected to the protective conductor can prevent dangerous fault currents.

...Which sounds to me very much like an implied endorsement of Jeff Thomas's original suggestion, that perhaps double insulated items would be safer in such situations, if they had an internal plate connected to mains earth.

(To be fair to Professor Biegelmeier, he also points out that for most other applications, Class II appliances have proved to be both reliable and extremely safe. He suggests that it's only in this particular situation that they are less safe that earthed appliances.)

Immersion detectors

Before we leave the subject of electrical safety in the bathroom, at least for the present, I should acknowledge another letter from Mr Drew Winning, of Townsville in Queensland. Mr Winning draws our attention to another kind of safety device, quite distinct from the ELCB/RCD, and designed specifically to cut off the power in the event that an appliance is immersed in water.

The device he refers to is called the *Immersion Detection Circuit Interruptor* or 'IDCI', and apparently various models are available — mainly in the USA at this stage.

Mr Winning encloses with his letter a copy of an article in the April 7, 1988 issue of the magazine *Machine Design*, giving details of IDCI devices and the way they operate. As far as I can see from this, they are designed to be built either as an integral part of the appliance itself, or to operate with specially designed appliances. This is because they appear to rely on a 'sensing wire' electrode, built into the appliance.

The sensing wire is configured so that in the event of the appliance falling into water (or any other conductive liquid, for that matter), any current flowing from the 'live' internal parts will immediately raise its potential. And the idea is that the sensing wire is connected to the gate circuit of a sensitive SCR or triac, so that when this occurs the SCR/triac immediately fires and operates a solenoid to break the supply to the appliance.

There are various 'frills', such as components to prevent the SCR from being spuriously triggered by mains transients, but that's the general principle involved.

From this the IDCI looks to be quite a worthwhile little device, and one whose operation seems to complement that of the RCD/ELCB in terms of safety protection. As it's also a fairly low cost device, it would therefore provide a practical way to increase the safety in bathrooms — with or without an RCD/ELCB — without adding dramatically to appliance costs.

By the way, note that the IDCI is essentially another approach to overcoming the difficulty of maintaining safety of a double- insulated appliance, when it's immersed. And as with Jeff Thomas's proposed approach it still involves modifying the actual appliance to incorporate an additional electrode. The only difference is that Jeff Thomas would earth the electrode, to ensure that a residual current would flow on immersion (to trip the RCD/ELCB), while with the IDCI the additional electrode is used to trigger an SCR and circuit-breaker directly.

With Jeff Thomas's approach you're still relying on the RCD/ELCB to actually break the circuit, while with the IDCI you get the protection even if an RCD/ELCB is not fitted.

I wonder how soon it will be before we see appliances fitted with IDCIs in Australia? Hopefully fairly soon; they've obviously been available in the USA for a couple of years.

Thanks to Drew Winning for drawing our attention to this further type of safety device.

Those 'CD pens'

You'll hopefully recall that a couple of months ago, in the October column, I made reference to a product called the CD-XP Digital Audio Pen distributed by Audio Q Imports of Hawthorn, Victoria. It's essentially a felt-tipped marker pen with a dense green ink, and the idea is that you use the pen to apply the ink around the outer edge of your compact discs — and possibly the edge of the centre hole, as well. This is claimed to result in noticeably 'cleaner' sound, at a cost much lower than that of fancy cables (the pen only costs around $10).

The reasoning behind the pen is that when the CD player's infra-red laser beam scans the microscopic pits, from below, some of its energy may be reflected from the sides of the pits so that it passes laterally through the body of the disc, to either the outer or inner edges. Here it may be reflected back again, from either the plastic/air interface or the aluminium coating (if the edge concerned happens to have been aluminised, as some are). And if it *is* reflected back, it may then be reflected back down again by the sides of the pits, with a time delay corresponding to the additional path length, to cause interference with the main scanning beam. If this occurs there could presumably be reading errors, forcing the player's error correction logic to 'work harder', and possibly causing audible deterioration.

By coating the edges of the disc with the green ink (after carefully scraping off any aluminising that may be present), the idea is that any IR energy that reaches the edges will be absorbed rather than reflected, and hence prevented from causing any trouble. That's the theory, anyway.

Not long before I wrote the October column, Vincent Tester from Audio Q Imports sent me a sample of the pen to try it out for myself. And as I related in that column, my preliminary tests listening to known discs 'before and after' they were coated with the green ink suggested that there *was* a subtle improvement in the sound. My daughter Penny and I both thought many of the discs sounded 'cleaner' with the coating, losing a subtle 'edginess' that we had previously not even noticed.

As I also noted, though, it was hard to be sure that we weren't having ourselves on and 'hearing what we were expecting to hear', with this kind of simple testing. So I wanted to do further testing, before trying to come to any conclusions.

Keen to assist in this regard, Vincent Tester actually sent up a pair of identical CDs — one of which was in mint condition with its edge aluminisation, while the other had had its edges carefully scraped and coated with the green ink. This obviously gave the potential for more satisfying A-B type switching, back and forth between the two, rather than simple 'before and after' testing. The discs were of Bizet's *Symphony in C*, played by the Royal Philharmonic conducted by Charles Munch (Chesky CD-7). Ideally one would do this kind of testing with a pair of identical CD players, with the discs playing corresponding tracks and switching controlled by a third party for true 'double blind' control. We couldn't easily achieve this, but we *were* able to use Yamaha's new CDC-705 five-disc carousel CD player, as reviewed by Louis Challis last month.

What we did, in an effort to prevent any listener from kidding themselves, was to have another person place the two discs at random in the player beforehand, and then close the player's drawer so that they couldn't be seen. Then the listener would come in, and try to compare the tracks on the two discs by skipping back and forth between them, to see (a) whether they could hear any difference between the two, and (b) if so, which one they believed was 'cleaner' or 'sweeter'. Without at that stage knowing which was which, of course.

A total of six people were used for this experiment, with ages ranging from 16 to 51, and including my daughter and I. The result was rather interesting.

I should stress that under these conditions, we all found it *very* difficult to detect the differences and decide which one we preferred. This suggests that random variations may well form a significant component in the outcome, and for this reason we each performed a number of listening runs to try and increase the significance of the results.

I have to report, however, that most of us couldn't pick the disc with the green ink coating. In fact more often than not we tended to pick the untreated disc as the one with the 'cleaner' sound — except for *one* of our number (no names!), who chose the treated disc an impressive 6 times out of 9!

Whether that means that the rest of us have 'cloth ears', and the person concerned is the only one capable of appreciating truly clean sound, I don't know. Perhaps it was just a fluke, and if the person concerned had listened to the discs another 9 times they might have picked the untreated disc enough times to end up with just as bad an average as the rest of us...

Yes, I *am* aware that the results of this experiment suggest that my daughter and I were indeed kidding ourselves with the earlier tests, when we thought we could hear an improvement. Ah well, it's easy for we humans to hear what we expect to hear, isn't it?

All the same, I was still hoping to find a more objective way to decide whether or not the green ink had an effect. It was then that I thought of another test.

If it's true that some of the player's laser beam can be reflected to the edge of the disc, and then back again to cause trouble, what would happen if one were to coat only *half* of a disc's periphery (180°) with the green ink? Surely this would result in a *modulation effect*, with the ink absorbing most of the reflected radiation for half of each disc revolution, but not for the rest of the time...

I reasoned that this should result in some kind of detectable modulation of the replayed sound, at a frequency of between 5 and 8.3Hz — corresponding to a CD's rotational speed, which varies from about 300 to 500rpm. And this modulation should be detectable either audibly, or ideally with instruments.

Because this kind of modulation would be easiest to detect with a plain audio sinewave signal, I tried it with my Denon 'Audio Technical CD' (38C39-7147), with its multitude of very high quality test signal tracks. This disc was duly coated with green ink, over 180° of its periphery, and then we tried looking to see if we could detect any sign of the expected modulation components — both by ear and using the instruments.

Incidentally we tried this test using both a mid-range Sony CD player, of reasonably late vintage, and the Yamaha CDC-705. The instruments we used included two different 20MHz scopes, and our Sound Technology 1700B distortion measurement system (which was fully overhauled by the distributor only a few months ago, to correct for any ills resulting from our fire).

And the result? Try as we might, we could neither hear, see nor detect any sign of modulation components produced by the half-disc inking.

At this stage, then, we really can't find any 'hard' or even reliable 'soft' evidence to support the theory that there *is* an edge reflection problem with CDs. Nor can we find any evidence which suggests that the green ink coating technique achieves a reliably agreed upon improvement in sound quality. Sorry Mr Tester, but we tried!

I'd be very interested in hearing from any readers who have carried out other tests of their own, though. Perhaps there's more to it than we realise. It might also be one of those situations where only those with 'golden ears' can detect both the distortion concerned.

Incidentally, in one of the references to the 'CD pen' that I've seen in the popular media, there was a suggestion that it might either damage your CDs, or cause some kind of *deterioration* in sound quality. Even though we haven't been able to find any evidence of actual benefit from the green ink, we certainly haven't found any evidence of negative effects, either.

The green ink applied by the 'CD-XP Digital Audio Pen' in particular is water-based, and if you wish can be removed from the disc at any time, by wiping the edge on a moistened rag or paper towel. And whether or not you leave it there, there seems to be no way that it could cause any deterioration of the sound from the CD — assuming, of course, that you apply it as directed only around the disc's edges.

After all, in theory the light from the CD player's laser basically enters the disc from below, at an axis of 90°, bounces from the top mirrored surface and pits, and then leaves again from the bottom along the same axis. It isn't *supposed* to go anywhere near the edges — unless there are secondary reflections of the type proposed by the green ink people. And in that case, the green ink can surely only do good, not harm...

So there doesn't seem to be any risk in trying out the pen, if you are so inclined.

The other point is that the CD-XP pen is extremely low in cost: around $10. So experimenting with it won't cost anything like as much as with certain other 'hifi improvement' products! ■

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Vac 200mV, 2V, 20V, 200V, 750V
Adc 200uA, 2mA, 20mA, 200mA, 2A, 20A
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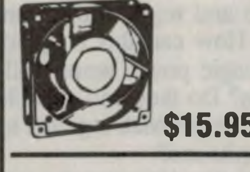

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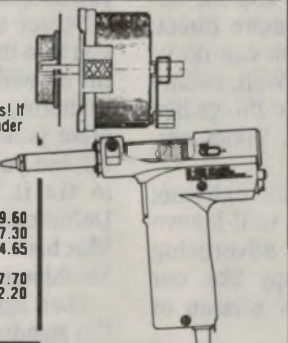

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Moffat's Madhouse...

by TOM MOFFAT

'User friendly' or 'Hostile'?

User friendly: a classic buzz-phrase. It's part of the traditional hype used to sell computers. But now the term is finding wider appeal, selling things like cars and washing machines. Twenty years ago buzz-words were few and far between, and phrases were more direct: Easy to use! Even a woman can do it! (Oh, no — did I say that? Well, twenty years ago lots of people said things like that, and got away with it. Times certainly change, don't they?)

But what about the other extreme: *hostile*? Perhaps not such a well-known term, because your local advertising agency doesn't produce copy like 'our product has reached a new plateau of user hostility'.

I first heard 'hostile' used in a very telling way when I was on my ham radio set, talking with a guy in Victoria. We had both been asked to assess a new radio; I'd done my bit and now he had it. "It's really hostile, you know," he said. Yeah, that was spot on. I'd noticed that the thing *had* dug its heels in and refused to cooperate in just about everything I'd tried to do with it. The other guy was going through the same thing, and had found a good word to describe it: hostile.

Homely example

Simple things can be either friendly, or hostile. As part of the price I pay for working from home, it is my job to do the laundry. This involves the use of a washing machine, which surely must be one of the devil's original inventions.

Step one in this technological battle is called 'adding the detergent'. One would expect you would just chuck the clothes in, sprinkle some of this stuff on top, and let 'er rip. But no; the detergent is totally insoluble in cold water, and we refuse to waste hot water on the washing machine. So you have to put some of the detergent in a cup, add some boiling water, dissolve the powder, and then pour the resulting bubbly slush into the washing machine.

This is fine until the cold water hits it. Then the detergent, which is spread all over inside the machine, manages to undissolve and regroup back into a solid clump. How can this happen? Is there some magic power among all the little particles? Do they yell at each other — "Hey, let's get back together again!" — just to spite me?

Forget the detergent for now. When you turn the washing machine on, it may fill up with water and then emit an ear-shattering squeal. This means the main drive pulley is in the process of falling off, but you can't get under the machine to fix it because it's full of water. Definitely a bailing-bucket job. Score: Machine 1; Me 0. Machine wins. Machine is hostile.

Then again the machine may work. If I'm standing there watching it, acting as its attendant, it will always work. But if I decide to go have a shower while it's doing its thing, it will wait until I'm covered in soap, and then go 'ka-WHUMP-a-ta WHUMP-a-ta bang bang BANG!'. The clothes are all to one side; it's out of balance.

By the time I get to it, dripping soap everywhere, this miserable machine is doing a little Mexican two-step across the laundry floor, still tethered to the wall by its two hoses. If it gets to the end of the hoses before I get to it, it will rip them from the wall and we will have a generous flow of water from the taps.

Why does this machine do this to me? It's had a pleasant sheltered life. I've even suffered the indignity and extreme expense of replacing its transmission a couple of times — major surgery performed in the back garden, so it can smear its dribbles and grease all over the grass, and me. I've never found any demons in there. Where are they hiding? The machine is simply hostile.

Even the clothes pegs — yes, clothes pegs! — seem to have some kind of voodoo curse on them. They were made with miserable little springs, specially designed to drop the whitest garment in the mud at the first gust of wind. And they were made with special rough edges so as to tear the clothes better. The whole washing system, everything in that laundry, is HOSTILE!

Many computers are hostile, but they needn't be. I have a friend who just bought one of those little Amstrad laptops. It's a pretty straightforward computer running MS-DOS in the traditional way. You can type the name of a program and the computer will run it. Or you can type DIR for a directory of the programs it has available to run. Pretty common stuff.

But this fellow is terrified of that machine. Somebody told him computers are hard, so he sees the Amstrad as 'hard'. A self- fulfilling prophecy. A simple browse through three or four pages of instructions would put him right, or at least get him going, but he's afraid of the instructions too. Somebody told him they'd be 'hard' to understand.

Enter icons

The Apple people tried to overcome the fear problem by getting rid of all the words and commands, and replacing them with little pictures called icons. The main job of the keyboard was taken over by a 'mouse' you could use to scoot a little arrow around the screen, pointing at the pictures. With this you could control the computer. Or at least some people could. This MacIntosh machine probably originated the term 'user-friendly', and for very many users it overcame all the confusion of typing in funny commands. But other users found it an abomination.

When the Mac first came out I went to a computer store that specialized in them and asked for a demo. I particularly wanted to have a look at the Mac's *Forth* language I'd heard so much about. So the salesman sat me down in front of the machine and I tickled the keys: 'DIR'. Nothing happened.

"You're supposed to use the mouse", he said. So I used the mouse, and pointed at this and pointed at that and clicked its buttons, and little pictures and windows popped up all over the place. But it never did give me a decent DIR. Phooey!

Finally the salesman got the *Forth* running (after much digging through stacks of books) but the thing still wouldn't let me type in and run a simple program. It still wanted that mouse! That one experience stamped HOSTILE all over the MacIntosh as far as I was concerned, but I appear to be in the minority. Macs are now seen as quite legitimate business machines, and they're being used more and more in offices by people who hate computers.

You either is, or you ain't, a Mac person. Few people would enjoy BOTH Macs and traditional MS-DOS computers. I'm not a Mac person, but it looks like I'm still going to have to get a Mac because so many of the products I develop must now exist in both MS-DOS and Mac versions. I'm not looking forward to it.

Current project

The project that's occupying me at the moment is a thing called 'Listening Post II' — a product that decodes shortwave radiofacsimile, radioteletype, and Morse code onto the screen of an IBM-PC. Listening Post II is a conglomerate of the best features of several earlier designs, with some new technology thrown in to provide the best performance ever for a really low price.

I've been working my fingers to the bone trying to make the system as friendly as possible, and to me that means dead simple. There are no flashy multi-coloured menus, just a suite of little individual programs that work straight from MS-DOS. If you want to receive fax, you type FAX. If you want to receive RTTY you type RTTY. What could be easier?

As of a couple of days ago the MS-DOS software for Listening Post II was finished, and I must say I'm pretty pleased with it. Simple, direct, and it works. But I keep getting these mumbles from people: "What about the Mac, what about an Amiga version?". It looks like the writing is on the wall and I'm going to become a Mac person, like it or not. And maybe an Amiga person as well, before long.

But I'll be damned if I'll accept a system where you have to scoot a mouse cursor around to a little picture of a storm cloud if you want a weather map, or a typewriter if you want RTTY, or a Morse key if you want Morse code. There would be a terrible amount of effort needed to program such a thing, and then it would be a real pain to use. Can't we just type FAX and get fax? I'll try to keep it simple, I really will...

Getting back to those radios — they seem to come in two breeds, just like computers: as simple as possible, and as complex as possible. I've looked at and used a lot of ham gear over the past couple of years. Some of it simply bristles with knobs and controls, other stuff is strictly Plain Jane. There seems to be one school of thought that the more controls a rig has the better it is, and the better the value for money.

The Japanese manufacturers picked up this idea pretty quickly and produced devices that any knob freak would drool over. The fact is that it doesn't cost a lot to include extra controls nowadays, because modern radio gear is almost all based on microprocessors. Sometimes extra controls mean little more than some simple pushbuttons and some extra software for the radio's micro. I remember once reading a review of a new transceiver which trumpeted that the rig had something like 110 controls on the front panel. A world record for hostility, perhaps?

The same microprocessors have allowed some Japanese engineers to go in a totally opposite direction. It is quite possible to use a minimum of controls to make a microprocessor step through a number of functions, setting a value for each in some internal register where it is out of sight, out of mind. But you can inspect the various settings by stepping through the registers again and change anything you want to.

2m handheld

This technique has produced a radio from the Icom company that must be the ultimate in simplicity, a little two-metre walkie- talkie called the IC-2SA. This amazing radio has the usual volume, squelch, and channel change knobs on the top, and as I remember two buttons on the front. And that's it. All radio functions, programming and so on are done by pressing the two buttons in various combinations and twiddling the channel change knob. Once that's done and everything's programmed in, you have what must be the world's friendliest, easiest to use radio.

I very nearly bought one of these IC-2SA's, just because it was such an elegant design. But I wanted UHF coverage as well, so I ended up with a close cousin, the IC-24AT. It's got a complete set of button controls, so its features aren't so gracefully hidden away. But it's still pretty easy to drive. Once everything is programmed you seldom need to stray from the volume, squelch, and channel change.

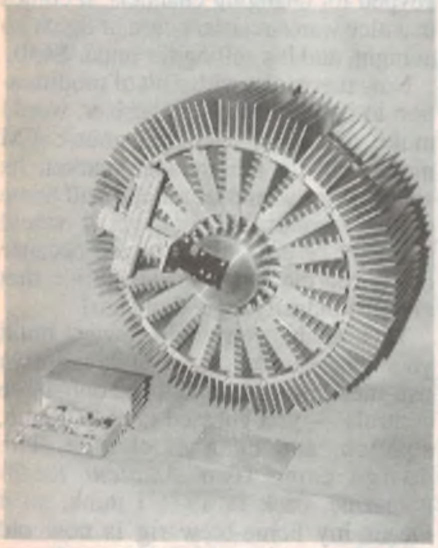
So we see, then, that things can go both ways — be they radios, computers or clothes pegs. Manufacturers can turn out complex, feature laden products, which may be a little on the hostile side. Or they can go for simple, elegant designs; easy to live with but perhaps lacking in some of the more esoteric features. Which way will the trend go? Which way do we WANT it to go?

Do we let the Japanese drag us along, or do we break free somehow? Australia CAN still make simple and elegant gear, at the right price. A case in point is the VHF radio on my boat, made by the GME company. This set has little more than volume and squelch controls and a keypad for changing channels. It comes in a nice water-resistant case, it lights up at night, and it's selling for under $450.

Now that radio, with a bit of modification to its frequency synthesizer, would make a mighty nice two-metre FM mobile rig for the amateur market. Its selling price would be around half some of the Japanese models, yet it would probably be a lot more rugged because of its marine heritage. Wouldn't that give the industry a good old stir!

Then again, you could always build your own simple gear. I built my own two-metre rig once, and it had only three controls — you guessed it! — volume, squelch, and channel change. The design came from *Amateur Radio* magazine, back in 1971 I think, so it means my home-brew rig is now old enough to legally drink beer and only two years off its 21st birthday. And it still works as well as the day it was new. I just wish I did. ■

SPECTRUM
Communications News & Comment



AUSSIE BEACON TX FOR AUSSAT B'S

At a recent ceremony in Brisbane Senator John Button, Minister for Industry, Technology and Commerce handed over the first of three Australian-designed and manufactured satellite beacon transmitters, to a representative of the Hughes Aircraft Company for inclusion in Aussat's new B-series satellites. Hughes is prime contractor for the satellites, but the beacon transmitters have been produced by MITEC Ltd – the only Australian sub-contractor to

have responsibility for design, manufacture and testing of satellite hardware.

Based in Brisbane, MITEC was formed only three years ago. Specialising in microwave communications technology, it grew from a research and development centre at the University of Queensland's Department of Electrical Engineering. Currently it employs some 75 people and produces a wide range of state-of-the-art products for frequencies from 30MHz to 30GHz.

Other noteworthy MITEC products include a 30W class-A 14GHz solid state amplifier presently in use at OTC, a larger 70W amplifier for the same band, and a 1.6GHz receiver for the Russian-sponsored international 'RADIOASTRON' radioastronomy satellite. The firm also makes terrestrial microwave link systems, primarily using the 10.5-10.68GHz band.

BEAZLEY OPENS OTC'S PERTH TERMINAL

The Hon Kim Beazley, Minister for Transport and Communications, has officially opened the Perth International Telecommunications Centre (PITC), providing West Australians with direct satellite and submarine cable links to the rest of the world.

West Australian telephone traffic will now be routed directly to more than 25 international destinations, using the PITC digital telephone exchange and accessing either the Australian-Indonesian-Singapore submarine cable system or the INTELSAT satellite network.

The PITC provides specialised satellite tracking, telemetry, command and monitoring services for spacecraft from both INTELSAT and the European Space Agency. Additionally, there are four 18 metre antennae on site directed to satellites in geostationary orbit above the Equator. A larger 27.5m dish will be built next year to allow more flexible access to special events such as the 1992 Olympic Games.

Maritime communication facilities are also a feature of the PITC. This makes it the only international communications complex in the Southern Hemisphere which covers all modern communication technologies – satellite, cable and radio.

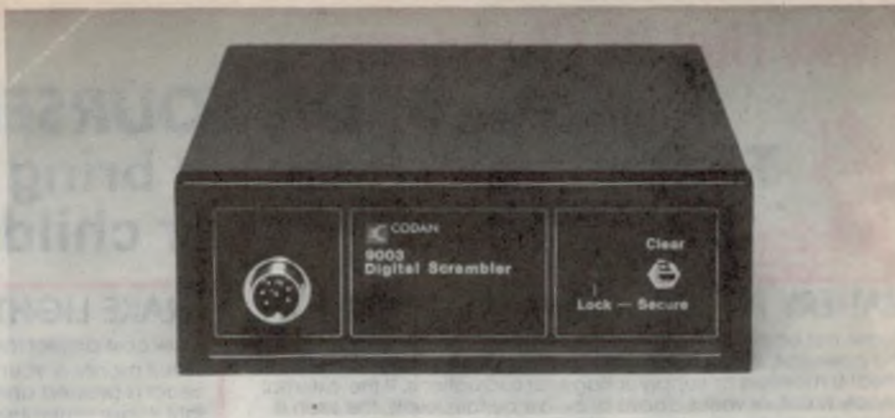
The new complex is located 20kms north of Perth CBD. It represents an OTC investment of over $70 million.

PIRATE RADIO GEAR SEIZED IN SA

Officers from the Department of Transport and Communications' Radiocomm Operations Branch accompanied South Australian police in a recent raid on 'pirate' radiocommunications operators in Adelaide. Seized in the raid were scanning receivers, CB radios and modified commercial transceivers, allegedly being used by the 'pirates' to jam authorised transmissions and harrass legitimate radiocomm operators.

The activities of the alleged pirates apparently came to the attention of the Department following reports of interference to essential services radiocomm systems, and to private radio networks.

DIGITAL SCRAMBLER FOR SECURE COMMS



Australian firm Codan has launched its long-awaited type 9003 digital scrambler, giving users reliable, confidential radio communications that cannot be decoded into intelligible speech by outsiders.

The digital scrambler, which is available immediately, is expected to meet ready acceptance from radio users with a need for maximum security.

In launching the new scrambler, Codan Marketing Manger Graham Ware, said the company had not designed the product inhouse because the designs Codan engineers had seen over the years had been either too simple, too complex or too expensive.

"We have negotiated exclusive worldwide rights to a scramble module and incorporated it into the Codan 9003 digital scrambler. The 9003 can be used with most makes of HF transceivers, provided interfacing details are known to us," said Graham.

The digital scrambler is housed in a small unit fitted in series with the microphone lead, for easy installation into existing systems. On transmission in Secure mode, the analog speech signal from the microphone is digitised and fed into memory. The encryption or scrambling process divides each half second of speech into 8, 16 or 32 digital segments, the sequence of which is then rearranged according to a complex formula controlled by the programmed KEY code. The number of digital segments defines the level of security – 32 is the maximum – and this needs to be made clear when ordering.

Programming the 9003 with the 10-digit KEY code is performed with a 'Cryptofil' programmer, which is a hand-held computing device that looks like a simple computer.

BBC 'NARROWCAST' FOR SYDNEY

The highly respected 24-hour international news, current affairs, finance and sports programming of the BBC World Service may soon be available to a limited number of subscribers in the Sydney area on a private 'narrowcast' radio system.

The system will transmit the 24-hour programming of the World Service on a specialised telecommunications signal which can be received on dedicated compact receivers anywhere in the Sydney metropolitan area. These specialised sets will be made available to business and professional clients for an annual subscription of approximately $150.

In line with Government guidelines covering the use of 'narrowcast' telecommunications services, a limited number of receivers will be available and as a professional, education and business resource only. The system can also be used as an informative telephone hold service.

CHILE, EGYPT USING INTELSAT IBS

Both Chile and Egypt have begun using Intelsat's 'IBS' integrated digital communications system for private, domestic and international business network requirements.

Two companies are currently offering IBS services in Chile: SATEL and CHILESAT, with the former having some 11 circuits for 64kbps communications. In Egypt the Egyptian Telecommunications Organisation ARENTO has installed an F-2 (7.3m) earth station at Maadi, currently equipped to provide three 128kbps IBS carriers – one of which is being used by the Amoco oil company to link its Cairo office with that in Tulsa, Oklahoma.

The IBS system was initiated by Intelsat in 1983, and is one of the organisation's most rapidly growing services. By the end of 1989, there were 9,100 operational IBS channels.

THIRD OF UK'S DEFENCE BIRDS UP

The third Skynet 4 military communications satellite (Skynet 4C) built by British Aerospace Space Systems and Marconi Space Systems has commenced controlled drift orbit operations following its successful launch from Kourou, French Guiana, by Ariane flight V38 on August 30, 1990. The satellite's two solar arrays were deployed on September 3 and on September 4, its UHF antenna was deployed.

Skynet 4C is under control from the Satellite Control Centre at RAF Oakhanger and arrived on station at its geostationary position at 1° West in late September. The satellite has undergone a series of spacecraft and payload commissioning tests designed to confirm that its systems and payload meet prescribed operational parameters. The satellite is expected to be fully operational this month.

Built for UK Ministry of Defence, Skynet 4C, together with Skynet 4A and 4B, will provide the UK Armed Services with increased worldwide capacity for secure and reliable strategic and tactical communications. Skynet 4B was launched by Ariane in December 1988 and Skynet 4A by Titan in December 1989.

COMPANIES TRYING TELECOM'S MICROLINK

Some 16 Australian companies and government authorities are taking part in a nation-wide trial of a new digital network service, designed to give smaller operations access to the latest technology.

The selected customers are using Telecom's latest Integrated Services Digital Network (ISDN) service, called Microlink, which allows them to transfer voice, data, facsimile and even image on the one line.

The new Microlink service was launched at the end of July and is aimed at companies with a number of smaller branches or offices which have a lower volume of traffic.

Microlink is aimed at the lower-volume end of the market and offers customers a minimum of just two ISDN lines, rather than a minimum of 20 lines for ISDN Macrolink (launched in 1989).

SPOIL YOURSELF!

With The Meter You've Always Wanted

NEW!

With Built-in Logic Tester!

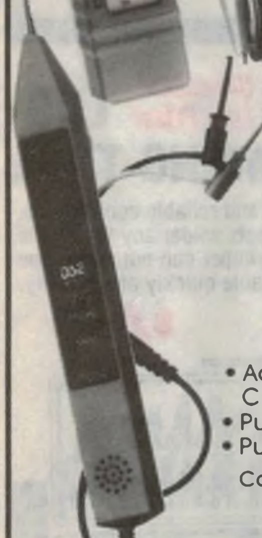
PROBE TYPE DIGITAL MULTIMETER

This would have to be the smallest, handiest DMM you'll ever have the chance to buy! It features Data Hold, fixed and auto Ranging, plus a full 3½ digit LCD display.

- 200mV to 500V range
- 0 to 20M Ohms
- Auto Polarity indication
- Diode and continuity testing
- AC/DC Current up to 200mA
- Soft carry pouch

Cat Q-1560

$59.95



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TRI-STATE LOGIC PROBE

No need to tie up your CRO or Multimeter for logic testing. Your new logic probe can detect high, low, and pulse states; needs no batteries; and has a tip fine enough to easily contact individual IC legs.

- Adjustable threshold for DTL, TTL & CMOS circuits
- Pulse and memory modes
- Pulse detection to 12.6MHz

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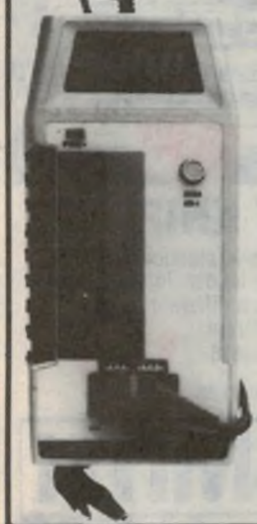
$35.95



DIGITAL CAPACITANCE METER

Battery operated, this meter is lightweight and comes with a handy carry case and highly flexible leads. With its 9 ranges and 3.5 digit display, it represents great value for a great price!

- 200pF to 20,000uF range
- 3.5 digit display
- Pushbutton range selection

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With Easy to Read Bar Graph!

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A full function Digital Multimeter with Transistor, Capacitance, Diode & Continuity testing — 34 ranges in all!

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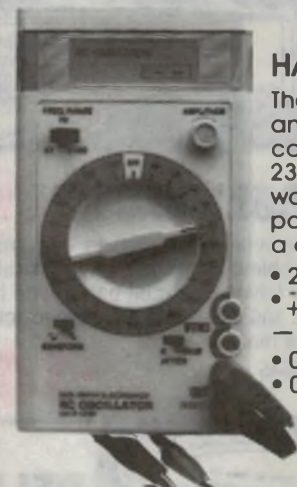
- 200uA to 20A currant range
- 200 to 20M Ohms
- 2nF to 20uF capacitance range
- Carry case included

Cat Q-1550

NEW!

$129



HAND-HELD RC OSCILLATOR

The RC Oscillator you can take anywhere! Great features like continuously variable amplitude, 23 ranges of sine and square wave, plus remote sync, are packed into a unit no bigger than a digital multimeter.

- 20Hz to 150kHz range
- ± 3% Accuracy 20Hz to 100kHz — (+ 5% above 100KHz)
- 0 to -20dB output control
- 0.3% maximum distortion

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Budget Priced!

6.5 MHz CRO

This is what you need on your workbench at home! It's the perfect CRO for the classroom too, with more going for it than just a tiny price tag. Retrace blanking, internal or external sync, low drift, and quick warm-up all add up to value for money.

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For fine solder work you really need 2 pair of hands — so here they are! Helping Hands is a PCB holder with magnifying lens that can hold your work at just the right angle and let you see in close without risking soldering your nose to the circuit board!

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This robust crimper has a ratchet drive for accurate control; variable pressure adjustment and double jaws for single action crimping.

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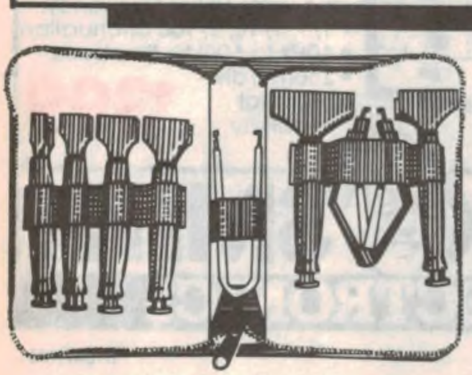

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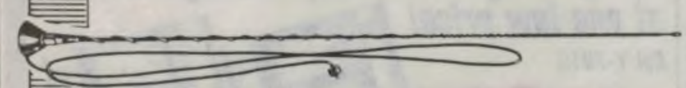

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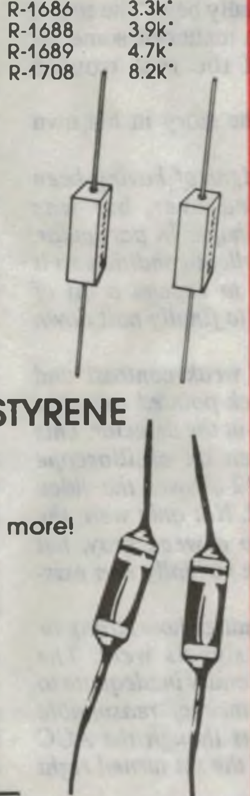
R-1638	33*	R-1678	1.5k*		
R-1640	39*	R-1680	1.8k*		



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R-2815	68pF	R-2835	470pF
R-2817	82pF	R-2837	560pF
R-2819	100pF	R-2839	680pF
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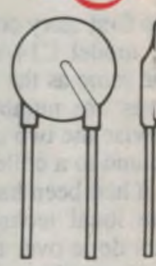
R-1787	$7.95	.70	.259
R-1788	$8.25	.90	.177
R-1789	$8.50	1.15	.123
R-1790	$8.50	1.35	.093
R-1791	$8.95	1.85	.059
R-1792	$9.95	2.45	.039
R-1793	$9.95	3.05	.030
R-1794	$10.95	3.90	.021



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Z-9325	511000-10	1Mb x 1	$25.95
Z-9318	511000-8	1Mb x 1	$26.95
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Z-9334	4464-10	64k x 4	$10.95
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Z-9328	44256-8	256k x 4	$26.95

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THE SERVICEMAN

The positive end goes to plus, right? Well yes — but not in this case!

This month I have three stories of electronic mayhem. Two of them tell of manufacturing defects, one of them quite weird, that by rights should never have happened. The third wouldn't have happened if yours truly had been on top of modern technology.

The first story concerns a fault with a GAC model C14AS, which appears to be the same as the Toshiba C820. Components are numbered differently, but otherwise the two seem identical.

It came to a colleague as a last resort, after it had been hawked around several of the local technicians. The various repairs done over the years had always turned out to be only temporary, and the set had really never been a very good performer. The owner had eventually decided to junk it because it now seemed to be beyond repair.

My friend is a teacher of electronics at the local technical college, and he has accumulated a vast collection of these 'unrepairable' TV's. The sets are given to him as 'guinea pigs' for his students, but the students rarely get to tackle them because he has the uncanny knack of solving the most intractable problems.

This set was working after a fashion, but the picture was unwatchable. It had almost no contrast — just a dull gray image — but more importantly, it had no sign of either horizontal or vertical hold and the raster was badly bent. The sound was quite normal, a matter of some interest in view of the real trouble revealed later.

I'll let him tell the story in his own words:

The set showed signs of having been extensively worked over, but was generally in good shape. In particular, the tube was in excellent condition so it seemed worthwhile to expend a bit of effort in an attempt to finally nail down the fault.

The symptoms of weak contrast and no line or frame lock pointed to a low level of video signal at the detector. This was confirmed when an oscilloscope check at test point 12 showed the video to be badly crushed. Not only were the blacks attenuated to a weak gray, but the sync pulses were virtually non-existant.

It didn't seem to matter how strong or weak the antenna signals were. The resulting video was totally inadequate to provide any semblance of reasonable picture. It seemed as though the AGC had the front end of the set turned right off.

My first thought was that there was something wrong with the quadrature detector IC-a02 (IC102), a TA7162. But replacing the chip made no difference.

The voltage on the AGC output from IC-a02 was nothing like the figure shown on the circuit diagram, so I decided as a first line of attack to nail down the AGC voltage with a battery box. This comprises a 9 volt battery and a 5k potentiometer, and allows the AGC rail to be swung through its normal range for testing purposes.

This simple test showed me that the whole front end of the set was perfectly normal. The video information returned to its full value and the screen image took on the full contrast range. But there was still no colour and no sign of sync.

Once I knew that the trouble was caused by bad AGC, I went straight to the bypass electrolytic on the AGC rail. This is a common cause of AGC trouble, but checking the capacitor is a waste of time unless you know you have AGC trouble.

The capacitor is a 470uF 16V unit and in this case it was open circuit. But replacing the cap didn't restore the AGC function. It still had to have the battery box in place to control the AGC.

So at this point I had regained partial control of the signal, but there was still no sign of any sync and still the bendy raster.

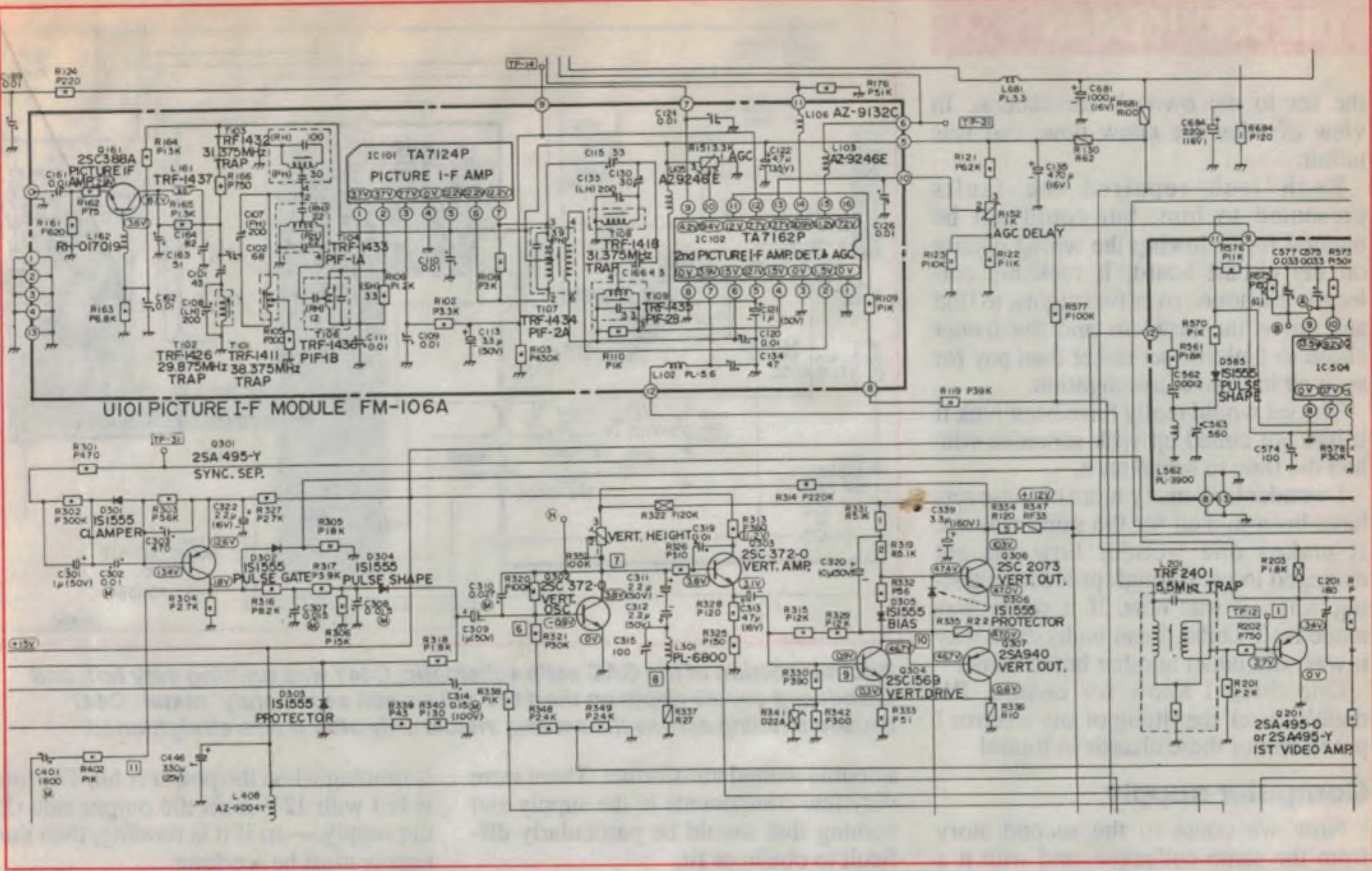
The raster problem took my attention next. It had the appearance of 100Hz ripple on the main DC rail, and in fact the scope showed deep scalloping on that rail. Yet the regulator and the main filter capacitor showed no sign of a fault.

I spent quite some time working around the power supply, but eventually came to the conclusion that the bendy raster was caused by the ripple. But the ripple was caused by some as yet undiscovered problem... So I went back to the 'no sync' symptom, and set about resolving that one.

The sync separator in this set is fairly conventional. The video is fed to the transistor via a diode and a series capacitor, in this case a 1uF 25V electro. Somebody had already been at this circuit and the capacitor had been replaced. But it was open circuit, all the same.

I fitted a new cap and then found that I had good video right up to the base of the sync separator transistor. But still absolutely nothing at the collector.

I checked the transistor and the few components around it and found another open circuit electro from the emitter to ground. This was Cc22 (C322), a 22uF/16V, and replacing this item restored normal sync.



Taken from the Toshiba C820 manual, this schematic is identical to that for the GAC model C14AS except for the component numbering. The capacitors indicated are those that produced the faults discussed in this month's first story.

The horizontal and vertical oscillators locked up and the set was showing a good picture, although still with the bendy sides that went with the bent raster.

Restoring lock had also cured the AGC problem, presumably because the synchronised picture allowed the keying pulses to arrive at the right time to set the correct AGC level.

Then, as I watched the picture, the sync slowly faded back to the unlocked condition. This didn't make any sense, and I spent considerable time checking for heat sensitive problems with the transistor and other components in the area.

There was nothing wrong with anything, except the new 22uF capacitor — it was open circuit. So, on the surmise that the cap I had used was faulty, I replaced it and that restored normal operation. But as I watched the sync faded away again and I had another open circuit cap.

By this time I knew that there had to be something wrong with the circuit, not the capacitors. So I put a meter on the cap terminals and even then it took me some time to recognise just what the fault was.

With the chassis turned up and checking from the copper side of the PC board, everything was normal. The voltage was within the cap rating and appeared to be applied in the correct sense. But on top of the board it was a different story.

Here I found a positive voltage on the negative terminal of the cap, and the positive terminal connected to ground. I checked the cap orientation again, and it was correct according to the silk-screened legend on the top of the board; but it was wrong according to the markings on the copper side.

So I checked some other electros and found them, too, to be fitted wrong way round. They were in right way round according to the top markings, but they all had positive voltages on their negative terminals.

Some of the smaller, low voltage capacitors had repolarized themselves and were working normally. But many others were open circuit and one, Cd46 (C441), a 47uF/160V cap on the input to the line output transformer was extremely hot and was close to blowing itself up.

It was this cap that was causing the bendy raster, and also the severe ripple on the main DC rail. It had obviously caused trouble before and had been replaced, but always the wrong way round. Let's face it, most of us follow the markings on the TOP of the board when fitting a component from the top. And if the markings are not right...?

Incidentally, with the picture locked up another symptom became obvious. There was a heavy shading from one side of the screen to the other. This was also attributable to a wrong-way- round capacitor, a 10uF/250V bypass on the video output rail.

Before I had finished the job, I had replaced no less than 15 electros, all of which had thick white deposits around the positive terminal. As mentioned above, some of the smaller caps had repolarised themselves and these were left in service.

The set is now working perfectly and is likely to do so for a long time yet. However, I have placed a sticker inside the set to remind me that the silk-screen legend on the top of the board has all of its electro symbols round the wrong way.

Well, that's my colleague's story, and I believe every word of it. I've seen the evidence!

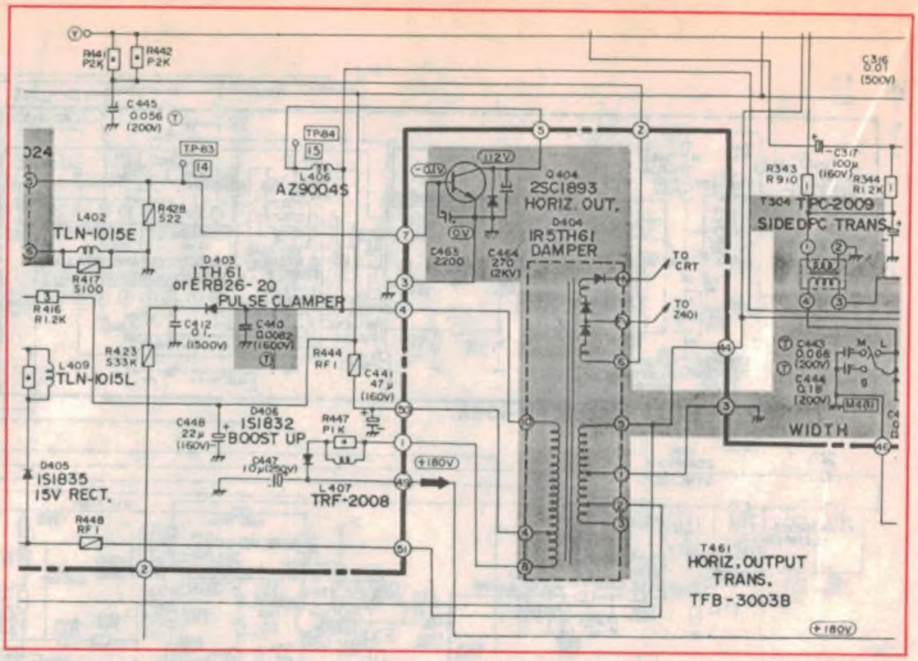
Back in the second paragraph of this story I may have seemed to be implying criticism of some of the local technicians, who had not been able to repair the set to the owner's satisfaction. In view of what we know now, that was unfair.

Each tech repaired the faults presented to him, but could not be blamed for following the wrong coding on the circuit board. It took my colleague six hours, over two nights, to find and solve the problem and the owner chose to junk the set rather than pay for such an intensive investigation.

The set would really have been junk if it had not ended up with someone who had the time to spend on it.

I wonder how many more of these sets have been junked for the same reasons. It makes one wonder how the set managed to get through production testing when it was new. If it really was made by Toshiba, I can understand why it was sold under another brand name!

One thing I know for certain. I'll double check the fitting of any electros I put in one of these chassis in future!



Another section of the GAC set's schematic. C441 was running very hot, and introduced severe ripple on the 112V rail as well as a 'bendy' raster. C447 caused shading across the screen, visible only after it was straightened.

Computer supply

Now we come to the second story from the same colleague, and with it a correction to an earlier tale.

In the July edition, I passed on a story about an 'IBM' computer monitor with an unsatisfactory focus chain. I regret to say that I maligned the company, because the monitor was not an IBM but a Taiwanese clone. All concerned apologise to IBM, but it just goes to show how easily a brand name can become a generic term for all similar products.

The error was brought to my notice when I was shown a fault in the power supply from the same computer as that in the earlier story. The problem was that the computer had been difficult to get started and now refused to go at all.

By employing the usual computer service techniques (changing the power supply), it was proved that the fault was in the supply and not the computer.

The recommended procedure would then be to throw away the faulty supply, but the friend who showed me the unit is made of old fashioned material. He determined that he would repair the supply and keep it for another time.

(Incidentally, he suggested that computer servicemen have inspired a new method of motor vehicle repair — jack up the numberplates and replace everything in between!)

Anyway, he opened the power supply case and inside found a very simple switchmode circuit. A common IC driving a chopper transistor, feeding in turn a double wound transformer. There were very few components in the supply and nothing that should be particularly difficult to obtain or fit.

A quick test showed that the transistor was not shorted, which implied that the IC was also probably OK. He fed the supply through an isolation transformer and soon found that there was no Vcc on the chip. And for a very good reason.

Because the chip is on the mains side of the supply, it cannot be fed from the 12V output of the transformer. Instead, it's fed from the rectified mains, through a 390k 1/4 watt resistor.

Yes, it was another grossly underrated resistor. This one had increased its resistance to something in excess of a megohm, and was the reason why the whole computer was in a no-go state.

In service, this resistor is required to drop over 300 volts at several milliamps. For reliable, long term operation, the resistor should have been at least a 1 watt type and that is just what my friend used.

If you have to repair any of these Taiwanese computers, be prepared to upgrade the ratings of any replacement parts you fit.

As a matter of interest, the supply was a model ESP135, a 200- watt unit rated for 220 volt operation. A replacement cost some $190, which the owner was happy enough to pay just to get his computer working again. But we hope he never learns that his junked supply was restored with a 3-cent resistor!

Finally, a simple test of these computer supplies is to note whether the fan is running when the power is on. The fan is fed with 12V from the output side of the supply — so if it is running, then the supply must be working.

Hi-tech trap

And now, a tale from my own workshop.

I don't know if I'm getting too old for it, but these days I seem to be caught in technology traps more often that I once did. Take the other day, for instance. A late model Philips 20-inch TV came in, with the complaint of 'no picture'. The owner didn't say 'no sound', but then owners often overlook such important symptoms.

Anyway, I got the set on the bench and fired it up, to be greeted with a bright white screen and retrace lines, and not a whisper of sound.

So far, so good. The screen problem could be either an open circuit bypass capacitor on the picture tube A2 supply, or no voltage on the collectors of the video output transistors.

Because the transistors are on the tube baseboard, and therefore easiest to get at, I chose to test there first. Murphy must have been on holidays, because all three collectors had zero volts on them, instead of the expected 100V plus. (It's the first time in months that I've beaten Murphy. Perhaps he's getting old, too!)

The cause of the trouble was easy to find, and just as easy to cure. It was 3583, an open circuit 4.7 ohm 1/4W fusible resistor in the 180V supply from the line output transformer. A new resistor soon restored full control over the brightness and the set looked as though it should be a goer.

When it had been brought into the workshop, the Channel 0 selector button was depressed. As there is no Ch0 around here, I suspected that it was the owner's video channel. So I pressed the Ch2 button, expecting to see some trace of picture or sound. At the very least, I expected to hear the usual hash that accompanies a snowy screen.

But there was nothing. No sign of a picture and not a skerrick of sound, even with the volume control turned full on.

My first attempt at a solution was to look for the audio supply rail, a 29V source taken from the chopper transformer. This seemed normal, so I checked the 12V and 25V rails from the line output stage. They too were normal.

This wasn't shaping up to be a very nice sort of a job, at all.

Next, I examined the voltages around the video IF chip, and then those around the audio IF chip. Everything looked normal, and I was beginning to get just a bit upset.

Then, I began to look at the tuner and its operating conditions — particularly the 12V rail. It was here that I seemed to strike gold. (But it was fool's gold — stay with me and you'll see why!)

The 12V supply enters the tuner on pin 6 and here I found only 0.25V or thereabouts. This had to be the fault I was looking for, and I spent the next hour trying to trace that 0.25V back to the 12V rail. I went over that board a hundred times, but there was simply no connection between that 0.25V and the 12V rail; at least none that I could see.

I was about to pull the tuner out for a more precise examination when I happened to glance at the board while leaning over it from the front of the set. I noticed that the pad around tuner pin 6 was now a different shape to the one I'd been testing earlier. Then it hit me. I'd been working on the board upside-down and was looking for the missing 12V on pin 9!

After kicking myself for all kinds of a fool, I checked the correct pin and found the 12V to be perfectly normal. So, if there was no fault with any of the supplies, why wasn't there some trace of activity in the speaker? The only sign of normality was the presence of 'off-channel' type snow on the screen.

At this point I began to think that perhaps all of the channel selectors were off tune — although that didn't explain the total lack of sound.

So I began to retune the local channel buttons. (I left the others untouched, because they may have been set to video or computer game channels and I don't like customers ringing in to say I've mucked up their video with whatever I did to the set!) But from the bottom of the VL band to the top of the UHF band, there was no sign of picture and not a whisper of sound.

At this point I had to put the set aside to attend to another short job, so I restored the board to its proper place at the bottom of the cabinet, pulled the power plug and pushed the whole lot along to the other end of the bench.

When I returned to the set a few hours later, I put the power plug back in its socket and connected the antenna to the set. When I switched back on I got the surprise of my life, because the picture had come back. Off tune, to be sure, but it was a picture and more than I had had all morning.

After adjusting the fine tune, I had a perfect picture; although still no sound. But that was easily cured. The last time I had fiddled with the volume control, I had left it in the 'off' position and a small adjustment restored normal sound.

So what had happened?

Earlier, there had been no sound at any setting of the volume control. Now there was. And the only difference was that now I had an antenna connected. So I pulled out the antenna. And both sound and picture disappeared!

In fact, the audio IF chip used in this set incorporates a circuit which mutes the output in the absence of a coherent input signal. An off-channel or no-signal input produces no 5.5MHz audio IF, so the sound is muted. But I didn't know this until afterwards.

When I had been working on the circuit board earlier, I'd had it tilted up against the picture tube base and it wasn't convenient to have the antenna connected. And for most of the sets I've serviced until now it wouldn't have mattered anyway.

Most of them have enough sensitivity to give some indication of picture and plenty of noisy sound, even without an antenna. But not this one!

So there it is. I'd been trapped into working several hours on a 15-minute job by a high-tech audio IF system that I hadn't struck before.

I won't get caught by that one again, but what other technical tricks are waiting around the corner to trap me? As I said at the beginning, maybe I'm just getting too old.

And before I leave this particular set, have you noticed that the Philips organisation now number components from 1 to whatever, without the benefit of an identifying letter prefix? In this story I had to replace '3583', which could have been anything.

Fault of the Month

GE TC53L2

(Hitachi NP6A-A chassis).

SYMPTOM: Fuse F903 (1A slo-blo) failed repeatedly, often after only 10 minutes. There was no sign of overload and each time the fuse failed very gently, without any splattering on the glass.

CURE: There was no fault in the set. The problem was that the static HT current had increased to about 950mA and a 1A fuse was too closely rated. The increase was probably due to aging components, but was not enough to overload or overheat any part of the chassis. Fitting a 1.25A slo-blo fuse cured the trouble.

This information is supplied by courtesy of the Tasmanian Branch of The Electronic Technicians' Institute of Australia (TETIA). Contributions should be sent to J. Lawler, 16 Adina Street, Geilston Bay, Tasmania 7015.

This particular circuit diagram was covered with four figure numbers that conveyed no sense of what they represented.

For the life of me I can't see why Philips chose to number components in this odd way. How much easier it was in the days when it was R583. Fortunately, no other manufacturer seems to have adopted this strange system of component identification.

Well, that's it for this month. I'll have more from our contributors and my own bench next time. ■

Basic Electronics – Part 8

Power Supplies

The power supply is the most fundamental requirement of any electronic circuit, and we devote this whole chapter to describing the full wave rectifier. Not just how they work, but also how to design and build your own. So get your soldering iron at the ready...

by PETER PHILLIPS

In the last chapter we looked at the diode as a component, and its use in a simple rectifier circuit. Now it's time to get serious and to examine rectifier circuits in more detail. Because virtually all electronic circuits need a power supply derived from the mains, we describe a simple method to design your own. No fancy maths, just a few simple 'rules of thumb'.

Power supply design is a very complex topic, so obviously the methods described here will not apply to all power supplies. But as most applications only need a relatively modest power source, you may be surprised as to how useful our simple rules are.

The rectifier circuit described at the end of this chapter costs around $12 or so to build, and is the basic 'front end' of a typical power supply. In the next chapter we will take this topic further and describe an easy to build variable, *regulated* power supply. The best way to learn electronics is to actually build something, and a power supply is surely the most important part of any line-up of equipment.

Full wave rectifiers

In the previous chapter, we described the *half-wave* rectifier circuit. This circuit works by blocking off the negative half cycles of the AC input, and passing only the positive half cycles to the load. By adding a capacitor to the circuit, the output is changed from a series of positive pulses to a smoother DC voltage suitable for use in powering an electronic circuit.

However, as we also said, the half-wave rectifier is only useful for low power applications, as the time between pulses from the AC supply is usually too long for the capacitor to remain fully charged. As well, the peak charge current into the capacitor is often as high as 10 times the load current, requiring a fairly substantial transformer and a diode able to handle high peak currents.

Obviously, if the frequency of the AC supply was higher, the time between positive pulses would be less, and energy would be transferred from the AC supply to the DC output more frequently. In certain applications, such as in aircraft, the AC frequency is often set to 400Hz, allowing the half-wave rectifier to be used quite successfully. But here on land, we have a 50Hz supply. So if the efficiency of a rectifier circuit is to be increased, other techniques have to be used.

In the half-wave rectifier, as the name implies, only half the available input energy is used. The negative half cycle is blocked off, and does nothing except make the time interval between positive half cycles longer. The trick is to use the negative half cycle as well, but to somehow invert it to produce additional positive DC voltage at the output of the rectifier.

The full-wave rectifier does exactly that, and there are two commonly used circuits, each with their own advantages. The first one uses a centre-tapped (CT) transformer, and is really two half-wave rectifiers connected back to back. Here's how it works...

The CT transformer

The first requirement for this circuit is a centre-tapped transformer, which is made by taking a tapping from the secondary winding at a point midway between the two ends. For example, if a winding has 10V AC between both ends, it will have 5V AC between the centre tap and either end. The same thing could be achieved by connecting two 5V transformers together, but with the series connected secondary windings *phased* so that a total of 10V appears across them – as shown in Fig.1.

Phasing refers to getting the polarities right, much the same as connecting cells in series, in which the positive terminal of one connects to the negative terminal of the next. The dots on the transformers of Fig.1(a) are used to indicate

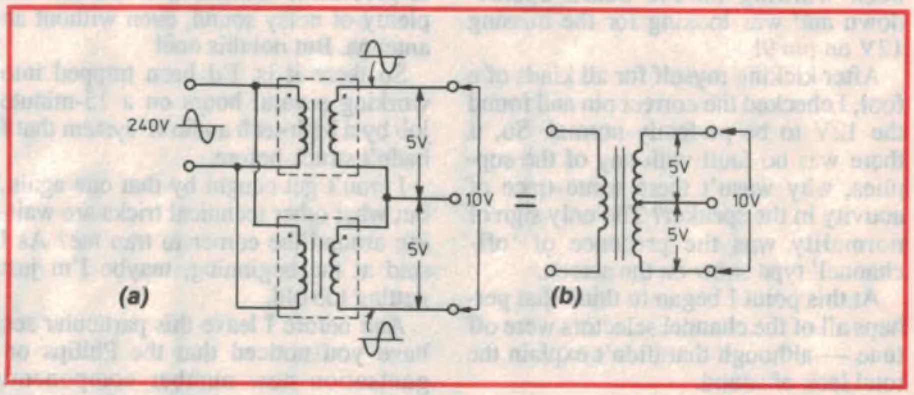


Fig.1: The centre-tapped transformer is virtually two transformers connected together, as illustrated in this diagram. In practice, a tapping is taken out after half the turns have been wound on the secondary.

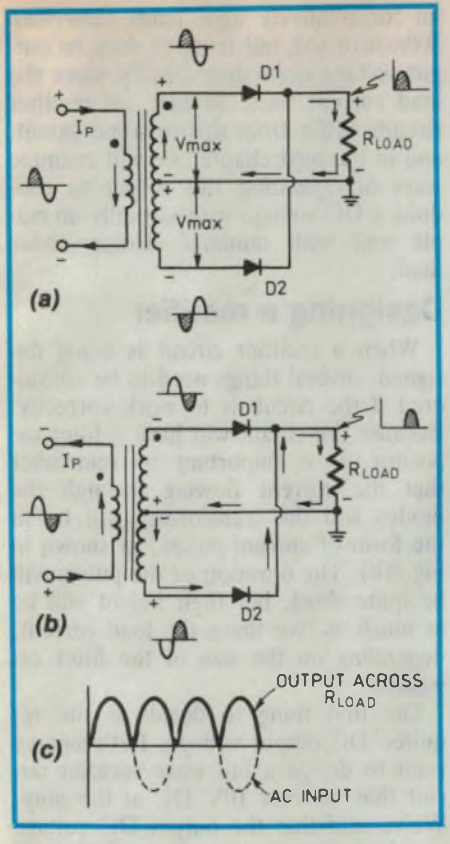


Fig.2: The centre-tapped transformer, full wave rectifier. During the positive half cycles of the input voltage (a), current flows in D1, through the load and the top half of the transformer secondary winding. When the supply voltage reverses polarity (b), D2 conducts, current flows in the lower section of the secondary and through the load in the same direction as before.

phasing, and show the relationship between the primary voltage polarity to that of the secondary. In the example shown, a positive voltage at the dotted end of the primary will produce a positive voltage at the dotted end of the secondary. By 'joining the dots' as shown, correct phasing is guaranteed.

Putting this transformer to work by connecting a diode to each half of the transformer gives the circuit shown in Fig.2, which as we've already said, is really two half-wave rectifier circuits joined together. As a diode only conducts when its anode is positive with respect to its cathode, either one diode or the other will be on at any one time, but never both together. This is because if the voltage at one end of the secondary winding is positive, the other must be negative.

In Fig.2(a), diode D1 is shown in its conducting state and diode D2 is off. Current therefore flows in the top section of the secondary winding in the direction shown, then through D1 and the load resistor, producing an output voltage across the load resistor as shown. Current also flows in the primary, from positive to negative as shown.

Perhaps you might wonder why the current *inside* the secondary winding is flowing from negative to positive. This is the same as a battery, where the current flowing through the battery is from negative to positive. Any voltage *generator* is the same, be it a battery or the winding of a transformer, in which the *external* current it produces flows from positive to negative, while the *internal* current is from negative to positive.

When the polarity of the supply reverses, the voltage across the secondary reverses in polarity as well, giving the conditions shown in Fig.2(b). This time D2 conducts and D1 remains off. Follow the arrows and you will see that the current in the load is in the same direction as before; the only difference being that the bottom half of the transformer is supplying the current. The result is again a positive voltage across the load, even though the input supply is in its negative half cycle.

Notice also how the current in the primary is flowing in the opposite direction to that in (a). The effect therefore is that an *alternating* current in the primary winding is being made to produce a *direct* current in the load. The waveform across the load is shown in Fig.2(c); as you can see it consists of a series of positive half cycles, one each for the positive and the negative input half cycles.

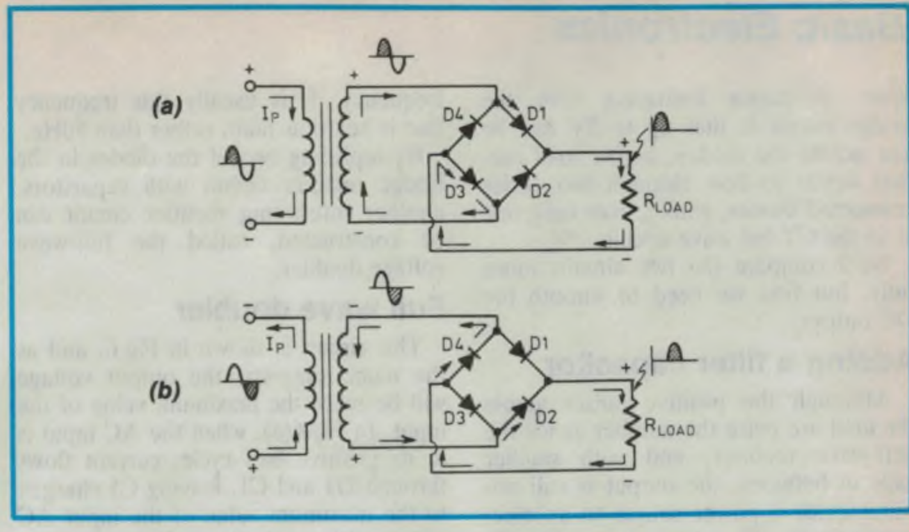


Fig.3: The bridge rectifier circuit uses four diodes to steer the alternating current from the transformer secondary into the load. The current in the load is always in the same direction, while the currents in the transformer are alternating.

A problem with this circuit is the need for a centre-tapped transformer. An alternative circuit is the bridge rectifier, which is probably the most common rectifier circuit.

The bridge rectifier

The bridge rectifier, shown in Fig.3, uses a conventional transformer and *four* diodes. The name *bridge* rectifier comes from the way the diodes are connected; in the form of a diamond. Any circuit connected in this way is called a bridge, and there are numerous bridge type circuits, such as the Wheatstone bridge, the Wien bridge oscillator and so on.

This circuit operates in such a way that two diodes conduct at a time. In Fig.3(a), the arrows show the direction of the secondary current when the input voltage is in its positive half cycle. Notice how diodes D1 and D3 are both conducting, while D2 and D4 are an open-circuit.

When the input voltage reverses polarity, diodes D2 and D4 turn on, and D1 and D3 turn off. The current in the load is still in the same direction as before, while the current in the secondary, (and in the primary) has reversed direction. Thus, alternating current flows in both windings of the transformer, and direct current flows in the load.

Because the bridge rectifier circuit is commonly used, packages containing four diodes connected as a bridge are manufactured. A range of these is shown in Fig.4, including those commonly used in electronic projects.

The output waveform of the bridge rectifier circuit is identical to that of the centre-tapped transformer full wave rectifier. A minor limitation with the bridge circuit is that up to 2V can be lost across the diodes, as the load current needs to flow through *two* series connected diodes, rather than only one as in the CT full wave circuit.

We'll compare the two circuits more fully, but first we need to smooth the DC output.

Adding a filter capacitor

Although the positive pulses across the load are twice the number as for the half-wave rectifier, and with smaller gaps in between, the output is still unsuitable for a power source to an electronic circuit. The answer is to add a filter capacitor, but the question is: what size?

As any electronics engineer will tell you, this is a difficult question to answer properly, so we'll use a simple rule: start with a 1000uF and add a 1000uF for each additional amp of current. Simple, but it usually works for load currents up to 2.5A or so.

Perhaps of greater importance is the resulting DC when a capacitor is used to filter it. Is it now useful? Most definitely, as the waveform of Fig.5(b) shows. Because the filter capacitor is receiving a charge every 10ms, compared to every 20ms for the half wave rectifier (assuming a 50Hz input), the capacitor will not discharge as much between each 'top up'. Thus, the voltage remains more constant – depending on how much load current is drawn, of course.

As the waveform of shows, the DC output voltage (ignoring diode and transformer losses) is virtually equal to the maximum (or peak) value of the secondary voltage. To be more precise, if the ripple voltage is known, the average DC output is equal to the maximum value minus half the ripple voltage. For example, if the AC voltage applied to a full wave rectifier circuit is 10V RMS, then the maximum value is around 14V (RMS x 1.41). If the ripple voltage is 2V peak to peak, then the average DC output will be approximately 13V DC.

Another important point is the ripple *frequency*. The time values shown in Fig.5(b) are for a 50Hz input, and one complete cycle of the ripple frequency takes 10ms. Remember that a complete cycle is always measured between two similar points on the wave, regardless of the overall shape of the wave. Frequency is the inverse of the period, which equals 1/10ms giving a ripple frequency of 100Hz, or twice the supply frequency. It is usually this frequency that is heard as hum, rather than 50Hz.

By replacing two of the diodes in the bridge rectifier circuit with capacitors, another interesting rectifier circuit can be constructed, called the full-wave voltage doubler.

Full wave doubler

This circuit is shown in Fig.6, and as the name suggests, the output voltage will be twice the maximum value of the input. In Fig.6(a), when the AC input is in its positive half cycle, current flows through D1 and C1, leaving C1 charged to the maximum value of the input AC supply with a polarity as shown.

When the AC input changes polarity, D2 conducts, charging C2 to the maximum value of the input, with the polarity indicated. Because the load is connected across *both* capacitors, the voltage applied to the load will be the sum of the charges on C1 and C2, which equals twice the maximum value of the AC input. If the AC voltage applied to the circuit is 10V RMS, the maximum will be 14.1V, giving around 28V as the output DC voltage across the load.

The output waveform is already filtered, as C1 and C2 also act as a filter capacitor, with a total value equal to their series combination. For example, if both C1 and C2 are 1000uF, then the effective filter capacitor value will be 500uF. Usually an additional filter capacitor is added, but it need not be as high a value as for a conventional rectifier circuit.

The full-wave voltage doubler is useful for relatively light loads (less than 300mA or so), but tends to drop its output voltage quite dramatically when the load current rises. In fact, all rectifier circuits suffer from this to some extent, and in the next chapter we will examine ways of *regulating* the output to produce a DC voltage with virtually no ripple and with minimal change under load.

Designing a rectifier

When a rectifier circuit is being designed, several things need to be considered if the circuit is to work correctly. Because the circuit will have a filter capacitor, it is important to remember that the current flowing through the diodes and the transformer will be in the form of current *pulses*, as shown in Fig.5(b). The duration of the pulses will be quite short, but their height will be as much as five times the load current, depending on the size of the filter capacitor.

The first thing to decide is the required DC output voltage. Let's say we want to design a full wave rectifier circuit that delivers 10V DC at 0.5 amp. We've said that the output DC voltage equals the maximum value of the AC input (see Table 1), so we need to determine the RMS value from the maximum value. This is done by dividing Vmax by the square root of 2 (1.41), or by multiplying it by 0.71.

For our case, this gives an RMS value of 7.1V. But this doesn't allow for voltage drops across the diodes, or for any resistive losses in the transformer, so we really need a voltage higher than 7.1V. Exactly how much higher depends on the size of the transformer and whether a bridge rectifier or a CT full wave cir-

Rectifier Circuit	DC output Volts	Required PIV of diode(s)	Ripple frequency	Comments
Half wave	V_{max}	V_{max}	f_{supply}	low power use only
Full wave, CT	V_{max}	$2V_{max}$	$2 \times f_{supply}$	needs centre tapped transformer
Full wave bridge	V_{max}	V_{max}	$2 \times f_{supply}$	looses two diode voltage drops (2V)
Full wave doubler	$2V_{max}$	$2V_{max}$	$2 \times f_{supply}$	low power use only

NOTES: (1) $V_{max} = 1.41V_{rms}$

(2) DC output value ignores losses in diodes and transformer, actual output will be less than V_{max}.

(3) CT full wave circuit assumes a transformer where each winding produces V_{max}. Total secondary voltage therefore equals $2V_{max}$.

(4) Table assumes a filter capacitor connected at output of each circuit.

Fig.4: This photo shows the various package styles for bridge rectifiers. Those shown in the second row from the bottom can handle forward currents of 25A or more. The bottom row have a more modest current capability of an amp or so, and are commonly used in low power electronic circuits.

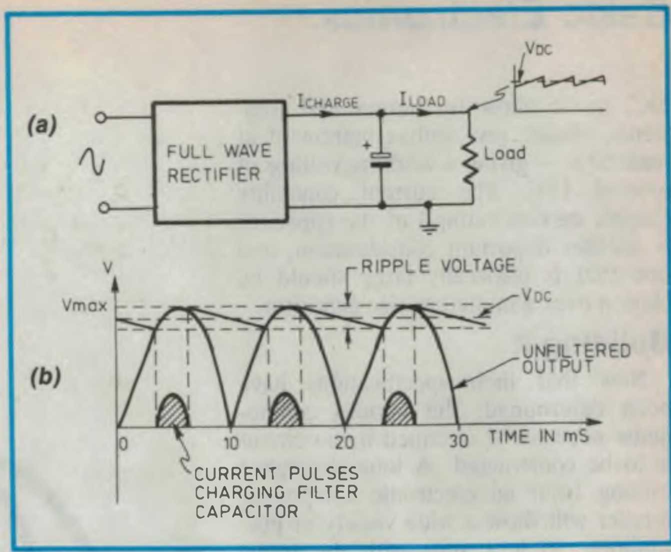


Fig.5: When a filter capacitor is connected across the output of a full wave rectifier as in (a), the resulting waveform is a DC voltage with a small amount of ripple. (b) shows the details of the waveform, including the current waveform taken by the capacitor.

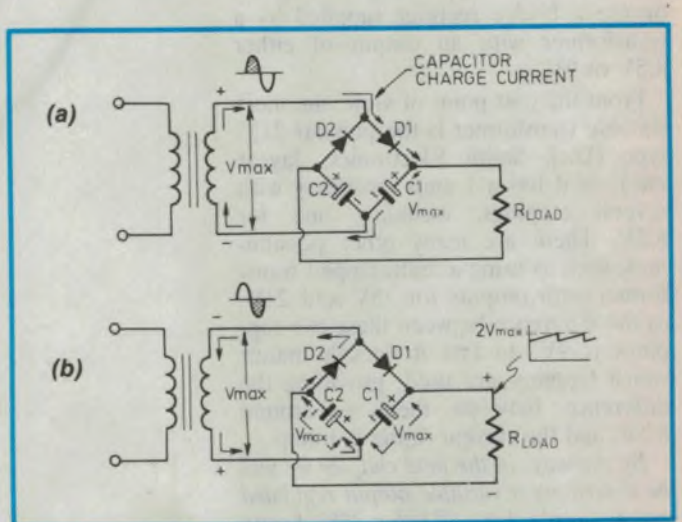


Fig.6: The full wave voltage doubler circuit replaces two of the diodes in a bridge rectifier with capacitors. (a) shows the current path during the positive half of the input AC, and (b) shows current flow during the negative half. The output voltage will equal twice Vmax.

cuit is being used. As a very rough guide, multiply the theoretical value by 1.2, which will give around 8.5V RMS.

If a CT full wave rectifier is being designed, a transformer that has a 17V secondary with a centre tap is required. For the bridge rectifier circuit, a transformer with a single 8.5V secondary would be needed instead. Either transformer needs to have a current rating somewhat higher than the required load current. As a rough rule, use a transformer with a current rating of around 1.5 times to twice the load current, which in this case works out at around 1 amp.

The diodes, like the transformer, also need to be able to handle peak currents of up to five times the load current; but because the conduction time is short, a diode rated at 1 amp continuous current would be suitable. Again, the current rating of the diodes should exceed the load current by up to two times.

The other diode specification that has to be considered is the *peak inverse voltage*, or PIV. As described in previous chapters, this is the voltage the diode must be able to withstand when it is reverse biased. Table 1 summarises the characteristics of the four rectifier circuits we've discussed, and from this table it can be seen that the PIV requirements vary between the circuits.

For our sample circuit, a diode able to withstand at least 10V is required for the bridge rectifier, and 20V if a centre-tapped transformer circuit is being used. Good design practice is to use a diode with a PIV rating that comfortably exceeds the actual value, and the higher the rating the better.

The last component to consider is the filter capacitor. If we use the approximation of 1000uF per amp, starting at 1000uF, then a 1000uF electrolytic capacitor is required. The maximum voltage across the capacitor will be 10V

DC, so to allow for surges and transients, choose one with a margin of at least 50% – giving a working voltage of around 15V. The current capability ('ripple current rating') of the capacitor is another important consideration, and one that is physically large should be chosen over a miniature size capacitor.

Building it

Now that their specifications have been determined, the various components need to be obtained if the circuit is to be constructed. A look through a catalog from an electronic component retailer will show a wide variety of possibilities, so let's start with the transformer.

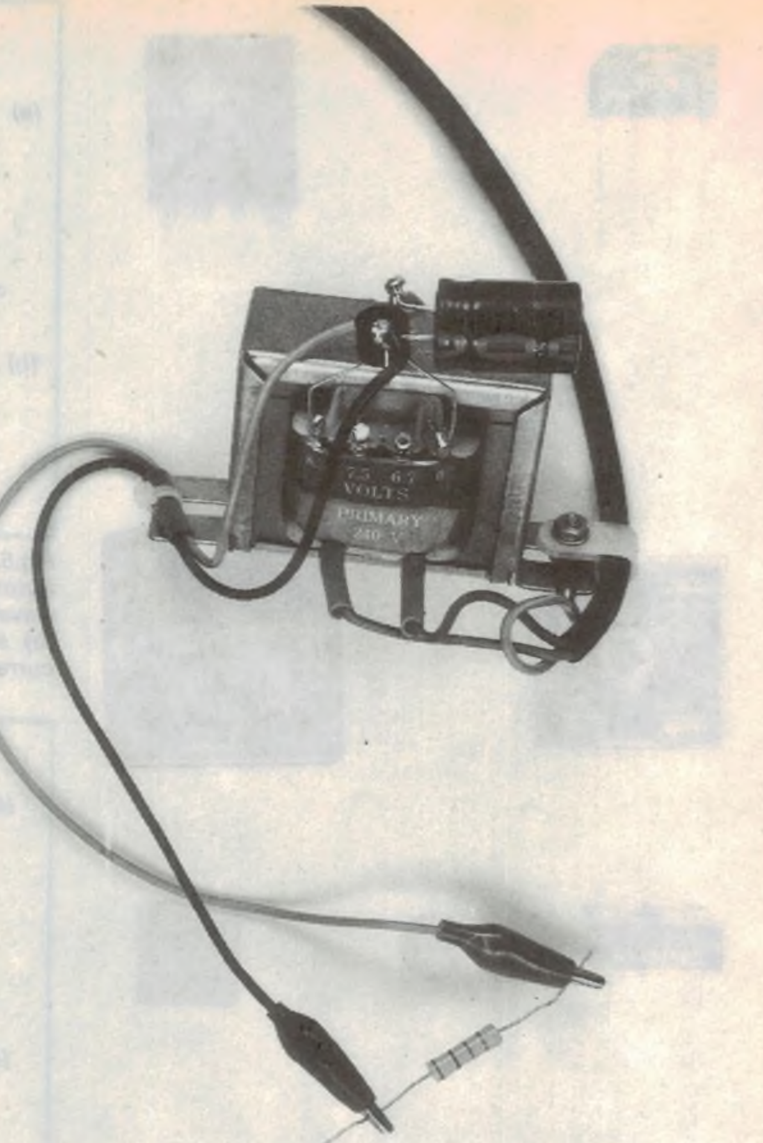
Because a centre-tapped transformer with the output voltages of 0-8.5-17 is not readily available, we can either settle for a 0-9-18V type (only 6% higher) or use a bridge rectifier supplied by a transformer with an output of either 8.5V or 9V.

From the cost point of view, the most suitable transformer is the popular 2155 type (Dick Smith Electronics, Jaycar etc.), as it has a 1 amp secondary with several tappings, including one for 8.5V. There are many other possibilities, such as using a multi-tapped transformer with outputs for 15V and 24V, as the difference between these two tappings is 9V. In fact it doesn't matter which tappings are used, providing the difference between them is around 8.5V, and the current rating is 1 amp.

By the way, in the next chapter we will be describing a variable output regulated power supply that will use a 30V, 1 amp transformer. This transformer can also be used here for experimental purposes, by connecting the diodes between the 15V and the 24V terminals.

The diodes can be either four individual 1 amp diodes, such as the 1N4001, the EM4005 or any 1A diode with a PIV greater than 10V, or a 1 amp bridge rectifier, such as the WO-4 device. The choice really comes down to convenience, as although the WO-4 is slightly more expensive than four single diodes, it is easier to connect.

The capacitor will obviously be an electrolytic type, and the choice now is whether it is a single-ended 'PCB mounting' type (often called 'RB') or a traditional axial lead type. The working voltage has already been determined at 15V or greater, so a capacitor with a 16V rating is fine. However, because of its larger physical size and therefore higher current capacity, a 25V rated device is probably a better choice. At full load, the filter capacitor will be receiving charge currents of around 2A or more, so the larger it is (physically) the better.



The circuit of Fig.7 in real life. The WO-4 bridge solders directly to the 0V and 8.5V terminals of the transformer, and the filter capacitor is supported by the WO-4. Watch the polarity of the capacitor when connecting it to the circuit.

In some power supplies the filter capacitors are under considerable strain, and may even have built-in relief valves to prevent them exploding under overload conditions. This is not a problem in our circuit, but it raises an important point about always replacing filter capacitors with the correct types.

The circuit diagram for our rectifier circuit is shown in Fig.7. The next task is to actually build it...

Construction

Because this circuit is for experimental purposes, construction is simply a matter of arranging everything so it is physically supported. The photo of the finished unit shows how we built it, by soldering the bridge rectifier to the transformer terminals then soldering the capacitor to the bridge rectifier. There are a few important points to consider about the construction, particularly the 240V connections.

The mains lead is connected to the transformer lugs marked 240V, and these connections should be well insulated with plastic sleeving. Don't as-

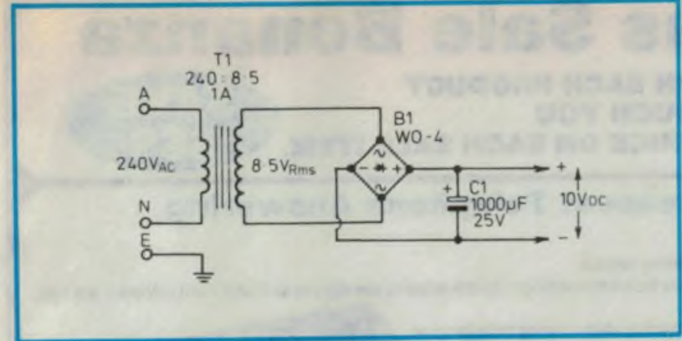


Fig.7: The circuit diagram of a simple 10V DC bridge rectifier circuit. This circuit can supply up to 0.5A of load current, but the output voltage will drop and the ripple voltage rise. A transformer with a higher current rating would help, and increasing the capacitance of C1 will also reduce the ripple.

assume it will be safe without the insulation: *it won't be!* The active and the neutral wires can be soldered to either terminal.

The earth lead of the mains cable should be reliably connected to the case of the transformer, using a lug soldered to the earth wire, and attached to the transformer with a screw and nut.

The WO-4 bridge has its terminals marked, and those indicated with a 'sine wave' symbol connect to the transformer. The terminal marked with a + sign is (obviously) the positive output, and the remaining lead is the negative output.

Note that the capacitor is *polarised,* meaning the end marked negative (the metal end for an axial lead type) connects to the negative terminal of the bridge. If you connect the capacitor the wrong way, it may heat up and become dangerous. Check carefully! We used a PCB mount type, as it gave a neater job.

The final result

If you actually build this supply, (which we hope you will), you can now verify all our design rules. However, make sure you take voltage measurements with a load connected to the output of the circuit, as the results will otherwise be meaningless. Try connecting a 1k ohm resistor across the outputs, then switch on the power.

You should find the DC output is slightly higher than 10V, but close enough to verify our method of design. When a current of 0.5A is taken from the supply, the output voltage will drop, to perhaps as low as 8.5V DC. Also, if you have access to a cathode ray oscilloscope, you will find the ripple voltage on the output has risen considerably, to around 3V peak to peak.

Increasing the size of the filter capacitor will help, but not to the extent you might think. And remember, that as the filter capacitor size is increased, so the peak charge current rises, putting more stress on the diodes and the transformer.

The result so far is therefore a simple rectifier circuit whose output voltage drops somewhat under load, with a corresponding increase in ripple, but one that works (within limits) to the required design specifications. But if you want a circuit that maintains the output voltage right up to the rate load current, and with virtually no ripple voltage at all, then you will need to wait for the next chapter when the voltage reulator is described.

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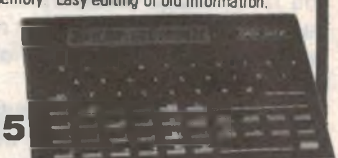

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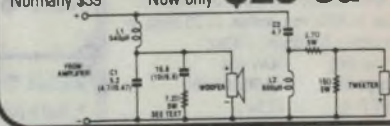

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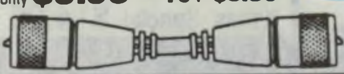

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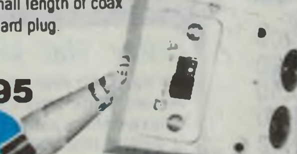

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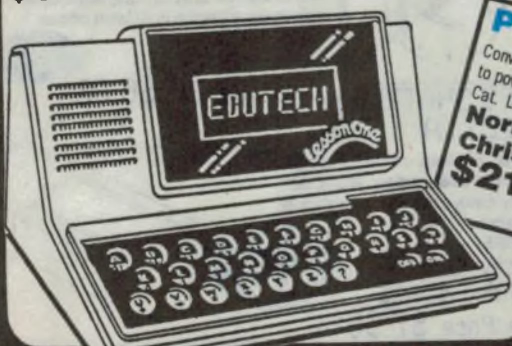

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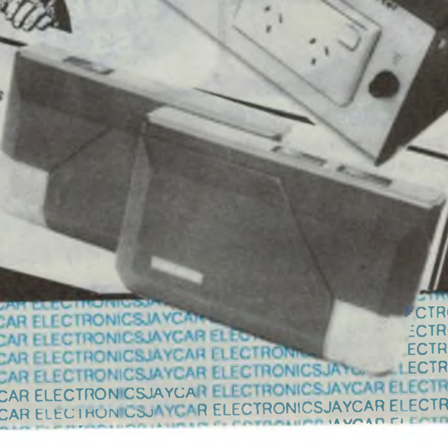

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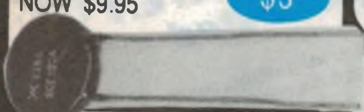

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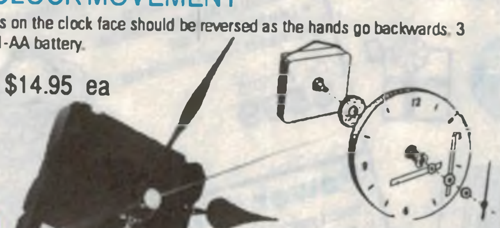

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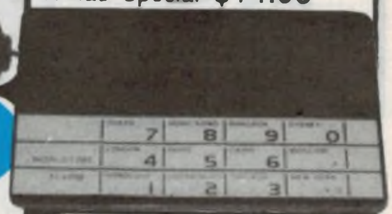

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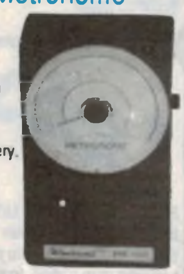
X'mas Price $29.95
$10



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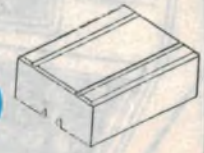

Low Cost Transistor/FET Tester Kit

Ref: EA Dec '90
This kit will test most discrete semiconductor divices as well as batteries.
The Jaycar kit includes PCB, box, front panel, panel meter an all components.
Cat. KA-1731
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NEW

LOW COST 3-DIGIT COUNTER MODULE KIT

Ref: Silicon Chip Sept '90
Looking for a cheap module for event counting or to be used as part of a larger project? If so, consider this 3-digit counter module. It uses only two low cost CMOS IC's and can be put together in a couple of hours. Buy 2 kits and gang them together and get 6 digits and so on!! Short form kit incudes PC board and compenents.
Cat. KC-5083 **$23.95**

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Ref: EA Oct '90 onwards
THE ULTIMATE HI-FI PREAMP
At Last! A totally new design premap to match up to the spectacularly successful Pro-Series 1 power amp! The Jaycar kit features a fully punched professionally Australian made cabin.
FEATURES: In line with state-of-the-art design philisophy extraneous control have been eliminated from the signal path. The design totally avoids the use of screened hook up wire. It is consequently very easy to build. Signal-to-noise performance is staggering - up to 115dB! Max distortion is 0.002%.
Inputs for phono, line, CD, etc. abound with the ability to record from source to tape and monitor another source at the same time. The only front panel control is for volume.
Jaycar colaborated with EA on both the Pro-Series 1 power amp and this exciting new preamp. Because of this, we are uniquely qualified to provide you with the best possible kit! As usual, nothing is spared to compromise quality. So if you want the best, this is it.
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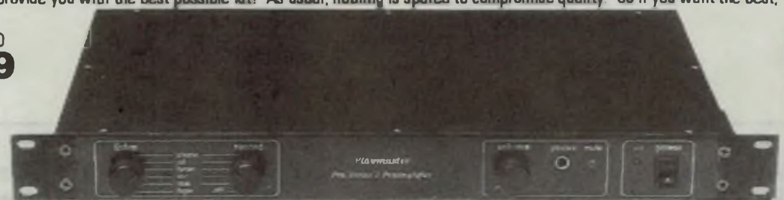
$329



Remote Control Extender Kit for VCR's

Ref: Silicon Chip Sept '90
There's no need to buy a second VCR for the bedroom. This simple kit will allow you to operate your VCR using its remote control from any room in the house. Kit includes all standard compenents, PC board and box.
Cat. KC-5084 **$29.95**

RF Voltmeter Probe Kit to Suit UHF Powermatch MK2

Refer: EA September 1990
Kit includes PC board and all components except 1 x 80mm length 16mm brass tube.
Cat. KA-1729
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Cordless
Cat. YT-7070
Normally $299
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$239

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Discolight Dimmer Kit

Ref: Silicon Chip Oct '90
This kit enables the Discolight (as described in SC July and August 1988) to be used simply as a four channel dimmer. Basically you can vary the intensity of the light on all Discolight functions, the added benefit for this is that the light globes will last a lot longer which consequently saves you money. Kit includes PCB, all components and hardware.
Cat. KC-5085
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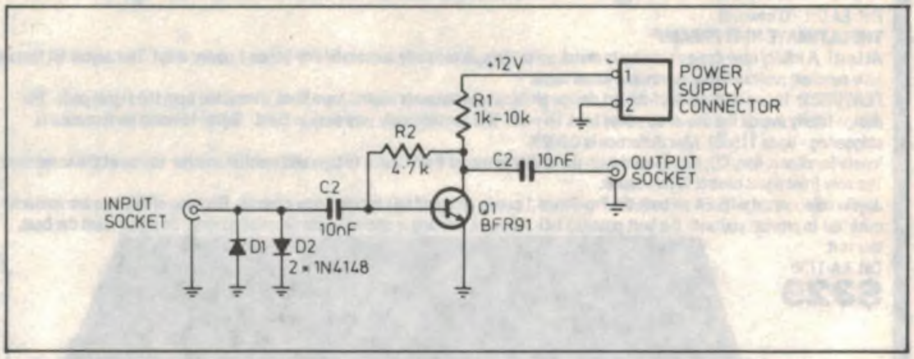
Circuit & Design Ideas

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

Simple RF preamp



This circuit is a wideband receiving preamplifier which I have been using with ham radio gear and TV sets. It's a good circuit to experiment with. These days when IC's do almost everything, it's refreshing to see a simple one transistor circuit providing great performance. On two metres, the prototype circuit provided a gain of 21.5dB!

The voltage gain cannot be accurately predicted, but is usually in the range 15 to 20dB. The circuit is a common emitter amplifier, biased to maximise gain.

It is best built on a piece of double sided PCB laminate, the bottom being used as a ground plane and 'pads' cut with a knife into the top copper surface (carefully)!

The BFR91 must be mounted as close to the board as possible; drill a hole for the transistor body so it will sit flush. All components should be soldered directly to the board – no long leads at all!

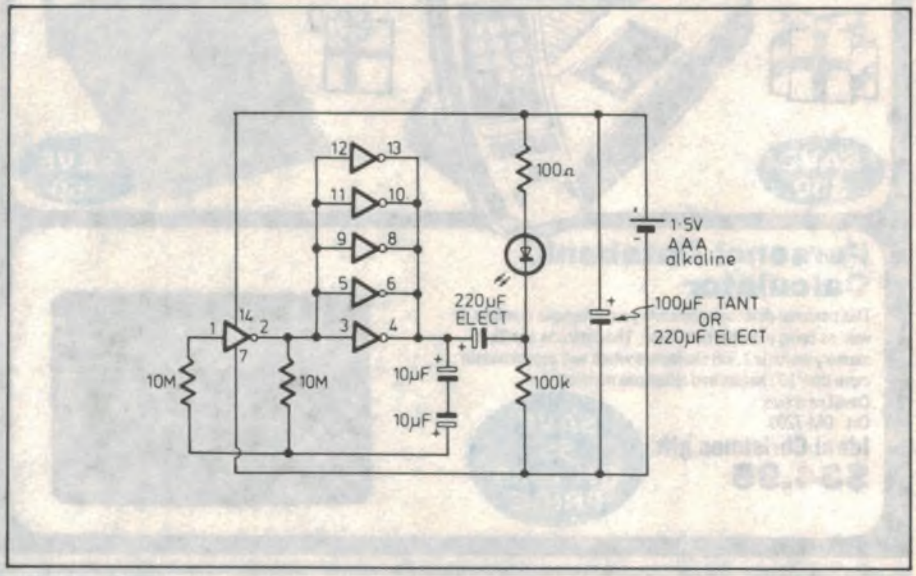
The two diodes at the input are for lightning protection. Setting up the circuit is simple – vary the collector resistor until the circuit draws around 5mA; this leads to low noise operation.

Put in a metal box and that's it! Finished.

Mr Eades,
Leura, NSW.

$35

Microwatt LED flasher



This circuit is an extremely low power LED flasher with an average current drain of less than 10uA. At least four years operation can be expected from a single AAA alkaline battery, this time being determined not from the capacity of the battery, but from its shelf life.

The low current is a result of using CMOS, and flashing the LED only once every two minutes. This slow flash rate is useful for smoke alarms or other battery powered devices, to indicate they're still functioning.

The circuit is designed about a low frequency oscillator, with a voltage doubler to give a bright 3V flash from a single 1.5V battery. Although the 74Hc family has a minimum guaranteed supply voltage of 2V, this limit is very conservative, and the circuit works down to 0.85V.

A 50% duty cycle, two minute oscillator is made from two inverters of a 74HC04, with the extra inverters in the package paralleled for more current drive. Two back-to-back 10uF tantalum capacitors make up a 5uF non-polarised low leakage timing cap. Note that the cathodes must be joined together. When the output of the 74HC04 is high, the 220uF charges slowly via the 100k resistor. The LED used had a turn on voltage of 1.51 volts, so there is only a very small leakage current through the LED via the 100 ohm and 100k resistors.

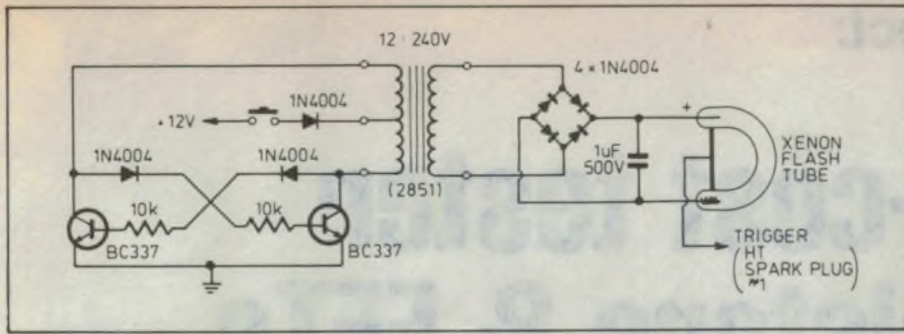
When the output goes low, both ends of the 220uF cap drop by 1.5V, taking the negative end of the cap to –1.5V. A bright flash results, ending in a pleasant fading as the cap is discharged.

The 100uF 3V tant bypasses the battery as it grows weaker, extending the life of the battery.

The flash rate may be increased by decreasing the value of the timing caps. The 100k resistor should also be reduced, so that the 220uF cap can still charge to close to maximum in the shorter time.

Andrew Moorhouse,
Parkville, Vic.

$40



Xenon timing light

This circuit enables a xenon discharge tube to be used as an ignition timing light. The two requirements of such a tube are a high DC supply voltage and a trigger pulse to start the arc discharge.

The first of these two requirements is met by a simple DC-DC step-up configuration. 12V DC is fed via a pushbutton and polarity protection diode to the centre tap of the 12V winding of a 12-240V transformer (e.g., 2851 type) used 'back to front'! A free running multivibrator switches each end of the winding in turn, at a fairly high frequency which causes about 320V AC to appear at the terminals of the normal 240V winding. This voltage is full wave rectified to slightly over 500V DC at the 1uF storage capacitor (steady-state conditions).

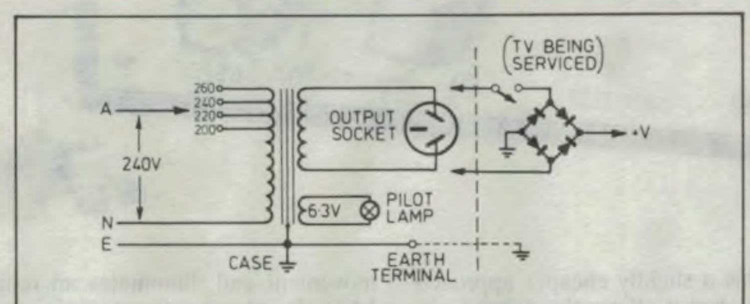
The trigger pulse is provided simply by a direct connection to the high tension lead of spark plug #1 on the engine, using well insulated wire.

Note that although the value of the storage capacitor can be increased to provide a brighter output, this will be at the expense of a lower RPM limit, since the larger capacitor will not have the time to charge to the required voltage.

The finished timing light was fitted in a short length of PVC tubing, making sure that all the high voltages were out of reach. It has been used on cars and motorcycles over several years, without trouble.

Olaf Bulenda,
South Yarra, Vic.

$40



Valve TV transformer provides isolation

A 240:240V isolation transformer is essential when servicing live-chassis TV sets, but if the only TV service you do is on your own set when it fails (hopefully not often), then you wouldn't want to purchase a commercial transformer. They're too expensive.

Fortunately there is an alternative. Many of us have a shelf full of power transformers salvaged from old valve TV sets. Many of these have a 200-210V secondary which used to feed a bridge rectifier. This is adequate to supply a load of about 80W, or more if it won't be operated continuously.

The switchmode regulators in modern sets are quite happy with a 200V supply, but if your transformer has a tapped primary, you can move the mains down to a lower tap to bring the output up close to 240V.

Another possibility is to fit the transformer permanently inside the TV set, if you want to fit audio/video inputs/outputs etc. Some ingenuity and metalwork will probably be needed. The 6.3V heater winding could then be used to power any additional buffers or drivers you may require, with a small rectifier or voltage doubler.

Experiment with placement, as the magnetic field may cause colour problems.

'Dr Henry Choke',
Ringwood, Vic.

$35

Construction Project:

New low-cost tester for transistors & FETs

This simple transistor tester is capable of checking most discrete semiconductor devices, and is particularly suited to testing bipolars and FETs. It's very easy to build, uses low-cost components, and provides an excellent way of becoming familiar with basic device operation.

by ROB EVANS

The basic design of this handy little instrument was conceived way back in 1971 by our current editor Jim Rowe, who has some reason to be proud of its popularity over the years. The same design was then revamped in 1978 by Greg Swain and David Edwards, who used a low-cost plastic jiffy box, a small PCB and miniature toggle switches – the original had used a diecast box, 'tagboard' and slider switches.

Well, the decade clock has more than turned, leaving us with higher component prices and the need for a fresh look at this valuable little instrument. While the meter movement in particular represents the bulk of the tester's total cost, it's definitely worth retaining in the interests of versatility and ease of use. A much simpler instrument may be produced using an LED to indicate when a gain (beta) threshold is reached, but many people find such a unit less satisfying than one with a meter.

Since the absolute accuracy of the meter reading is not really critical – the figure is usually relative to another device under test – a much cheaper movement can be used, without compromising the tester's usefulness. Fortunately, a suitable meter is readily available at around half the cost of the movement used in the previous design. This is a universal 'signal' meter with a current rating of 250uA, and a 35mm x 18mm face.

Looking at the design again we also found that the three toggle switches used in the past design could be replaced by two multi-pole (PC-mount) rotary switches, leaving a couple of spare positions for extra features. Not only is this a slightly cheaper approach nowadays, but it allows the printed circuit board (PCB) to mount directly on the back of the rotary switches, thereby eliminating most of the interwiring required in the older testers.

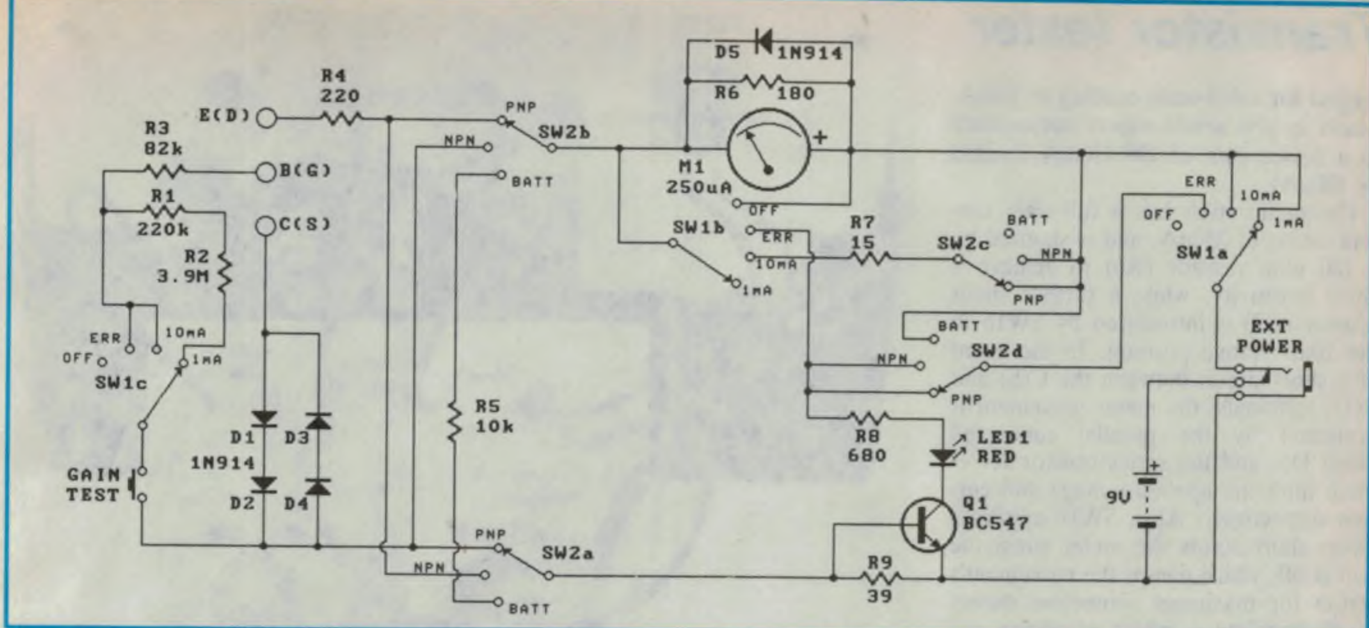
Taking advantage of the new switches, we have also found it possible to include two extra features in our new tester. These cause a negligible increase in the overall cost, and should make the unit more convenient to use.

A battery test facility has been added, since the battery is contained within the case and is quite inaccessable to normal testing methods – that is, a multimeter. As it happens, the tester's readings will be affected by the state of the battery, so it pays to be aware of the its actual terminal voltage during testing.

The other new feature is an 'error check' circuit, which bypasses the meter movement and illuminates an indicator LED if the circuit current is above about 15mA. The motive in this case is to reduce the chance of the meter pointer slamming into the end-stops – which tends to occur if the test clips are touched together or the device under test is faulty or incorrectly connected. The idea is that all connections and initial checks are performed with the switch in the 'error' position, where the LED will indicate an overload. The normal gain checks can then be performed with the meter in circuit – that is, the 10mA and 1mA positions.

In short, our new transistor tester is lower in cost, easier to build and offers more facilities than the past designs. On those grounds, we feel this to be an effective upgrade of a time-proven design.

For those who are not familiar with this style of basic checker, the unit sim-



The complete circuit for the tester – as you can see, it's really quite simple.

ply monitors the current through the device under test while applying a known current/voltage bias when the 'gain test' button is pressed. Essentially, this allows the user to verify that the device is intact, and note its relative gain figure.

As it happens, the tester's simple design belies the almost countless ways in which it may be used to check and understand semiconductor devices. For detailed information on how the instrument is used, see the 'Using the tester' section at the end of this article.

Circuit description

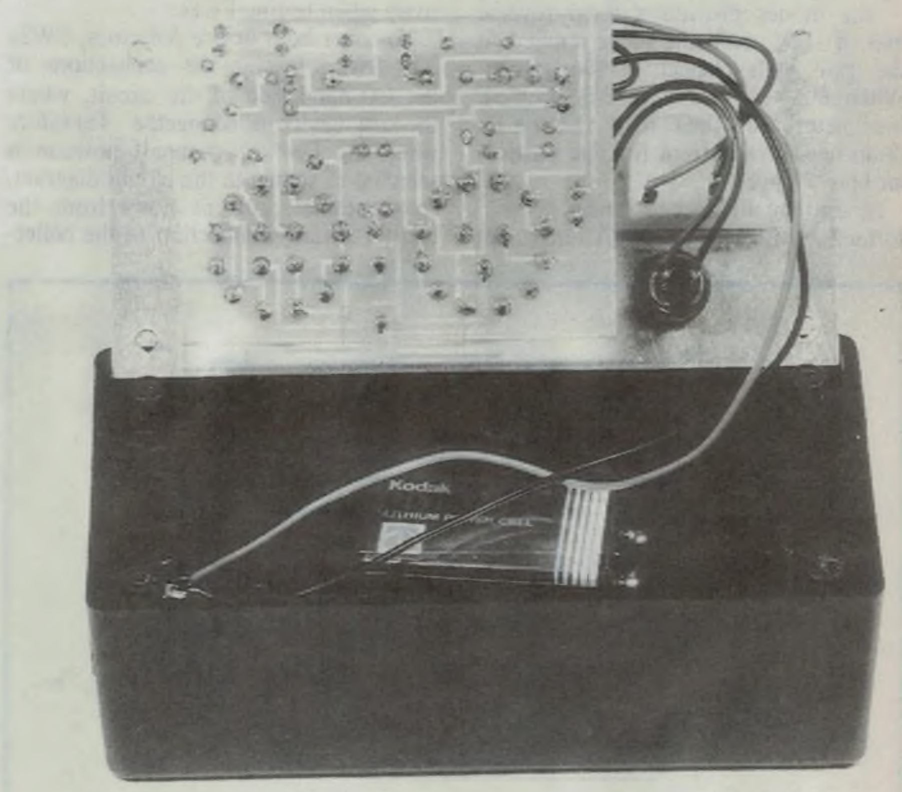
The circuit of our new tester is virtually identical to the original 1971 design, except for the additional components included for the battery test and error indicator features mentioned above.

Essentially, it consists of a 9V battery connected to a pair of test terminals, E(D) and C(S), via a meter movement – this is arranged to read full scale when a current of 1mA flows in the circuit. If we assume for the moment that the device under test is a bipolar transistor, and its emitter and collector legs are connected to the E and C terminals respectively, the meter will directly read the device's collector current (Ic). With this basic connection, the reading will in fact indicate the transistor's collector-emitter leakage current or Iceo. (For most modern silicon bipolars, this will be very small if the transistor is OK.)

However when the 'gain test' button is pressed, a known resistance is introduced between the C(S) connection and the remaining test terminal B(G), which connects to the base leg of our test transistor. Therefore a substantially fixed and known base current will flow, which in turn causes a collector current (and meter deflection) dependent upon the transistor's DC current gain (beta).

In the actual circuit (with the switch positions as shown) the test current is 2uA, since the total resistance between the collector and base connections is around 4M ohms (R1 + R2 + R3), and the applied potential is about 8V. So if the transistor has a beta of 500, its collector current will be 1mA, causing the meter to read full-scale.

When the 10mA range is selected on the other hand, SW1c bypasses R1 and R2 resulting in a base current of 100uA (via R3). In this case the meter is ar-



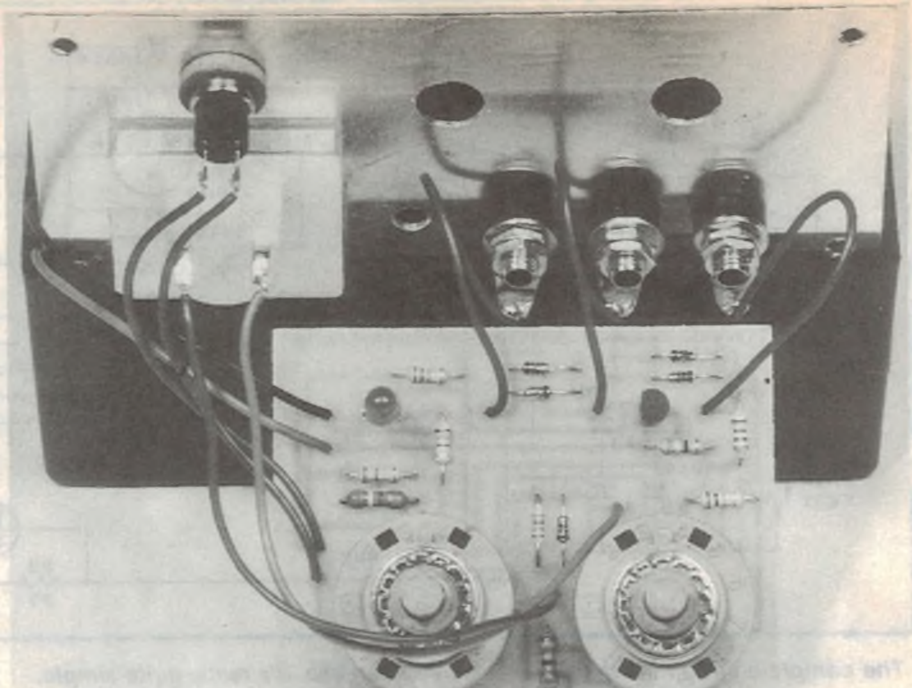
A view of the unit with the lid removed. The PCB is held in place by the two PC-mount rotary switches, which in turn attach to the front panel.

ranged for a full-scale reading of 10mA, which as you would expect corresponds to a device gain of 100 (10mA divided by 100uA).

The meter itself has a full-scale current rating of 250uA, and is shunted by a 180 ohm resistor (R6) to achieve a 1mA sensitivity, while a further shunt resistor (R7) is introduced by SW1b in the 10mA range position. In the event of a short circuit between the C(S) and E(D) terminals, the meter movement is protected by the parallel connected diode D5, and the series resistor R4 – these limit the applied voltage and current respectively. Also, SW1b applies a direct short across the meter when the unit is off, which damps the movement's action for maximum protection during rough handling – which of course will never happen!

The two sets of series-connected diodes (D1 to D4) at the C(S) terminal will merely reduce the transistor's collector voltage by around 1.2V, without effecting the actual gain figure – note that only one set of diodes will be forward biased at any time (D1 and D2 with the switch positions shown). However, when a FET device is connected to the appropriate terminals – drain to E(D), source to C(S) and gate to B(G) – the diodes provide a fixed reverse bias of 1.2V, available to be applied to the gate with respect to the source. When the gain test button is pressed, the meter will then read the FET's drain to source current for that particular bias voltage.

Again, the FET checks may be performed on the 10mA or 1mA range, but since these devices do not draw significant grid current, the changing series grid resistors (as selected by SW1c) will have little effect. In the practical sense, SW1 simply changes the meter sensitivity when testing FETs.



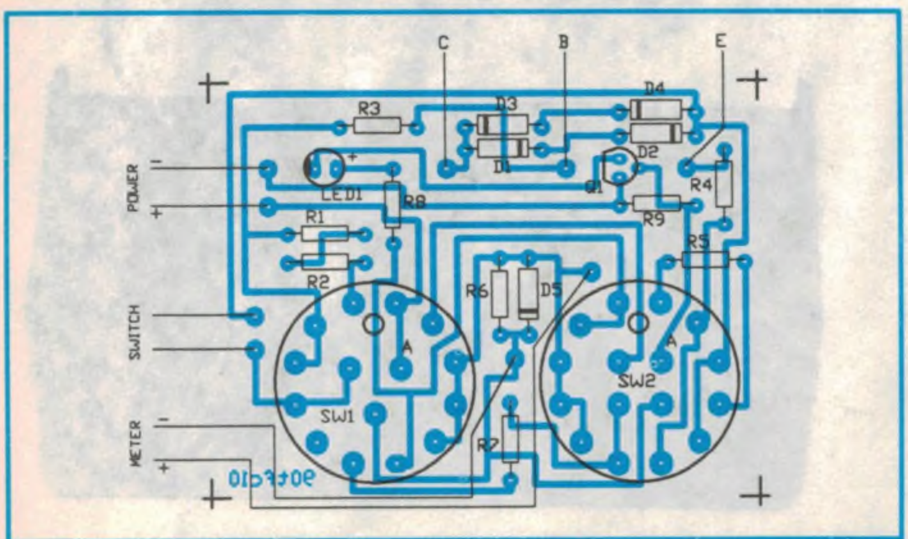
Virtually all of the parts mount on a small PCB, which makes the tester very easy to build.

To cover both device polarities, SW2a and SW2b reverse the connections of the left-hand side of the circuit, where the test device is connected. Therefore when the PNP (N-channel) position is selected as shown in the circuit diagram, (conventional) current flows from the emitter (drain) connection to the collector (source) terminal and D1/D2. Conversely when NPN (P-channel) is selected, current passes through D4/D3 and the C(S) terminal to the E(D) connection.

The third (batt test) position of SW1 simply replaces the device test circuit to the left of SW2a and SW2b with a 10k resistor. Hence a battery voltage of 9V will cause around 0.9mA to flow in the circuit, and a meter reading of '9'. SW2c disconnects the 15 ohm shunt resistor if SW1c is in the 10mA position, thereby maintaining a meter sensitivity of 1mA for the battery test function.

When SW1 is in the 'error' position, the meter is bypassed and Q1 illuminates LED1 if the circuit current is above about 15mA. In this case the test circuit is energised via SW1a, SW2d (except in the batt test position), and SW1b – rather than via SW1a and the meter, as in the normal 1mA/10mA positions. When the current through the circuit reaches 15mA, around 0.6V will be dropped across R9 and the base-emitter junction of Q1, which is in turn biased on. The saturated state of Q1 illuminates LED1 via the current limiting resistor R8, indicating an error – or more correctly, that the current in the test circuit is above 15mA.

If the battery test function is selected while SW1 is in the error position (meter bypassed), SW2d routes the cur-



The PCB overlay diagram. Note that the rotary switches have their plastic locking pins facing towards the top of the diagram.

rent path back through the meter. This ensures that the 'batt test' position will function in all modes of SW1, except 'off'.

Construction

As you can see from the associated shots of the tester, construction is very straightforward. All of the components, with the exception of the input sockets, pushbutton switch and meter, are mounted on a small printed circuit board (PCB) which is held in position by the two rotary switches.

Commence construction by installing all of the lower profile components on the PCB, taking care with the orientation of the diodes and the transistor – refer to the component overlay diagram at all times. Don't solder the LED in position at this stage, since its height above the PCB is determined by the front panel position.

Check that the two rotary switches are configured for the correct number of positions (three for SW1, four for SW2), and push their bodies firmly onto the PCB with the plastic locking pins at the top, as shown in the component overlay. Solder the switches in place, and trim off the locking pins so as to provide an even surface for the front panel. Next connect the meter, pushbutton switch, input sockets and power socket to the PCB via short lengths of hookup wire, and install (but don't solder) the LED.

Mount the various components onto the front panel, with the rotary switch/-PCB assembly installed last. We simply glued the meter in place with a silicone sealant. Arrange the body of the LED to protrude slightly above the front panel, through its mounting hole, and solder the legs in place.

Then connect the battery clip lead to the external power socket terminals (while double checking the polarity), and install a 216-type 9V battery. The battery can simply lie in the bottom of the box; however it should be covered with an insulating material to prevent the body contacting the PCB – we found the plastic section of the battery's original 'bubble' packaging to be quite suitable for this purpose.

Finally, screw the complete unit into the case, attach the knobs and you're ready to start testing.

Using the tester

Operating the checker when it is completed should present few problems, since the front panel labelling clearly shows the unit's various functions. The error facility is particularly useful when the polarity or connections of a transistor are unknown.

The circuitry of the checker is such that an incorrect setting of the polarity switch, or an wrongly connected transistor is unlikely to cause damage to the device or the checker. This is particularly true in the error test position (since the meter is disconnected), which should always be selected first.

To check an unknown bipolar transistor for example, first connect the tester's C(S) and E(D) terminals to any two of the device's legs. Select the 'error check' function and try both the NPN (P-ch) and PNP (N-ch) positions. If the error LED illuminates on both, repeat the test with a different pair of legs – in fact, there are only three possible combinations (the polarity is not important at this stage).

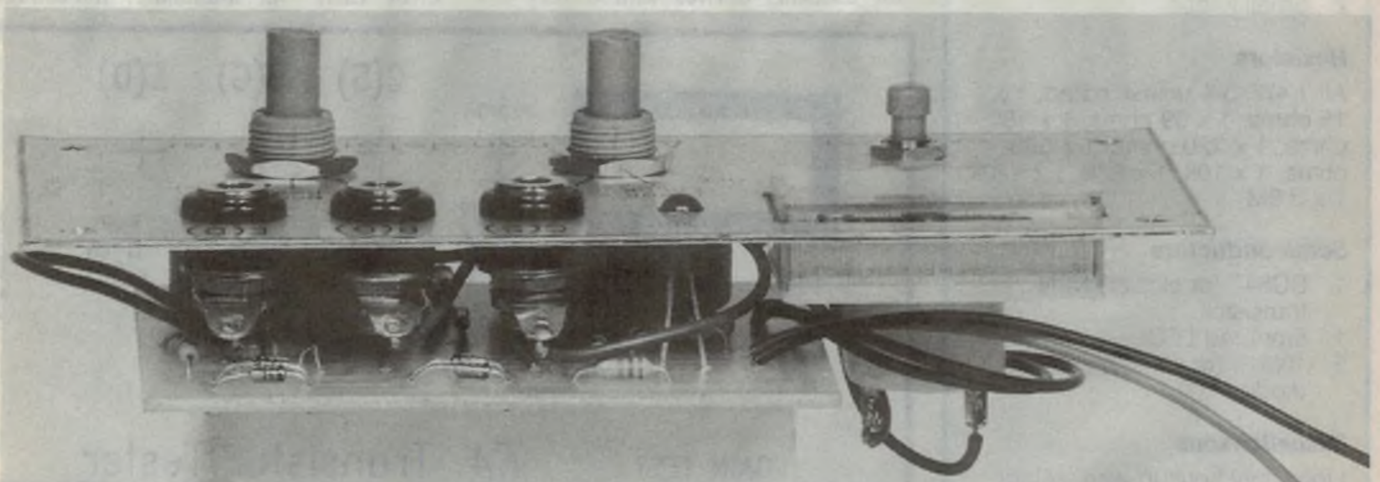
Once you have found a configuration where the LED does not light when either NPN or PNP is selected, you have identified the device's collector and emitter leads. Next, connect the remaining leg to the tester's B(G) terminal, and switch to the 10mA position. If the meter shows a reading, switch the tester to the other polarity (NPN or PNP) and press the gain test button – the meter should then show the transistor's gain. If not, swap the collector and emitter connections and try again. While the above method may sound a little protracted on paper, in practice an unknown transistor can be checked in a very short time.

Once a device is connected correctly, you have the choice of the 10mA or 1mA range, which will often provide different gain readings. Most current low-power silicon transistors for example tend to show a relatively low reading (less than 100) on the 10mA range, yet indicate a beta of many hundreds on the 1mA setting – the appropriate range really depends on the transistor's final use.

Silicon power transistors, on the other hand, tend to show a more realistic gain figure on the 10mA range – ideally, the gain of these devices should be checked on a dedicated power transistor tester, such as the unit presented in the May 1988 issue of *Electronics Australia*.

When the test button is not activated, the meter is in fact reading the device's leakage current. In the case of a bipolar transistor, this as noted earlier is the leakage saturation current or Iceo – the collector-emitter current which flows when the base is left unconnected. With a good silicon device it should be very low.

The test for Iceo is a good preliminary check, since there are few faults in bipolar transistors which do not cause a significant increase in this leakage current. In fact those few faults which don't show up in this test will generally make themselves quite apparent in the



A side view of the completed assembly. Make sure that the banana socket terminals don't contact any component legs on the PCB.

Transistor tester

gain test. For example, an open circuit in the base, collector or emitter lead will not produce a high Iceo, yet will result in a gain reading of zero.

In general, you will find that the Iceo of most healthy (silicon) bipolar transistors is so low that there will no noticeable meter deflection during the test, even on the 1mA range. However temperature will play a part, since the Iceo of silicon devices will roughly double for every 5°C rise in temperature. Also, the Iceo of a device is roughly proportional to its gain, so this should be taken into account.

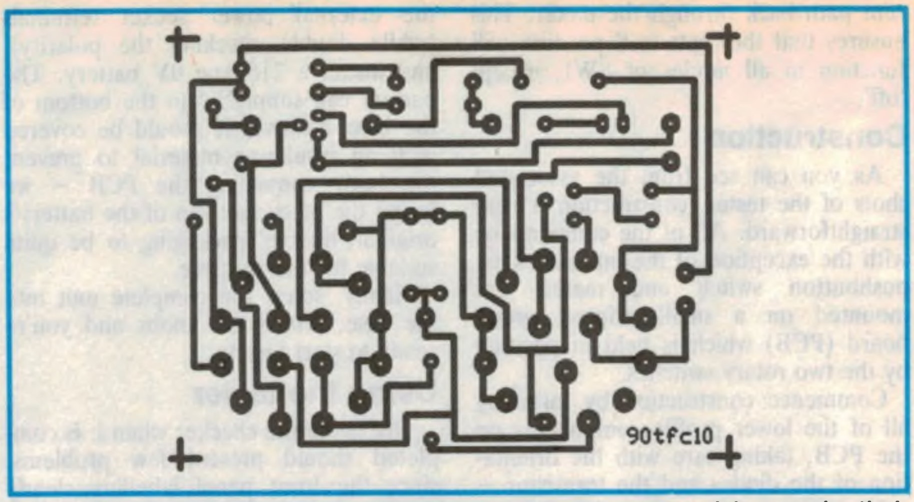
For FETs, the checker first measures the zero-bias channel current Idss – the current which flows between the drain and source when the gate is either left open-circuited or connected to the source. Pushing the gain test button then applies a reverse gate bias of about 1.2V, and the effect of reducing the drain-source current may be seen. This gives a measure of the device transconductance (gm). The transconductance is not indicated directly, but may be readily calculated by dividing the observed drop in channel current by 1.2.

The test for Idss is a very useful one for checking FETs, as Idss is one of the main parameters which determine the DC behaviour of a FET in most circuits. It is also a parameter which varies quite significantly among currently available devices, and is therefore an important one to be taken into account when selecting or matching FETs. The transconductance check is also a very useful test, both for straightforward 'good-bad' testing, and for selection and matching.

As for the bipolar transistor tests, the FET tests may be performed on either the 10mA or 1mA current ranges. With most FETs the 10mA range will be the more appropriate, as most of the devices currently available have an Idss falling within the 1mA-10mA range. However the 1mA range may be useful for checking devices with a very low Idss, and/or a high transconductance. In fact, a FET with an Idss figure approaching 10mA may be of limited use in most practical circuits.

With FETs an incorrect polarity setting generally does not show up on the Idss test, because the channel of most FET devices is symmetrical and conducts equally in either direction. However, incorrect polarity will immediately show up when the 'gain test' button is pressed – the meter reading will increase rather than decrease, revealing that the gate is being forward-biased instead of reverse-biased. This effect should always be taken as a sign that the polarity switch has been set to the incorrect position.

It's very easy to check diodes on the tester, both for the reverse leakage current Ir and forward conduction. Simply switch the tester to the error function, connect the diode to the C(S) and E(D) terminals and try both positions of the NPN/PNP switch. In one position the error LED will illuminate, indicating



A full size reproduction of the PCB artwork for those who wish to make their own.

PARTS LIST

- 1 Plastic jiffy box, 130 x 68 x 41mm
- 1 PCB, 55 x 72mm, code 90tfc10
- 1 3-pole 4 position rotary switch
- 1 4-pole 3 position rotary switch
- 1 Momentary action pushbutton switch
- 1 250uA/650ohm 'signal' meter
- 3 Banana sockets
- 1 9V (216-type) battery clip
- 1 Panel-mount switching power socket
- 2 Small knobs

Resistors

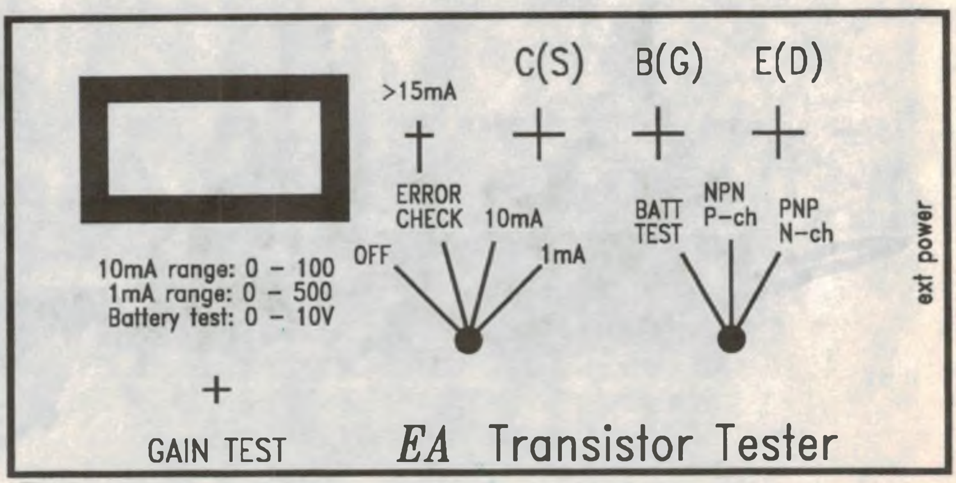
All 1/4W, 5% unless noted: 1 x 15 ohms, 1 x 39 ohms, 1 x 180 ohms, 1 x 220 ohms, 1 x 680 ohms, 1 x 10k, 1 x 82k, 1 x 220k, 1 x 3.9M

Semiconductors

- 1 BC547 (or similar) NPN transistor
- 1 5mm red LED
- 5 1N914 (or similar) silicon diodes

Miscellaneous

Light-duty hookup wire, solder, etc.



The front panel artwork includes the meter range for each of the tester's main functions.

the correct polarity for forward conduction. Then select the opposing polarity and either the 10mA or 1mA current range, where the meter reading will then show the diode's reverse leakage current.

LEDs may be tested in a similar manner. However in this case, both the error LED *and* the LED under test will illuminate to show forward conduction. The actual test current will be a little less than 30mA, giving a good indication of the colour and brilliance of the LED under test (at this current).

Although the checker has basically been designed to test bipolars, FETs and diodes, it can be used to test various other devices if a little ingenuity is used. It is possible to test sensitive low power SCRs, for example, by connecting them to the checker as for an NPN transistor (anode corresponding to collector, cathode to emitter and gate to base), and noting if the device triggers into conduction when current is applied to the gate via the gain test button.

Higher power SCRs may be tested in a similar fashion, but in this case an external resistor may have to be connected between the anode and gate to provide sufficient triggering current to initiate conduction.

Programmable unijunctions or 'PUTs' may be checked in much the same way as low power SCRs, but with the anode and cathode reversed so that they correspond respectively to the emitter and collector of a bipolar. The polarity switch in this case should be set to the 'PNP' position.

Other devices may be checked by analysing the action of the checker's circuit, and a little experimentation. Remember that when the circuit is switched to the 'NPN' position, a positive potential (in a relative sense) is applied to the C(S) terminal – conversely, 'PNP' switches positive to the E(D) connection. In both cases, the gain test switch introduces resistance between the C(S) and B(G) terminals.

As a final point, keep in mind that the battery voltage will determine the current through the test circuit, and therefore has an effect on the final gain reading. While the change should be insignificant during a consecutive series of tests, it's a good idea to activate the battery test facility when you first commence testing. Also, when using the external power facility, make sure that the plugpack or power supply used matches the polarity of the tester's power socket, and its output voltage is not too high – that is, an off-scale reading when 'batt test' is selected.

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NOTE: This offer applies only until 500 boards have been supplied — so be quick! Free boards will only be supplied by mail; normal prices will apply for those supplied over counter.

Construction kit review:

AT&M's V23/RS-232 'radio modem' kit

When Australian Test & Measurement came up with a low-cost 'V23 radio modem' module kit to allow linking up its ATM 22 and ATM23 16-channel multiplex controllers via radio transceivers, they made many customers happy. But others immediately became jealous – because *they* wanted to use the same modem to link computers and other equipment with RS-232 serial ports. So now AT&M has produced a matching second module, adapting the modem for RS-232 use...

by JIM ROWE

Increasingly, radio links are being used to convey digital data between computers, controllers, remote sensing units and remotely controlled equipment. It isn't always feasible to link up every part of a distributed digital system via dedicated physical wiring, or even 'as needed' via Telecom's PSTN (public switched telephone network). A pair of transceivers and antennas working on a suitable band can often provide a practical, reliable and cost-effective alternative.

In response to many requests from customers for low-cost modem kits to use with their ATM22 16-channel multiplexing remote control module and matching ATM23 16-channel decoder module, Clive Chamberlain and his crew at Australian Test & Measurement came up with the ATM25 modem module kit. This is essentially a simplex modem, based on the CCITT 'V23' standard originally developed for 1200-baud communications over the PSTN, but designed specifically for use with virtually any standard radio transceivers providing a normal 'speech' audio band-pass characteristic.

The basic ATM25 module is a single PCB which was designed originally to plug directly into the top of either the ATM22 or ATM23 module boards. The

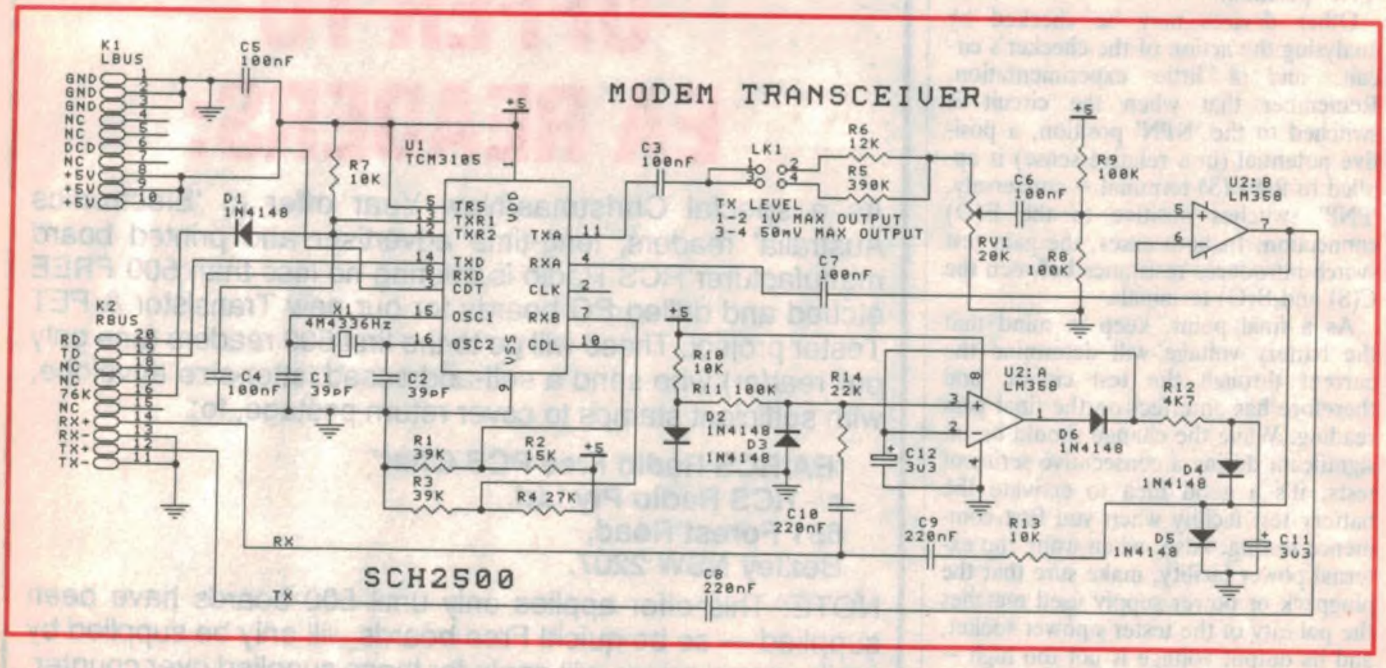
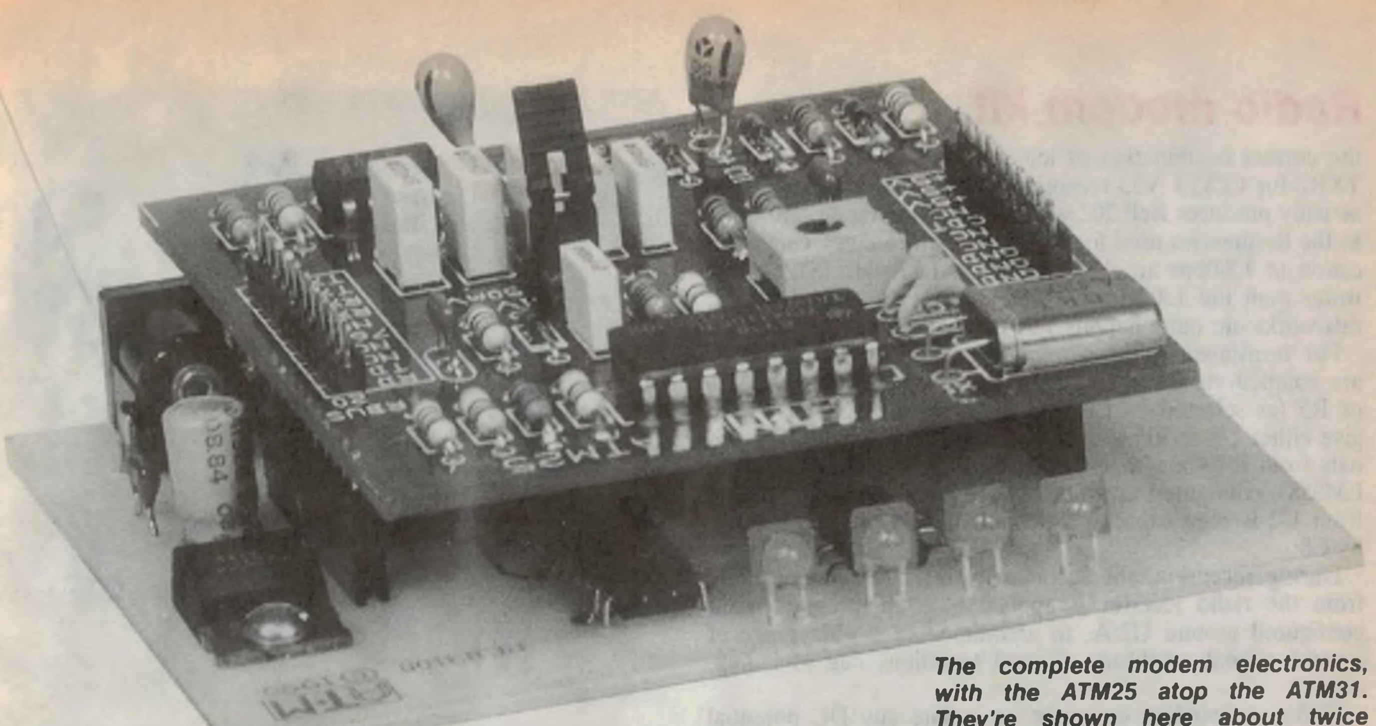


***Fig.1:** The circuit schematic for the basic ATM25 radio modem module. At its heart is a Texas Instruments TCM3105 chip, which does most of the work; an LM358 dual op-amp provides buffering and receives level compression.*



The complete modem electronics, with the ATM25 atop the ATM31. They're shown here about twice actual size.

plug and socket system used automatically configures the ATM25 for 1200bps data *transmission* when plugged into the ATM22, or for *reception* when plugged into the ATM23. The digital data is converted into audio FSK (frequency-shift keying) tones at 1300Hz and 2100Hz, which are essentially pure sinewaves and thus very suitable for transmission within the usual bandwidth of radio transceivers.

The module is provided with adjustments so that its transmit audio output level can be set for correct operation with either a high level 'line' input to a modulator, or a low level transceiver 'mike' input. Similarly the receive circuitry incorporates a simplc but effective compressor circuit, which allows it to accept virtually any audio input from 20mV to 20V peak to peak – making it suitable for connection to a speaker output, a headphones output, a tape recording output or even a direct connection from a low-level detector circuit.

I gather that the ATM25 works very well with the ATM22/23 combination, and quite a few of them are now in use providing reliable radio data links. However Clive Chamberlain tells me that no sooner had the ATM25 been announced, he began to get requests for an interface to allow it to be used not just with the ATM22/23, but more generally with personal computers and other gear provided with standard RS-232C serial ports.

The new ATM31 module has been produced to achieve just that. It mates with the ATM25 with the same plug and socket system, and provides it with a standard 9-pin 'short' RS-232C interface as used on many current PC's. At the same time it also allows the ATM25 to be switched between *transmit* and *receive* modes under software control, via either the RTS (pin 7) or DTR (pin 4) RS-232C control lines.

So the combination of the ATM25 and ATM31 boards makes a neat little 'radio data modem', for general use with RS-232C gear. And it's all very easy to put together and get going, as you'll see.

How it all works

At the heart of the ATM25 modem module is the Texas Instruments TCM3105 chip. This provides virtually all of the circuitry for a complete FSK data modem on a single silicon-gate CMOS chip, operating from a single +5V supply. The ATM25 schematic is shown in Fig.1.

Inside the TCM3105 is a programmable frequency synthesiser, capable of producing the correct audio tones for transmission according to either the CCITT V23 or Bell 202 (US) standards, from the on-chip crystal oscillator. A switched-capacitor low-pass filter limits the harmonics and switching noise content of the output, while an inbuilt analog low-pass filter removes harmonics due to the transmit filter clock. The only external components required for this section of the device are a common 'PAL colour' 4.433MHz crystal (X1) and a pair of capacitors (C1, C2). Digital data for transmission is fed to the chip via pin 14 (TXD), while the audio output tones appear at pin 11 (TXA).

As for transmission, the receive section of the TCM3105 has circuitry to receive and demodulate audio tones for a variety of baud rates corresponding to either the CCITT V23 or Bell 202 standards. The circuitry again uses both analog and switched-capacitor filtering, and contains a group-delay equaliser to correct phase distortion, AGC (automatic gain control) to compensate for signal level changes, carrier detect level adjustment and bias distortion adjustment, to give the lowest possible bit error rate.

The incoming received FSK audio enters the chip via pin 4 (RXA), with the demodulated data emerging at pin 8 (RXD). A 'carrier detect' output signal is also produced, emerging from pin 3 (CDT). The only external components needed are the R1/R2 divider, which sets the receive comparator bias level, and R3/R4 which sets the carrier detect comparator threshold.

Pins 5 (TRS), 13 (TXR1) and 12 (TXR2) control the mode in which the TCM3105 operates. In the ATM25 pin 5 is tied to +5V, while pins 12 and 13 are used to switch the device between its transmit and receive modes. This is achieved by pulling them high via R7, with diode D1 used to pull them low via the '76K' input (pin 16 of K2) when desired. The TCM3105 is in receive mode with pins 12 and 13 high, but switched to transmit mode when D1 pulls them low.

(Incidentally, using pins 12 and 13 in this way for transmit/receive switching is slightly unorthodox. Strictly speaking

Radio modem kit

the correct combination of logic levels on TRS, TXR1 and TXR2 for CCITT V23 reception is LHL, not HHH – which actually produces Bell 202 simplex reception mode. However as the frequencies used for Bell 202 'main channel' communication at 1200bps are 1200Hz (M) and 2200Hz (S), slightly *wider* than the 1300Hz (M) and 2100Hz (S) used for V23, this works out quite happily.)

For transmission, the sinewave tones from the TCM3105 are coupled via C3 to the attenuator consisting of either R6 or R5 (as selected by LK1) in series with 20k pot RV1, to give either 1V or 50mV maximum output as desired. The signals from RV1 are then buffered by op-amp U2:B (half an LM358), configured as a non-inverting amplifier. The output from U2 is then capacitively coupled out to the transmitter by C8.

During reception, the incoming two-tone sinewave audio from the radio receiver is applied to a compressor circuit configured around U2:A, to accommodate a wide range of possible signal amplitudes – and variations due to fading, etc.

C10 is a coupling capacitor, to isolate any DC potential which may exist on the incoming audio. The signal is then applied to the positive input of U2:A, which is configured as a peak detector with D6 and C12 producing a DC level which is equal to the peak value of the incoming audio. D2, D3 and their associated resistors provide a reference bias for U2:A, and also provide some pre-detection of negative signal peaks to ensure better operation.

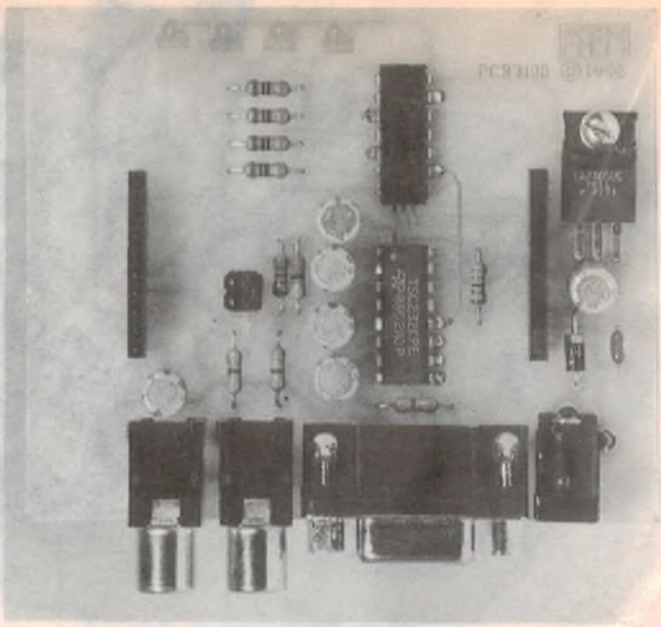
The resulting DC from the detector is then applied to R12, in series with D4 and D5. The diodes exhibit a resistance which is inversely proportional to the current passed through them via R12. The higher the audio voltage, the greater the current through the diodes and the lower their resistance. R13 forms a potential divider in series with this diode 'resistor', and the nett result is the higher the input signal, the higher the attenuation and the lower the proportion passed to the modem chip.

In practice, with an input varying from 20mV to 20V peak-to-peak, the output fed to the TCM3105 only varies from 20mV to about 80mV p-p. The compressed output is AC coupled to the RXA (Receive audio) input of the TCM3105 via C7.

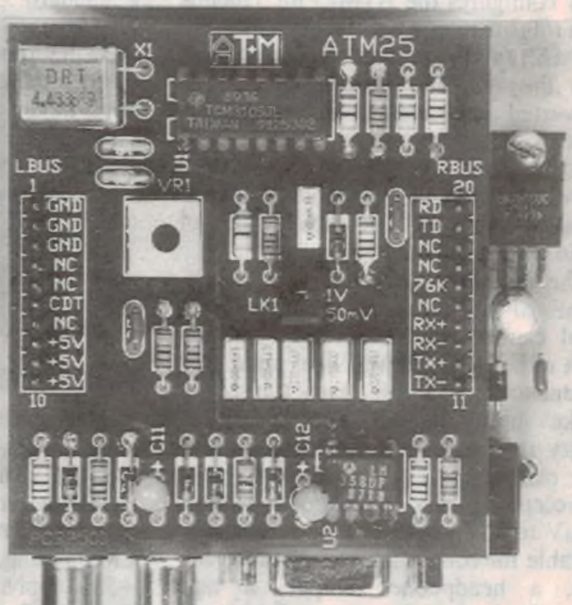
So much for the ATM25 module, which interfaces with the audio input and output of the radio transceiver and provides what is essentially a data comms interface with 'TTL' logic levels, at K2 bus pins 19 (Transmit data), 20 (Receive data), 16 (Transmit/Receive control) and K1 bus pin 6 (Carrier detect). Now for the new ATM31 module, which transforms this TTL interface into one suitable for connection to a normal RS-232C comms port.

The ATM31 schematic is shown in Fig.2. It's really quite straightforward, with U1 (a TSC232) providing virtually all of the TTL/RS-232 and vice-versa interfacing for the four data/control lines. The TSC232 provides two RS-232/TTL buffers, used here for Transmit data and Tx/Rx control; and two TTL/RS-232 buffers, used here for Receive data and Carrier detect signalling. It also includes internal circuitry to generate +10V and –10V supply lines from a single +5V supply, to produce RS-232C output signals with the correct bipolar characteristics. The +10V output from pin 2 is also used as a pullup source, for the RS-232C 'DSR' and 'CTS' lines (K2 pins 6, 8), via resistors R2 and R1.

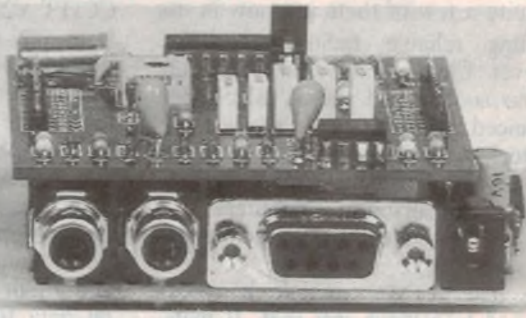
As noted earlier, provision is made for software control of transmit/receive switching, via either the 'DTR' or 'RTS'



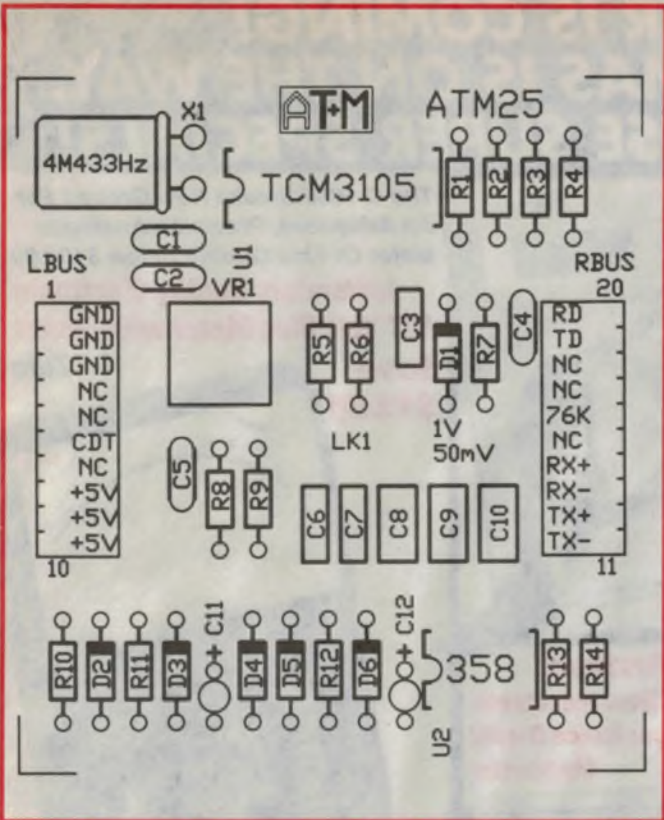
Top view of the ATM31 interface board, with the audio, RS-232 and power connectors along the bottom (rear) and the four indicator LEDs along the top (front).



Here's a similar view of the ATM25 board, again sitting atop the other module. Link LK1 and pot VR1 are used to set transmit audio level.



And finally, a rear view of the modem assembly.



Here's an overlay diagram for the ATM25 board, showing clearly where everything goes. The crystal is held in position with some double-sided tape.

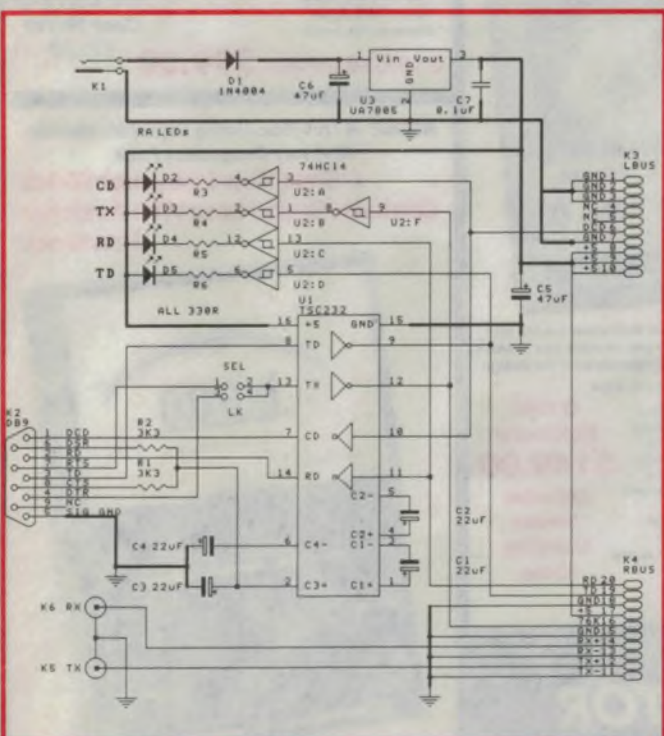


Fig.2: The circuit schematic for the ATM31 interface module. It's again very straightforward, taking advantage of the TSC232 chip.

lines (K2 pins 4, 7) as required to suit the host computer's comms software. This is achieved by linking either 1-2 or 3-4 on the header link block connected to pin 13 of the TSC232.

The other main chip on the ATM31 is U2, a 74HC14 hex Schmitt inverter, which is basically used as a set of buffers to drive four status LEDs. U2:A drives LED D2 for Carrier detect indication, U2:B drives D3 for Tx/Rx mode indication (with U2:F being used here to achieve the correct drive polarity), U2:C is used to drive D4 to allow monitoring of Receive data, and finally U2:D drive D5 for monitoring Transmit data.

The only other chip on the ATM13 is a 7805 regulator (U3), used to provide a stable +5V supply for both the ATM31 and ATM25 modules. U3 accepts unregulated input from any standard 'plug pack' DC supply, with an output of between about 9V and 14V. Series diode D1 is used to protect against accidental polarity reversals.

That's about it for the ATM31. As you can see the transmit and receive audio from the ATM25 are simply passed straight through, with the new module merely providing a pair of RCA connectors (K5, K6) which are connected to the TX and Rx lines from the ATM25 (K4 pins 12, 14).

Trying them out

AT&M sent us kits for two pairs of ATM25 and ATM31 modules, so that we could try them out.

Both the ATM25 and ATM31 modules went together quite easily, following the instructions which accompany the kits. AT&M's PC boards are nicely finished, with silk-screened overlays which indicate clearly where everything goes.

The only thing we had to watch was soldering the 'top' side of some of the component leads. Both boards are double-sided, but for economy are not provided with plated-through holes – so that certain leads must be soldered on both top and bottom, to perform through-board links. The need to do this is covered in AT&M's instructions, but you still have to be careful.

In the case of the ATM31 module all of the connectors fit on the PCB itself, with the RCA connectors, DB9 socket and DC input connector all along the rear. The two 10-way sockets into which the ATM25 module plugs are in the centre sides of the board, with the indicator LEDs along the front. This allows the two modules to mate together and form a neat and compact assembly – which also fits into one of AT&M's elegant little HWK/UB70 extruded aluminium packaging kits, if you wish.

Both module assemblies seemed to work nicely when we powered them up, and produced the expected 1300Hz or 2100Hz sinewaves for either 'mark' or 'space' respectively, in transmit mode.

We didn't have ready access to a pair of transceivers, so we did the next best thing; hooking the two modems together, via a pair of RCA-RCA cables. Each modem was connected to a PC, and both PC's were running compatible comms programs. In fact they were both running the Australian package *Supercom 2*, which we've found very reliable and easy to use.

Toggling each modem back and forth between receive and transmit mode was achieved from each PC's keyboard, using *Supercom's* 'CONnect to Line' and 'DISconnect Line' menu commands. These effectively toggle the DTR control line, on pin 4 of the serial port's DB-9 connector, so it was merely necessary to have each ATM31 link set to the 1-2 position, to achieve the right software control.

Using the 'X-modem' error-correcting protocol, we were able to transfer files of about 10k bytes very happily between

Continued on page 121

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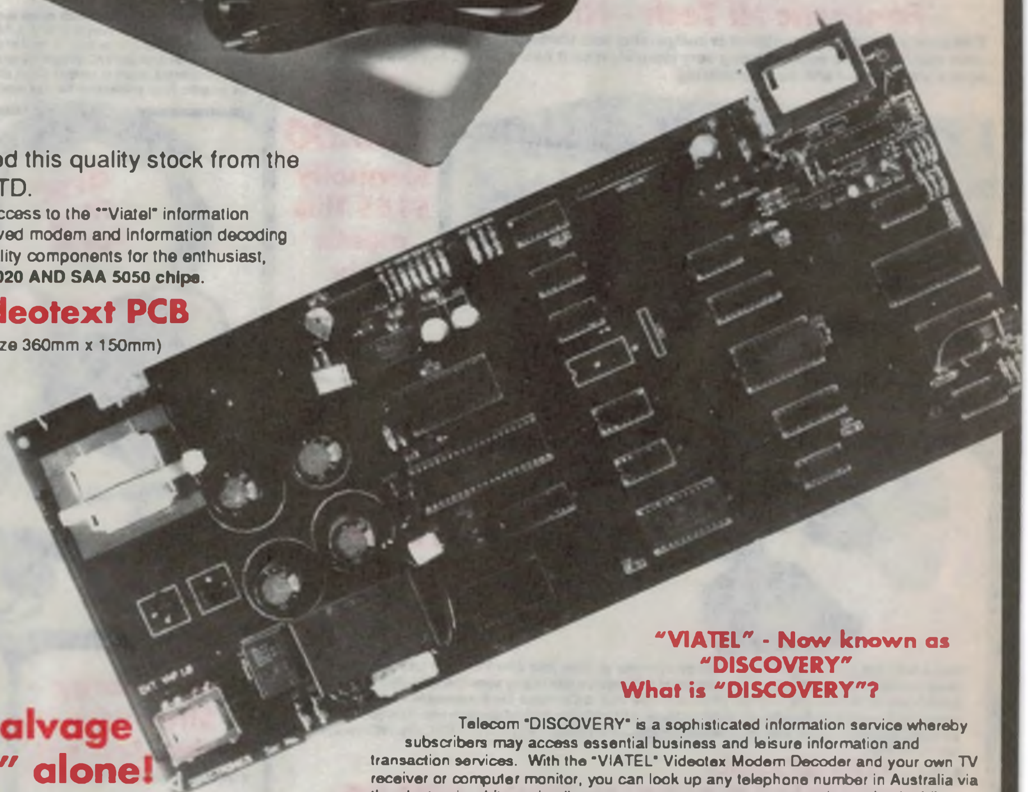

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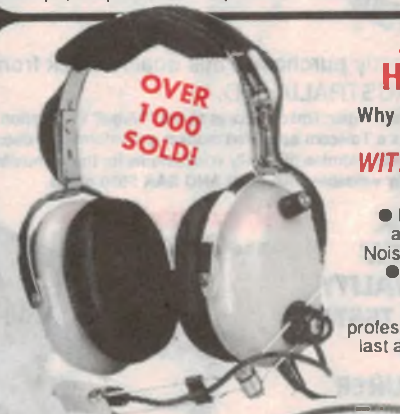

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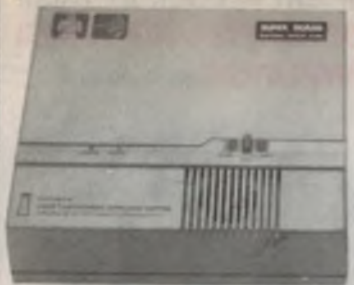

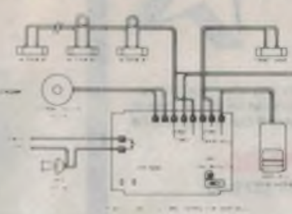

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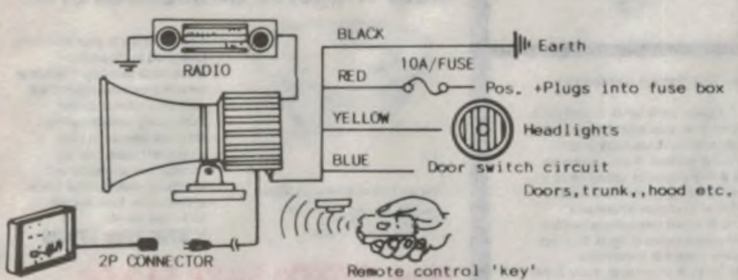

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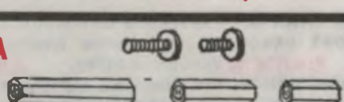

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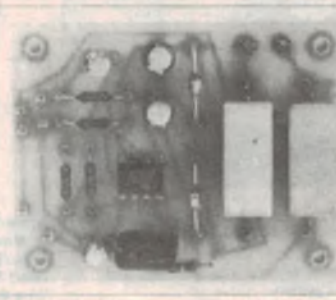

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NEW BOOKS AND LITERATURE

Spectrum info

FREQUENCY SPECTRUM REFERENCE, Volumes 1 and 2, by Rodney M. Letts. First edition, 1990, published by the author. Soft covers, 292 x 204mm, 356 and 350 pages respectively. Price for each volume $68.00 plus $4.00.

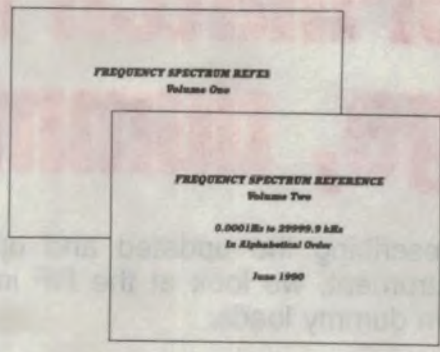
If you've ever tuned across some part of the electromagnetic spectrum with a communications receiver, or played around with a scanning receiver, you'll almost certainly have come across interesting but unknown signals that made you wish for a really comprehensive reference listing of frequencies. Well, you need wish no longer!

There have been other such references before, of course 2 the long-running *World Radio TV Handbook* is one – but by and large, they've been relatively limited in scope. The *WRTH* really only covers international shortwave and TV broadcasters, for example, while reference books for scanning receiver users generally deal only with the VHF and lower UHF bands.

These new volumes are the first of a much more thorough and comprehensive project, by Victorian enthusiast and radio amateur Rodney Letts VK3ZLW. The overall project is planned to span eight volumes in all, covering from DC right up to cosmic rays and including not only broadcasting stations and radio comms, but almost every significant natural and man-made source of electromagnetic radiation!

Judging from these first two volumes, which are large enough in themselves, the overall project is going to be both enormous and extremely valuable. After spending just an hour or two dipping into them, I'm filled with respect for Mr Letts' ambition, diligence and obvious capacity for hard work. Already Volumes 1 and 2 are an invaluable reference in themselves – in this case to the spectrum from DC to 29.9999MHz.

There are some 15,000 entries so far, listed in order of frequency in Volume 1, and in alphabetical order in Volume 2. About 70% of the entries are for Australia, with the rest consisting of essential, important or interesting signals from the rest of the world. The listing is

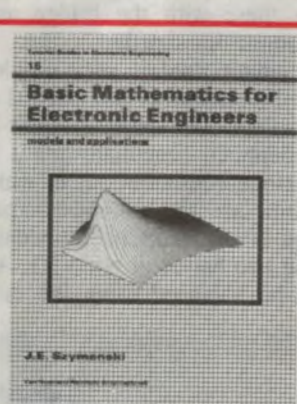


very comprehensive, with all kinds of radio communications services, beacons, fax, RTTY and so on.

It's particularly thorough down below 500kHz, too – an area often ignored or overlooked. There's even entries for common sources of interference, like harmonics from TV's and common computer video monitors (CGA, EGA, VGA and so on).

In short, these volumes are probably the most comprehensive reference yet produced to the spectrum below 30MHz. As such they should be incredibly valuable to anyone with an interest in what that part of the spectrum contains. Congratulations, Mr Letts – and when can we see further volumes in this splendid series?

Copies of the present two volumes are available only from Rodney Letts himself, at 446 Boronia Road, Wantirna South, 3152. The two are available separately, but payment by cheque or money order must accompany your order. (J.R.)



Maths for electronics

BASIC MATHEMATICS FOR ELECTRONIC ENGINEERS: Models and Applications, by J.E. Szymanski. Tutorial Guides in Electronic Engineering, No.16. Published by Van Nostrand Reinhold (International), 1989. Soft covers, 246 x 190mm, 193 pages. ISBN 0-278-00068-1.

Essentially a text for the early undergraduate student in electronics engineering, this one – a little too deep for the general reader. The author is a lecturer in the Department of Electronics at the University of York, in the UK, and his book is derived from a series of tuitional 'workshops' he gave to first-year students.

There is of course no shortage of texts covering the maths needed in electronics engineering. But as the author explains in his preface, his goal here has been avoid a shortcoming common to many existing books: the tendency to illustrate the mathematical methods in only an abstract sense, or within a very narrow range of standard applications. And his approach has been to present not only the necessary mathematical 'tools', but also a wide range of examples to show how they're used in real-world electronics.

There are 10 chapters in all, with the first five dealing with basic mathematical methods and models – and their applications – and the second five delving deeper into the maths 'tools' whose applications have already been discussed. The approach is clear and concise, with illustrative worked examples as well as marginal notes and comments to augment the text.

In short, it should be very handy and useful, both as a text for both students and as a 'brush up' reference for engineers. Electronics engineers, that is – despite the title (presumably an 'electronic engineer' would neither need, nor benefit from a lot of inked characters on paper).

The review copy came direct from the publisher, but in case of difficulty, the local distributor is Thomas Nelson Australia, of 480 La Trobe Street, Melbourne. (J.R.)

Construction Project:

VHF Powermatch Mk2: RF Z-bridge, dummy loads

In this third and final article describing the updated and upgraded version of our popular multi-purpose VHF-UHF test instrument, we look at the RF impedance bridge accessory and (finally!) a pair of low cost 50-ohm dummy loads.

by JIM ROWE

As hinted in the second of these articles, I have finally been able to produce an updated version of the Powermatch's RF impedance bridge 'attachment', with a performance that turns out to be very pleasing. In fact it seems to be capable of making quite reliable measurements even at 1296MHz, despite its simplicity and low cost.

I've also been able to come up with a pair of low power and fairly easy to build 50-ohm dummy loads, one designed around a BNC socket and the other around an N-series socket. The performance of these is not quite as pleasing, but they perform quite nicely up to 450MHz or so, and compare well against many of the commercial loads that will cost you considerably more.

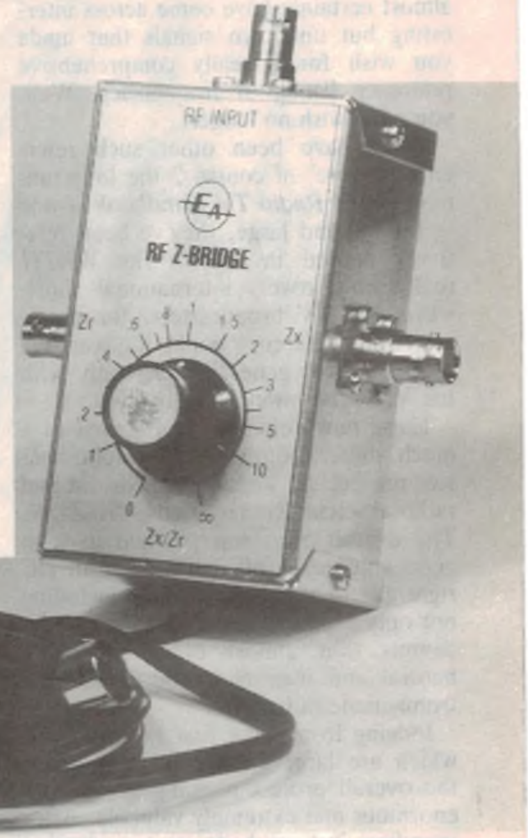
Having now had the chance to try them out and verify their behaviour, the details of these two remaining elements of the VHF Powermatch Mk2 'system' can now be given. But before doing so, I would again like to thank Dick Norman, VK2BDN for his kind help in checking their performance. Thanks, Dick!

Impedance bridge

The original bridge was described back in the June 1971 issue of *EA*, and used compact 'open air' point-to-point wiring. However a fair bit of care was taken to ensure that the construction was symmetrical, to assist in balancing stray capacitance and parasitic inductances. This paid off reasonably well, with the bridge performing fairly well up to and including the 432MHz band.

As part of the current re-vamp of the overall Powermatch project, it seemed a good idea to try upgrading the bridge as well. And in view of the success achieved using microstripline techniques with the SWR reflectometer, I decided to use these with the bridge as well. More about this shortly.

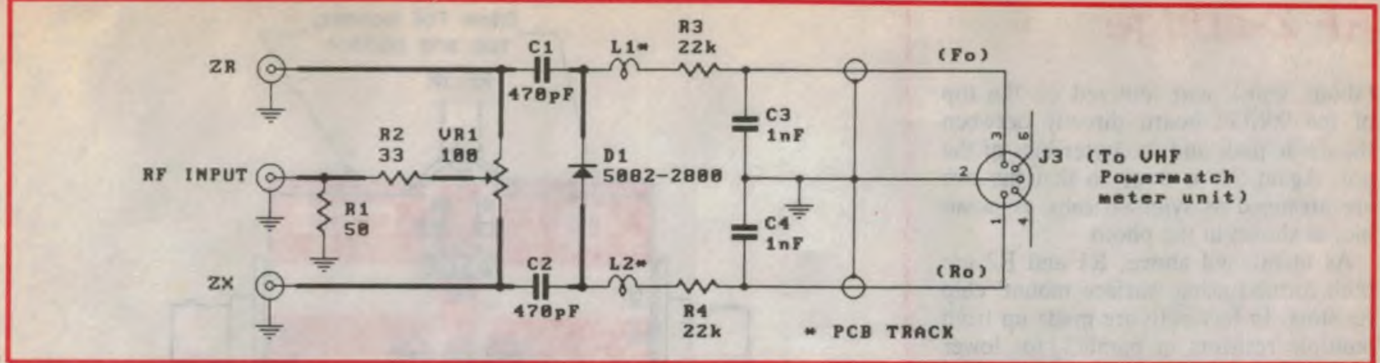
The circuit used is very simple, and those who remember the original design will see from the schematic that it's almost identical. Essentially it's a simple Wheatstone configuration, in which the four arms are the unknown impedance Zx, the known reference impedance Xr and the two halves of pot VR1. As such it will be balanced when the ratio between the two halves of VR1 is equal to Zx/Zr, allowing VR1 to be calibrated to directly indicate this ratio.



What makes the bridge a little unusual in appearance, compared with a DC bridge, is that here it is arranged so that the unknown impedance Zx, known impedance Zr and the bridge's RF source can all have one side grounded. This allows them all to be connected to the bridge via co-ax connectors and cable – essential if the bridge is to be useful at VHF and UHF.

If you like, the moving wiper of VR1 is the 'top' of the bridge, with the earthy side of Zx and Zr forming the 'bottom'. The RF input is applied to the 'top' via protective series resistor R2, with R1 purely a terminating resistor for the RF generator (usually a low power unmodulated transmitter).

With this bridge configuration, the null detector must be connected between the centre junctions of the two 'sides', so it must be *floating* – i.e., neither side can be earthed. This is



The schmetic for the bridge. It's essentially a simple wheatstone configuration, arranged so that the two 'upper' arms are formed by VR1 while Z_R and Z_X form the 'lower' arms. This allows both of these impedances to have one side earthed, as well as the RF source.

achieved as shown, with Schottky diode D1 forming the detector in conjunction with capacitors C1 and C2. Resistors R3 and R4 couple the detector's DC output to the Powermatch metering unit, with C3 and C4 filtering out any RF component.

Although the detector is basically just a half-wave rectifier, as you can see it is deliberately designed to present a balanced loading to the RF circuitry of the bridge. This is the reason for the twin coupling capacitors C1-C2, and for the twin output resistors R3-R4. It's also the reason for using small decoupling inductors L1 and L2, which are carefully matched 20mm-long sections of thin PCB track.

In fact the whole aim, as before, has been to keep the active arms of the bridge as short as possible, and the bridge itself as symmetrical as possible. To see how *this* has been achieved, we need to refer to the PCB layout and photographs.

As with the SWR reflectometer, the bridge is based on a pair of small PC boards. In this case they measure 51 x 40mm, and as before they're designed to go together with copper sides outermost, to form what is effectively a single board 3mm thick. This allows the 'active' track for 50-ohm microstripline to be relatively wide (5mm), and consequently less sensitive to manufacturing tolerances.

The board with pattern coded 90rfb9t is the 'upper' one of the pair, with the active microstripline conductors, while that coded 90rfb9b is the 'lower' one and provides the groundplane copper. The pair are held together in this case by straps of 0.1mm copper foil, which also bond earthy areas on the upper board to the groundplane copper on the lower board.

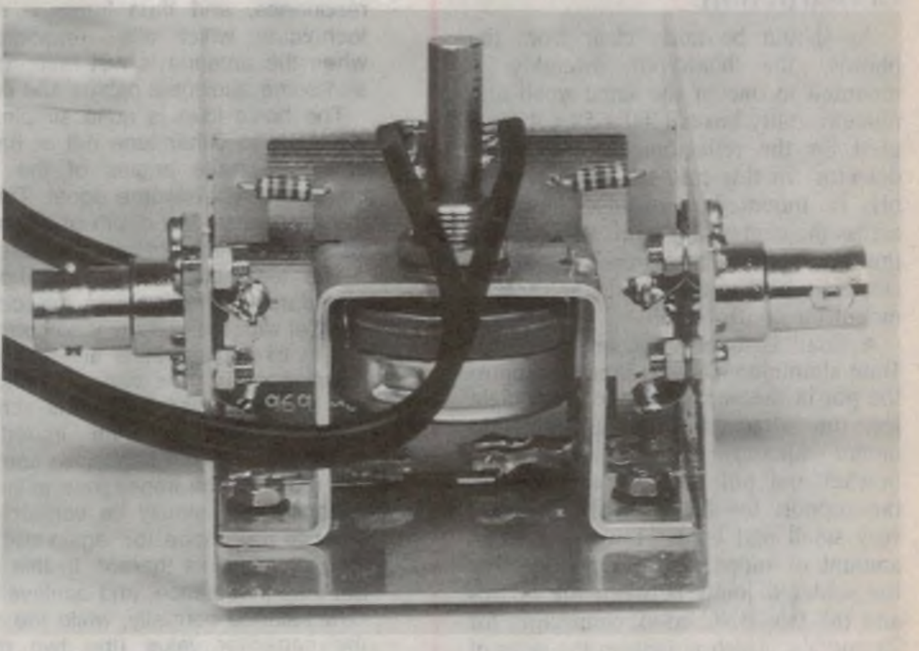
Since pot VR1 forms such an integral part of the active section of the bridge, it is mounted hard up against the board assembly, with its three lugs passing through 3mm clearance holes in both boards so that they can be bent over and soldered directly to the ends of the three microstriplines. This means that the pot's control shaft axis is parallel to the boards, as you can see from the photos.

Incidentally, it should be stressed that if the bridge is to operate correctly at UHF, VR1 *must* be of the non-inductive carbon track type. It must also be linear, if you want to use the calibrations of the front panel artwork shown. These were made using a high quality moulded-track 'Ohmite' pot (type CU1011-100R), kindly supplied by Crusader Electronic Components of 81 Princes Highway, St Peters NSW. Crusader also provided the Beyschlag chip resistors used for R1 and R2, and can supply all of these components in small quantities to normal retailers.

All of the remaining smaller components fit on the PCB assembly in fairly conventional fashion, as shown, although there are a few points that should be noted.

Diode D1 is suspended in a 4mm diameter hole cut in the 90rfb9t board, between the two connection pads, so that its leads can be kept to the absolute minimum. In fact since its body is just on 4mm long, the solder joints virtually touch the body and leave no excess length, for mimumum inductance. Needless to say this dictates considerable speed and care when soldering, to avoid damaging the diode.

Capacitors C1 and C2 are both compact ceramic 'bead' types, with their leads again cut to minimum length



A look inside the bridge case, slightly larger than actual size, to show how the pot is supported by a small U-shaped bracket.

RF Z-bridge

(about 3mm), and soldered on the top of the 90rfb9t board directly between the diode pads and the outer lugs of the pot. Again this is done so that the two are arranged as symmetrically as possible, as shown in the photo.

As mentioned above, R1 and R2 are both formed using 'surface mount' chip resistors. In fact both are made up from multiple resistors in parallel, for lower inductance and higher dissipation capability. For ease of supply, they both use 100-ohm resistors as used in the SWR reflectometer – with R1 formed from two, and R2 from three. The Beyschlag type number is MMA 0204-50-1%-100R.

As shown in the photo and layout diagram, the three resistors forming R2 are mounted alongside each other across a gap in the microstrip line feeding the centre lug of the pot, while the two forming R1 are mounting 'in line' with one on each side of the line, bridging across to the adjacent earth copper areas.

Resistors R3 and R4 are conventional 1/4W leaded components, which mount at the rear of the PCB assembly with their leads passing through holes in both boards, in the usual way. However output bypassing capacitors C3 and C4 are both small disc ceramics, which mount like C1 and C2 on the surface of the upper board.

Construction

As should be fairly clear from the photos, the board/pot assembly is mounted in one of the same small aluminium utility boxes (100 x 58 x 45mm) used for the reflectometer and power detector. In this case the board assembly is mounted vertically, however, across the centre of the box. This allows the pot spindle to extend through a clearance hole in the top of the case, to mount the control knob.

A small U-shaped bracket bent from 1mm aluminium sheet is used to support the pot in the box, at the correct height for the attached PCB assembly to mount squarely and vertically. The bracket and pot thus provide most of the support for the boards, which are very small and light. However a small amount of support is also provided by the soldered joints between the boards and the two BNC co-ax connectors for Zr and Zx, which mount on the sides of the box immediately at the ends of the two microstrip lines extending to the sides of the boards. Again this should be fairly clear from the photos and the overlay of Fig.1.

Note that as with the SWR reflectometer and power detector, the 'earthy' connections between the board groundplane and the co-ax connectors are made via solder lugs – two for each socket. These are clamped under the mounting screws on the 'pot side' of each socket, after the PCB assembly is in place, and then bent and soldered to the ground plane copper of the 90rfb9b board.

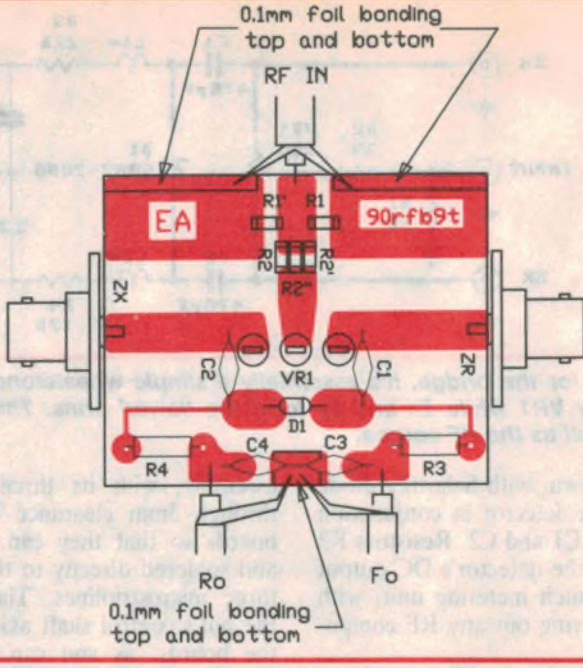


Fig.1: The overlay diagram for the bridge. Use this with the photo opposite to guide you in wiring it all up (but note: this is inverted).

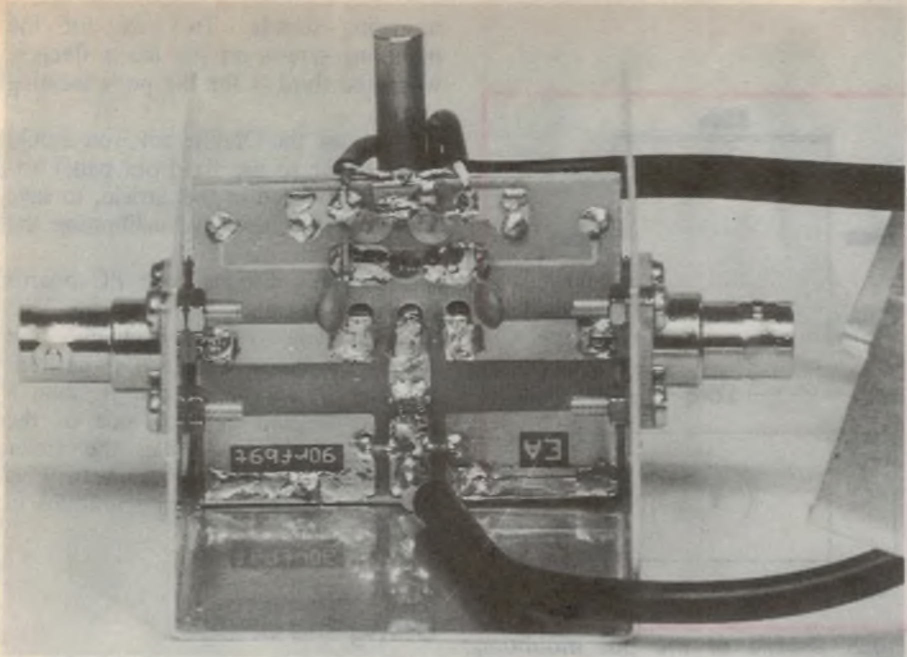
What if the antenna isn't at resonance?

A simple RF bridge like that described in this article can, in itself, only measure the resistive component of antenna impedance. As a result, accurate measurements can normally only be made when the antenna is at resonance, and thus forms a resistive load. However there are simple techniques which allow reasonably accurate measurements to be made when the antenna is **not** resonant, by using a calibrated variable capacitor and some additional cables and connectors.

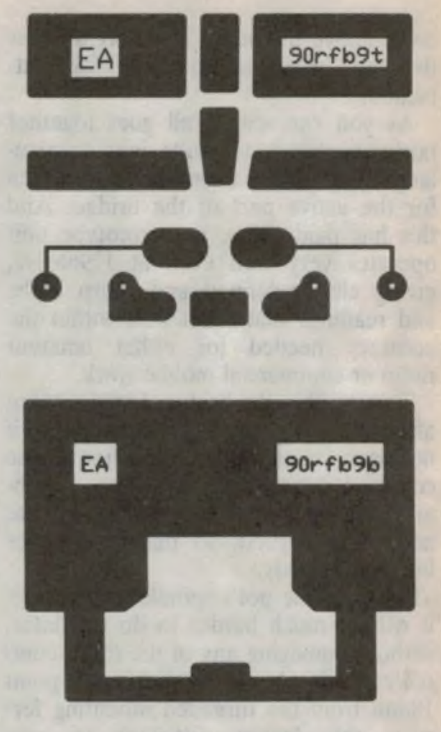
The basic idea is quite simple. All that is involved is using the variable capacitor to either tune out or balance against the antenna's reactance, so that the phase angles of the known impedance Zr and the unknown impedance Zx become equal. This allows normal bridge balancing, restores the sharpness and depth of the null and also gives a good indication of the value and polarity of antenna reactance.

The techniques used are shown in the diagrams. When the antenna impedance is *capacitive*, the calibrated capacitor is simply connected in parallel with the dummy load connected to the bridge's Zr input (a) – using a length of cable that is an electrical half-wave long, to prevent impedance transformation. The capacitor and bridge pot are both simply adjusted until the deepest, sharpest null is achieved; the bridge then reads the resistive component of antenna impedance, as before, while the capacitor corresponds to the capacitive component.

If the antenna impedance is *inductive*, two approaches are possible. The capacitor can simply be connected in parallel with the antenna, to the Zx input of the bridge (b), again using cables which are an electrical half-wave long or multiples thereof. In this case the capacitor is used to tune out the antenna inductance, and achieve a resistive load in this way. The bridge will now balance normally, while the antenna inductance can be calculated from the capacitor value (the two must obviously have equal and opposite reactances at the frequency concerned, if you've tuned for the sharpest null).



Another inside view, this time showing the 'top' side of the board assembly. All components except R3 and R4 mount on this side.



Here are the etching patterns for the two PC boards used in the bridge, reproduced actual size. They're held together by the copper foil and also the pot lugs.

As the connection for the RF energy input is not strictly part of the bridge proper, it is taken to the lower end of the central microstripline via a short length of co-axial cable. The BNC socket for this input is mounted on the end of the box that is remote from the pot, while the DC output cable to the Powermatch metering unit leaves via a grommetted hole in the opposite end. The connections for the DC output cable are made to the appropriate pads at the 'top' of the 90rfb9t board when it is mounted in the box; there is just

The second approach is as shown in (c). Here the capacitor is connected back across the dummy load on the Zr side of the bridge, but in this case via a length of cable that is an electrical *quarter-wave* long. This causes the capacitor's reactance to be transformed into a 'complementary' inductive reactance, with a value given by:

$$X_L = Z_o^2/X_C$$

where X_L is the transformed inductive reactance, Z_o is the characteristic impedance of the cable (usually 50 ohms) and X_C is the reactance of the variable capacitor at the frequency concerned. All are assumed to be in ohms.

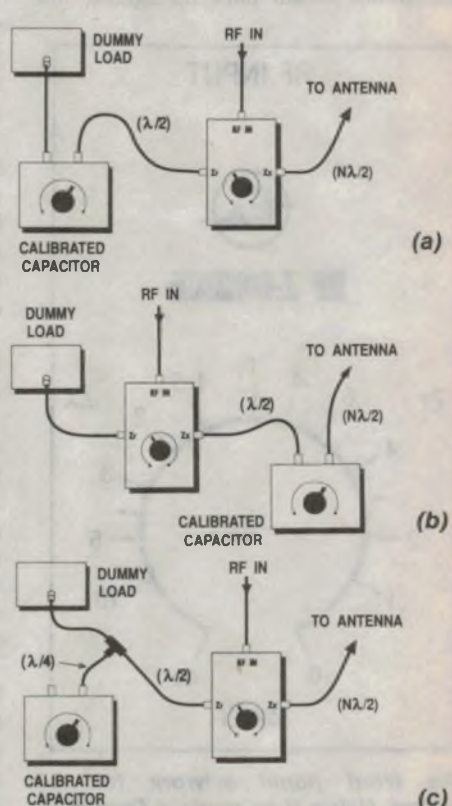
The procedure here is still the same as before: the capacitor and bridge pot are adjusted to produce the deepest, sharpest null. The bridge pot then indicates antenna resistance, while the antenna inductance can be calculated using the equation above.

How do you know whether your antenna is capacitive or inductive? Initially you don't, of course. In practice you have to determine this by trial and error, trying one measurement configuration and then the other until you find the one that can produce a well defined, deep and sharp null. It sounds tedious, but it's quite practical.

The necessary calibrated variable capacitor is made by mounting a suitable component in a small metal case, with its stator plates connected via a metal plate or strap (for minimum inductance) to the inner active electrode of a pair of co-ax sockets. The capacitor's spindle is then fitted with a suitable knob, and simple dial to allow calibration.

For VHF and UHF work the capacitor need only have a maximum value of around 50pF or so; you can calibrate it using a conventional R-C bridge, or a digital capacitance meter.

The bridge itself can be used to cut cables to the correct electrical lengths needed for these techniques. This is explained in the main article.



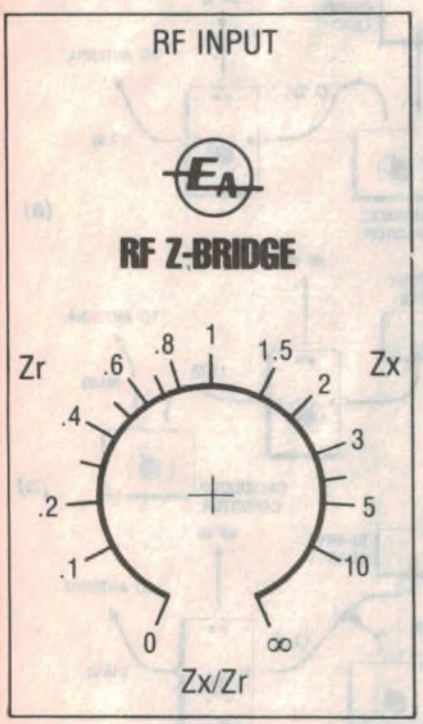
room above the board assembly to clear the leads, when the lid of the box is attached.

As you can see, it all goes together fairly neatly, and results in a particularly compact and balanced construction for the active part of the bridge. And this has paid off – the prototype unit operates very well even at 1296MHz, giving clearly-defined and sharp nulls, and readings that seem well within the accuracy needed for either amateur radio or commercial mobile work.

To assemble the bridge, I suggest that after checking the PC boards (and if necessary, drilling them) you first fit the copper foil straps to bond them together. Make sure that the two boards are accurately aligned, so that their holes line up correctly.

Now cut the pot's spindle to length – it will be much harder to do this later, without damaging any of the other components. It should be cut at a point 18mm from the threaded mounting ferrule; this leaves sufficient to pass through the front panel, and mount the control knob.

Then mount the pot to the PCB assembly. You may need to trim a little off the sides of its outer lugs, so that they pass through the PCB holes. The pot should mount hard up against the



The front panel artwork for the bridge. Using it to make a Dynamark label will give a professional look.

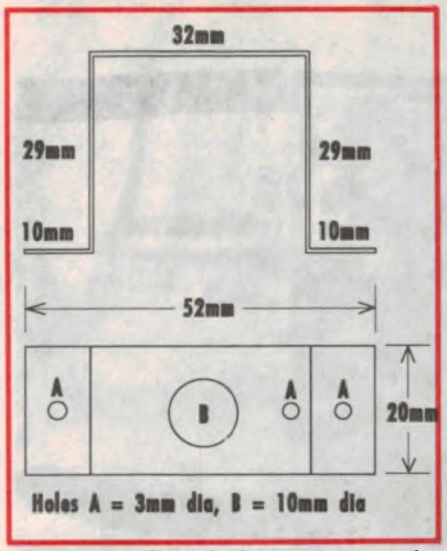


Fig.2: Details of the pot mounting bracket, which is bent up from 1mm-thick aluminium plate.

lower board, for minimum lug length, and as squarely as possible in both axes. This is a little tricky, but persevere until you get it right – to a large extent, the performance of the bridge depends upon it. Only solder the bent-over lugs to the ends of the microstripline conductors when you're satisfied that everything is squared up.

With this done you can fit the Schottky diode D1, trimming each of its leads to about 3mm long and soldering them to the (pre-tinned) pads as quickly and as carefully as possible.

My suggestion again is that you now fit the five chip resistors. This is also fairly tricky, but by no means impossible. I used tiny strips of masking tape (cut to about 1.5mm wide) as 'clamps' to hold each resistor in place while I quickly soldered the ends to the copper – which was again pre-tinned. The masking tape can then be removed and discarded.

This done, you can fit resistors R3 and R4, and solder in both these and the capacitors C1-C4. Your basic board and pot assembly will then be complete, and ready to mount into the case – after preparing it, of course. This involves drilling the appropriate holes, and also making up the small pot mounting bracket.

The dimensions of the pot mounting bracket are shown in the diagram of Fig.2. It's bent from a strip of 1mm aluminium sheet, measuring 20mm wide by approximately 113mm long, and has three 3mm-diameter holes in addition to the main 9.5mm holes for the pot's mounting ferrule. Two are for the mounting screws on the lower flanges, while the third is for the pot's locating spigot.

If you use the Ohmite pot, you should also be able to use the front panel artwork reproduced in this article, to save you from the hassle of calibrating the bridge.

Incidentally although the PC boards have been designed to mate with BNC sockets, you could probably use N-series connectors instead if desired. All that should be needed is filing a small depression at each side of the PCB assembly, to clear the inner 'mound' of the N-series sockets. Plus making different hole configurations in the box, of course...

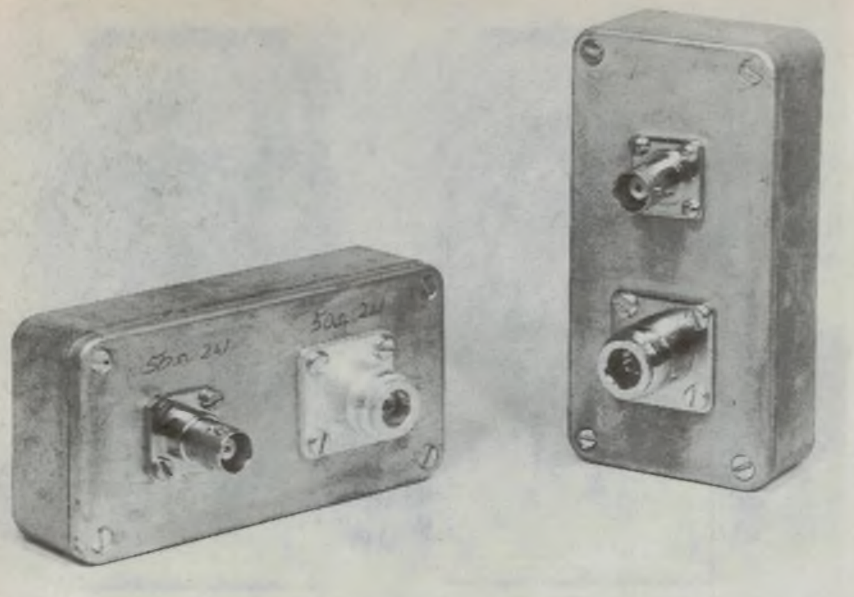
Using the bridge

The setup for using the bridge to measure the resistive component of an antenna's impedance is basically the same as for any RF bridge. The detector output cable is connected to the Powermatch's metering circuit (K3), the Zr socket is connected to a 50-ohm dummy load, the RF input socket to a signal generator or low-power transmitter, and the Zx socket to the antenna to be measured – via a 50-ohm cable whose length should be either a half wavelength, or a relatively small multiple of this (allowing for the cable's velocity factor).

The reason for specifying the length of cable between the bridge and the antenna is that only a half wavelength will reflect a reasonably accurate version of the antenna's impedance at the bridge end, assuming that it isn't 50 ohms to begin with. Only if the antenna is 50 ohms and resistive (i.e., both resonant and matched), will the cable length be non-critical. So for the general case, the cable length should be an integral number of electrical half-wavelengths at the frequency concerned.

Ideally it should also be a relatively *short* number of half wavelengths as well – particularly at UHF – to minimise the effects of cable losses. These tend to make the impedance reflected at the bridge end of the cable move towards 50 ohms, falsifying the measurements. In fact if the cable is long enough, its losses will make the impedance reflected at the bridge end look very close to 50 ohms and resistive, even if the antenna isn't connected to the other end!

The source of RF power used to drive the bridge should have an output of be-



The two prototype dual dummy loads, one using regular chip resistors and the other the 'HF' type. Why dual loads? The text explains...

tween 500mW and 1W, to avoid damaging the terminating resistors and pot, and prevent overloading the Powermatch metering circuit. You may need to make a temporary modification to the transmitter, or use a suitable attenuator pad, to achieve this low output. Of course the transmitter's frequency should be set to correspond to that for which the antenna concerned has been designed. It should also be unmodulated, if possible.

The actual measurement procedure is quite straightforward. The function switch of the Powermatch should be set to the 'DIF' position, and the sensitivity pot set initially to a fairly low level – say '9 o'clock' – to prevent overload. The Powermatch can then be turned on, and the RF generator/transmitter turned on as well.

At first the meter will probably show a significant reading, as the bridge is unlikely to be balanced. The sensitivity pot can be adjusted to make the reading a fair proportion of FSD, after which the bridge's balance pot VR1 can be turned, in order to find the balance point. This will be indicated by a minimum, or 'null' in the meter reading.

You may well need to turn up the meter sensitivity as the null is approached, to ensure that you find the exact pot setting for minimum reading. When this point is reached, the setting for the bridge pot indicates the ratio between the antenna's resistive component and the dummy load resistance. I.e., a ratio of 1.5 would indicate an antenna impedance of 75 ohms (1.5 x 50), while a ratio of 0.7 would indicate an impedance of 35 ohms (0.7 x 50), and so on.

Note that the ratio between the two halves of VR1 can in theory vary between zero and infinity, because either side can be turned down to zero. However in practice reasonable accuracy can only be achieved over the range from 0.1Zr to 10Zr, probably due to parasitic L and C inside the pot. Accordingly the pot scale has only been calibrated over this range – which is still very useful, extending from 5 to 500 ohms.

The bridge can be used in this way to make quite accurate measurements of antenna impedance, on bands up to and including the 1296MHz or '23cm' amateur band. However this assumes that the antenna impedance is basically *resistive*; i.e., that the antenna concerned is close to resonance at the frequency concerned. If it is well away from resonance, so that its impedance has a significant reactive component, the balance 'null' of the bridge will become rather shallow and ill-defined, making measurements somewhat more difficult – as well as less accurate. This is the case with any simple AC bridge.

Happily there are ways of getting around this problem, although they call for additional components and rather more patience. See the details, in the box marked 'What if the antenna isn't at resonance?' These techniques are rather tricky when you get to the higher UHF bands, but they're still practical.

Note that the bridge itself may be used to cut cables accurately to the electrical half-wave and quarter-wave lengths needed for the reactive measurement techniques – or for any other similar purpose, such as making baluns, matching stubs, phase shifters and cable transformers.

This is done as shown in Fig.3, taking advantage of the fact that an open-circuited half-wave line reflects an effectively infinite resistance at its 'other end', while an open-circuited quarter-wave line similarly reflects a resistance of zero. By setting the bridge pot to the centre 'unity' position (1.0), and balancing the cables concerned against either an open-circuit or a short-circuit respectively, they can be trimmed quite accurately until a null is reached.

The 'open circuit' used as a reference for the half-wave length is achieved merely by plugging nothing into the bridge's Zr socket. Similarly the 'short circuit' for reference against a quarter-wave length is produced by using a special BNC plug, fitted internally with the shortest possible 'inner wire' and a low-inductance shorting disc.

Note that when you're using this technique, one end of the cable being cut to length must be fitted with a BNC plug so that it can be plugged into the Zx socket. Note too that as well as achiev-

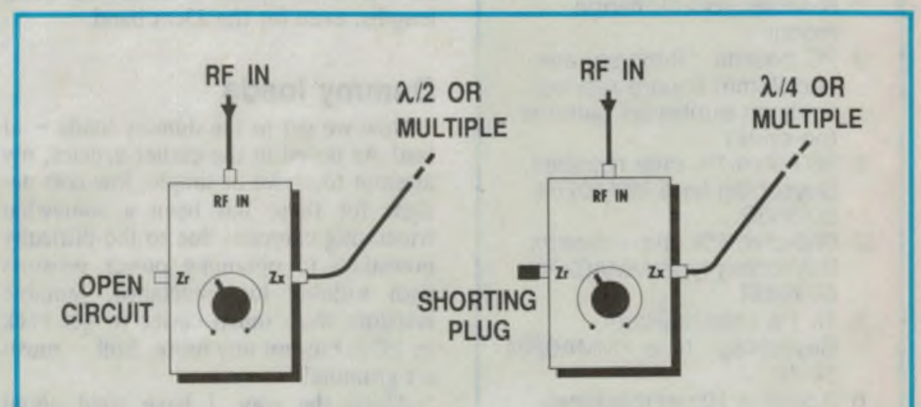


Fig.3: How to use the bridge to cut co-ax cable to an electrical half- or quarter-wave length - or multiples of either.

ing a null with a single half-wave length of cable, you can also achieve one with multiples thereof – and similarly for odd multiples in the case of a quarter-wave length. So it's best to start with a cable length just a little longer than the length you want (say the nominal length, ignoring velocity factor), and then trim it down.

The trick is also to trim down the length in very small decrements, particularly when you're obviously getting close to the null. It's easy to cut bits off, but extremely hard to stick them back on again if you discover you've gone past the right point!

By the way, it's also important to make clean cuts to the free end of the cable, so that after each cut the end is left as an open-circuit. Use a sharp hobby knife blade or single-sided 'Gem' razor blade, checking visually after each cut to make sure that a strand from the braid isn't shorting to the centre conductor.

If you follow this approach, you should be able to use the Z-bridge to cut cable to quite accurate electrical lengths, even for the 23cm band.

PARTS LIST

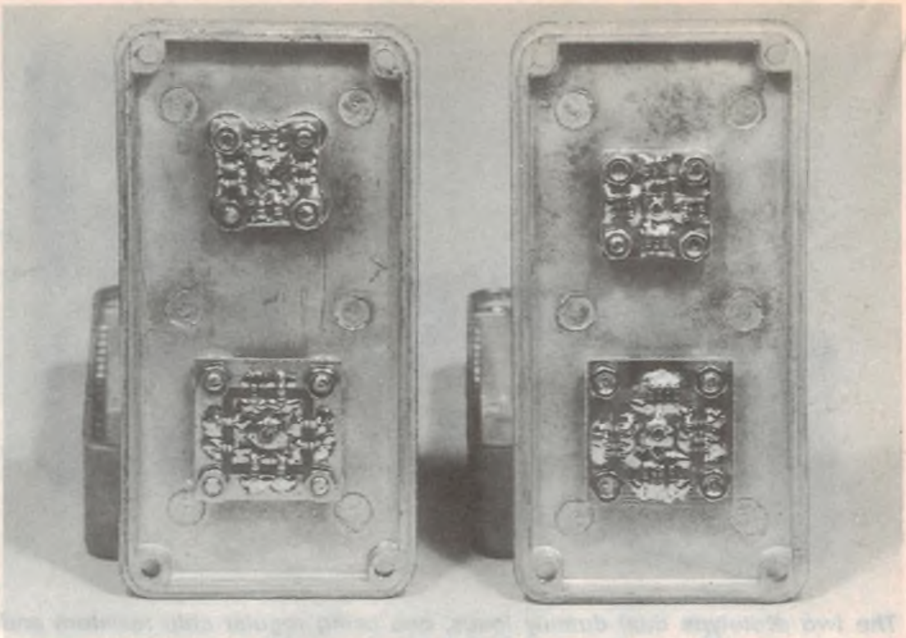
VHF Z-Bridge

- 1 Pair PC boards, 51 x 40mm, coded 90rfb9t and 90rfb9b
- 1 Aluminium utility box, 100 x 58 x 45mm
- 3 BNC sockets, flange mount
- 1 5-pin DIN plug, cable type
- 1 100-ohm linear pot, moulded carbon, Ohmite type CU1011-100R (see text)
- 5 100-ohm 1% chip resistors, Beyschlag type MMA0204-50-100R (see text)
- 1 5082-2800 Schottky diode
- 2 22k 1/4W 1% carbon resistors
- 2 470pF ceramic capacitors
- 2 1nF ceramic capacitors
- 1 Small control knob

2m length of twin shielded audio cable; 6mm rubber grommet; small piece of 0.1mm copper foil; 12 x 2.5mm x 6mm machine screws and nuts; 2 x 3mm x 8mm machine screws, star washers and nuts; 4 x 2.5mm solder lugs; 113 x 20mm strip of 1mm aluminium strip to make pot mounting bracket.

Dummy loads (pair)

- 1 Small metal utility box (see text)
- 1 BNC socket, flange mount
- 1 N-series socket, flange mount
- 2 PC boards, 18mm square and 25mm square respectively, to published patterns (no code)
- 8 560-ohm 1% chip resistors, Beyschlag type MMA0204-50-560R
- 12 680-ohm 1% chip resistors, Beyschlag type MMA0204-50-680R
- 8 1k 1% chip resistors, Beyschlag type MMA0204-50-1k
- 8 2.5mm x 10mm machine screws, with nuts and flat washers



Inside the two prototype load boxes. The loads on the left use the 'HF' chip resistors, while those on the right use the normal type.

Dummy loads

Now we get to the dummy loads – at last! As noted in the earlier articles, my attempt to arrive at simple, low cost designs for these has been a somewhat frustrating exercise, due to the difficulty nowadays in obtaining power resistors with suitably low reactance. Suitable resistors were much easier to get back in 1971, but not any more. Still – mustn't grumble!

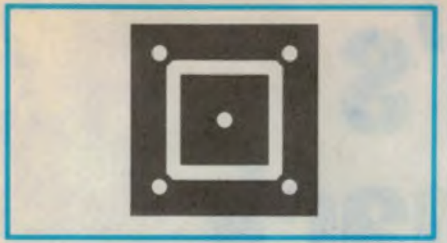
Along the way, I have tried about seven different approaches, using a variety of resistor types and physical configurations. These all gave rather mediocre results, with SWR rising in many cases quite significantly above 150MHz – and in some cases, even lower.

The best results to date have been achieved with the loads shown, which use multiple chip resistors mounted on small 'postage stamp' PC boards, immediately behind the co-axial sockets. One load is designed around a BNC socket, and the other around an N-series socket.

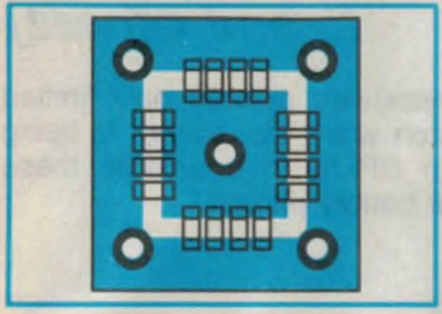
Actually I've built up two different versions of these loads, as you can see from the photos, with virtually identical physical arrangements. This was to try out two different versions of the chip resistors – one the 'normal' type, with an internal element that is laser trimmed to value in the usual spiral fashion (which you'd expect to result in higher inductance), and the other a special 'HF' type which is trimmed in a special way to avoid increasing the inductance.

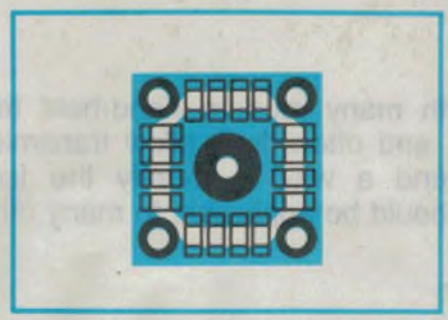
The chip resistors used in both versions were again from the 'Beyschlag' range, and Beyschlag's Australian distributor Crusader Electronic Components very kindly supplied samples of both kinds of resistor, to allow me to compare the results.

To be honest, the performance of the versions using the 'HF' resistors was very little better than those using the standard type, giving an SWR at 1296MHz of 2.7 (N) and 3.0 (BNC) respectively, compared with 4.4 (N) and 3.6 (BNC) for the 'standard' type. At 432MHz, the differences were almost negligible: the 'HF' versions gave fig-



Here are the actual-size etching patterns for the two versions of the dummy loads – for the N-series socket (left) and the BNC socket (right). They're too small for coding!





And here are the wiring overlays for them, just for guidance. Note they're both shown here as if they used 16 chip resistors.

ures of 1.25 (N) and 1.85 (BNC), while the 'standard' versions gave 1.28 and 1.20 respectively. (These figures can't be compared directly, though, because different numbers of chip resistors had to be used.)

My suggestion is therefore to go for the 'standard' resistors, as their performance is almost as good even at 1296MHz. Even an SWR of 4.4 is still useful as a 'rough' dummy load on the 23cm band, as it corresponds to only 40% of the incident power reflected. Down at 432MHz the figures are much better, of course, with an SWR of 1.28 corresponding to only 1.6% of incident power reflected. At 144MHz and lower frequencies the performance is virtually perfect.

A further advantage of the 'standard' chip resistors is that they're available in a full range of values, whereas the 'HF' type is only available in values up to 490 ohms. Since we're achieving the final figure of 50 ohms by effectively connecting the chips in parallel, this limits the number of 'HF' chips we can use – and hence the power rating of the final loads, as the individual chips are only rated for 0.25W continuous dissipation, or 1W for short periods.

The maximum rating I could achieve with the 'HF' chips thus turned out to be 2W continuous/8W intermittent, using eight chips (6 x 390 ohms, 2 x 430 ohms). However with the higher chip resistances available for the 'standard' chips, I could use 16 chips with the N-series socket and 12 with the BNC socket, giving power ratings of 4W/16W and 3W/12W respectively. Not a dramatic increase, to be sure, but worthwhile nonetheless – especially as the 'standard' chips are actually cheaper.

The actual values used for the N-series version are 8 x 1k and 8 x 680 ohms, all in parallel. This gives a nominal value of 50.59 ohms, and hence a nominal SWR of 1.01. The 16 chips are arranged in four groups of four, around the board and socket as shown in the overlay and the photo. I used two of each value in each group of four, to ensure current symmetry, but this may not be important.

For the BNC version, where only three chip resistors can be fitted around each of the four sides of the board, I used 8 x 560 ohms and 4 x 680 ohms, all in parallel as before. This gives a nominal value of 49.58 ohms, and a nominal SWR of slightly lower than 1.01. Again I interleaved the two values for symmetry, with 2 x 560 ohms and 1 x 680 ohms in each group.

The Beyschlag part numbers for the three values of chip resistors again all have the prefix MMA 0204-50-1%, with end codes of 1k, 680R or 560R for the three values. As before they're all available on order from Crusader Electronic Components.

The patterns for the two dummy load PC board are reproduced in this article, to allow you to copy them if desired. They carry no coding – there really isn't room for any. That for the N-series version measures only 25mm square, while that for the BNC version is even smaller: only 18mm square. They're both normal single-sided boards.

As you can hopefully see from the overlay diagram and internal photo, each board is mounted immediately behind its socket, using the same mounting screws and nuts. One or more small flat washers are used on each screw, under the PCB, to pack it out just sufficiently to clear the rear protrusion of the socket. This allows the centre spigot of each socket to extend through the PCB for soldering to the centre copper area, but with a minimum of excess (which would provide inductance). The earth return from the PCB outer copper area to the connector is made via the four screws and nuts – not an ideal system, but it seems to work reasonably well.

In each case the chip resistors are soldered across the gaps between the centre and outer copper areas, as symmetrically as possible. As before I pretinned the copper where all resistors were to go, and then used small strips of masking tape to hold them in place, while soldering. That's all the construction involved.

The loads built up using the 'HF' type chip resistors were made in exactly the same way. The only difference was that in this case, both versions used only eight resistors (6 x 390 ohms and 2 x 430 ohms).

Needless to say, a dummy load should be housed in a closed metal box, to prevent the escape of any RF energy. I housed each pair of the loads in one of the smallest diecast aluminium boxes currently available, measuring 100 x 52 x 25mm.

Why build a pair of loads in the one box? Mainly because even though this seems to be the smallest metal case currently available, it's still miles too large for a single load. It therefore seems less wasteful to use it for housing two, and this being the case the logical approach is to make one an N-series version, and the other a BNC version. Seemed a good idea at the time, anyway!

Needless to say if you have access to rather smaller boxes, or choose to make some yourself, you'd probably decide to build each load into its own box. This would be a bit more flexible.

That brings to a close the description of our new Powermatch mark 2 system. I hope you find it as useful as the original version seemed to be. Although not a particularly complex project, it's certainly presented quite a challenge in revamping the design to suit today's components, and achieving an upgrade in performance at the same time.

Improving Icom's BP-70 battery pack

(...and others)

The battery packs provided with many modern hand-held transceivers provide only limited operating time for each charge, and often don't allow transmission when the battery is being recharged. Our author has found a way to modify the Icom BP-70 to overcome these shortcomings, and his solution should be applicable to many other battery packs.

by LEW WHITBOURN, VK2ZIP

When Icom introduced its IC-2A in 1980, it was the the first amateur hand-held radio with a 'slide-on' battery pack. To some extent this made battery capacity academic, at least for users with two battery packs, who could charge one pack while using the other.

Taking full advantage of this, Icom supplied the IC-2A with the relatively low capacity 250mAh BP-3 battery pack. However the IC-2A still gave quite respectable time between charges, thanks to the quite low receiver drain of less than 25mA and a moderate transmitter current drain of about 600mA, for a nominal output power of 1.5W.

This battery performance represents, in my opinion, about the minimum acceptable for a hand-held radio: about 10 hours of continuous receiving time (with no signal), or about half an hour of continuous transmitting time.

The main advantages of the BP-3 battery pack were its small size and weight. It also had an inbuilt charging socket (for 13.8V DC), a crude current regulator and an LED charge indicator. However the need for packs of higher voltage (to give more power) and higher capacity for a variety of radios since the IC-2A – marine, commercial and amateur – led to the development of a number of packs 'slide-compatible' with the BP-3. These are listed in Table 1.

The transverse dimensions of all these packs are the same: 65mm wide x 35mm deep. Note that the BP-4 is really intended for use with dry cells, but I have shown the possible performance using commonly available AA-size NiCad cells. Also note that the capacities of some sizes have been upgraded slightly in recent times, as indicated in the table.

The most recent addition to this line of packs is the BP-70, which is supplied as standard with Icom's IC-2GAT and IC-4GAT amateur 2m and 70cm radios, the IC-32AT 2m/70cm dual-band hand-held as well as the very recent IC-40G UHF CB radio.

All this brings me to the point of this article. The BP-70 has only marginally greater capacity than the BP-3 from which it evolved, but it is powering radios with considerably greater current drain. Taking the IC-2GAT as an example, the receiver current is 40mA and the transmitter current is 1.8A, for an output power of 7 watts. This corresponds to a continuous receiving time of just over 7 hours, or a continuous transmitting time of only 9 minutes.

I discount the battery saver feature, which although very useful for monitoring a single channel, does not do anything when the radio is scanning or monitoring a signal. These short times can only be considered academic for those who want to spend something like $200 for a second battery pack of more reasonable capacity. (The best price that I have seen for a BP-5 is about $175.)

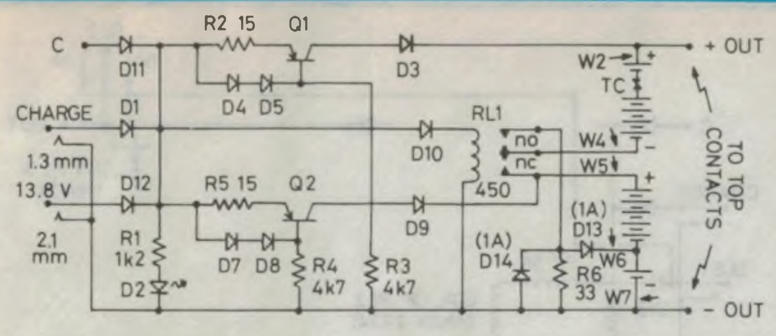
Another solution to the problem for base or mobile operation, is external powering – although only one of the radios mentioned above, the IC-32AT, has a socket for external 13.8 V power. Meanwhile the BP-70 has not one, but a luxurious *two* sockets for charging; so it is tempting to turn one of these into an external power socket!

In the rest of this article I describe what is inside the BP-70, and how to modify it for external powering of the radio through the 2.1mm coaxial socket. I have tested this modification with an IC-2GAT, and make numerous references to that radio in what follows. However I expect the same comments to apply to the IC-4GAT, IC-32AT and IC-40G radios.

Other Icom battery packs having two charging sockets and an internal relay are probably quite similar to the BP-70, and could probably be modified in much the same way. Packs which come to mind are the BP-7 and the BP-8, which are equivalent to the commercial

TABLE 1

Type No	No of Cells	Nominal Voltage	Capacity (mAh)	Height (mm)	Charge socket
BP-3	7	8.4	250-270	39	2.1mm
BP-2	6	7.2	425-450	39	(none)
BP-4	6	7.2	450-700	49	(none)
BP-5	9	10.8	425-450	56	(none)
BP-5A	9	10.8	425-450	80	1.3 & 2.1mm
BP-7	11	13.2	450	80	1.3 & 2.1mm
BP-8	7	8.4	800	80	1.3 & 2.1mm
BP-70	11	13.2	270	61	1.3 & 2.1mm



ICOM BP-70 Colour code for the wires is: W2 - red, W4 - brown, W5 - white, W6 - grey, W7 - black.

Fig.1: The original circuit for Icom's BP-70 battery pack.

battery packs IC-CM7 and IC-CM8 respectively.

The BP-5A pack has the same voltage and capacity as the BP-5. The only visible differences are its extra length and two charging sockets, so it probably has an internal relay and similar circuitry to that of the BP-70.

Inside the BP-70

On opening a BP-70, which is held together by four screws on top and one each side, I found the circuit shown in Fig.1. All the diodes except D13 and D14, which look like 1A power diodes, are small signal types such as 1N4148.

The 11 270-mAh cells are series connected in two batteries, one with five cells and the other with six. The component labelled TC is a thermal cutout. In normal (i.e., not charging) operation, the normally-closed contacts of relay RL1 connect these two sets of cells in series to the top and bottom contacts of the pack.

If external DC (13.8V nominal) is connected to either of the coaxial sockets on the sides of the battery pack, or to the spring loaded contact marked C on top of the battery pack, it is fed via one of the diodes D1, D11 or D12, and then D10, to the coil of RL1. The relay then breaks the connection between the two sets of cells described above and allows two independent constant-current charging circuits (Q1 and Q2) to charge the five and six-cell batteries independently at 43mA – which corresponds to a charging time of 8.8h for the 270mAh cells.

The normally open contacts of RL1 connect the negative end of the five cell battery to ground via a 33-ohm resistor (R6) which drops 1.4V at the 43mA charging current. This is roughly equal to the terminal voltage of one cell under charge, so the two constant current chargers charge at the same voltage and are therefore well matched. This might be considered to be important, because the regulation of the simple one-transistor constant current sources used, although perfectly adequate for the job, is not brilliant!

The reason for using a relay to split the 11 cells into two independent batteries for charging is to allow charging from a 12-13.8V source. Fully charged NiCad cells rise to about 1.4 volts, or 15.4V for an 11-cell pack, and a constant current regulator would need to drop another 2V or so – requiring a total voltage of nearly 18V, which is well over 13.8V. The relay cuts the voltage required by almost a half, allowing charging from sources of 12V or less.

Under charge the BP-70 still delivers power to the radio, but only from the five-cell battery in series with the 33-ohm resistor. This explains why the IC-2GAT will not transmit when its battery is being charged. It also means that, unless the power saver is on, the receiver current of the IC-2GAT (40mA) will consume virtually all the charge current meant for the five-cell battery, with serious long term effects on the battery pack.

The charge contact 'C' on top of the BP-70 does nothing with the IC-2GAT. This is obviously meant for use with radios like the IC-02A(T) and IC-04A(T), such as the IC-32AT, IC-12AT, IC-A20, IC-H16, IC-U16, IC-M11 and possibly others, where external DC can be fed to the radio through a top panel connector.

On these radios the external DC is fed to a special contact on the bottom of the radio for charging the battery pack. I have noticed that recent BP-3 battery packs (seven cells at 250mAh or 270mAh) have the same charge contact as the BP-70. These BP-3's have a proper constant current charger circuit, like one of those in the BP-70: they draw 40mA from a 13.8V supply and deliver a constant current of 30mA to the NiCads, the remaining 10mA going to the LED charge indicator.

The BP-70 delivers close to 43mA to its two internal batteries for any input DC voltage between about 10V and 16V. I measured almost exactly 43mA at 13.8V, for a load current of about 130mA; most of this is accounted for by the two 43mA charge currents, the relay current of about 30mA, and the LED. The output of the BC-17 charger supplied with the IC-2GAT, which has an open circuit voltage of 18V, drops to 13.8V at 130mA.

The only thing not completely clear in Fig.1 is the purpose of D13 and D14, which can only have an effect when the pack is being charged. D14 stops the reverse drop across R6 exceeding 0.7V, if the radio draws excessive current as a result of either high audio output on receive or an attempt to transmit. D13 stops the forward drop across R6 from exceeding about 2V, but I can't see why this would be of special concern.

Improving the BP-70

The modification described here uses a second tiny relay, almost identical to the one already in the BP-70, to switch DC from the larger DC coaxial socket (2.1mm) directly to the radio. Charging still operates normally if DC is applied to the top charging contact of the pack, or through the 1.3 mm coaxial socket, which is the one used by the BC-17 charger.

With the arrangement about to be described, it is possible to charge the battery pack and deliver external power to the radio at the same time. Power for both functions could be derived from the same nominal 13.8V source, connected simultaneously to both coaxial sockets on the battery pack. Both the 1.3mm and 2.1mm coaxial plugs required are available from DSE and Tandy stores. Note that the red LED in the battery pack will light up on charge only and is not affected by power sup-

TABLE 2

Relay	Coil V	Coil R	Coil I	Coil Power
Tandy 275.240	5V	55	90mA	450mW
Tandy 275.241	12V	320	37.5mA	450mW
Icom BP-70	14V	435	32mA	450mW

Battery packs

plied through the 2.1mm external power socket.

In my search for relays small enough to fit inside the BP-70 I discovered two at Tandy, which are physically identical to the one already in the BP-70; one with a 5V coil and the other with a 12V coil. These relays measure 6 x 8 x 10mm, have a 1A contact rating (SPST) and all bear the external marking 'OUC'. A physically identical relay is used for DC changeover in the Icom IC-02A(T) and IC-04A(T) transceivers. These relays are compared in Table 2.

I have assumed that the relay in the BP-70 is designed for 14V operation, and on this basis all three relays appear to be designed to give the same magnetic field for the same power input (probably into the same mass of copper).

For the present modification I chose to use the 12V type, with a 56-ohm resistor in series with its coil, which drops about 2V at 32mA, to ensure that its pull-in field and power dissipation in the BP-70 match those of the original relay.

Some readers will notice that this 1A relay is being used at currents up to 1.8A. My justification for this is that the 1A specification is for switching, but the relay here will never be required to switch 1.8A; that is done by the PTT switch in the radio. I am sure that Icom would agree – as I mentioned above they use similar relays for the same function inside a number of other radios, with transmit currents up to about 1.4A.

The only parts required for the modification are the relay, the 56-ohm resistor, five short lengths of hook-up wire and some sleeving. The modified parts of the circuit are shown in Fig.2.

Proceed as follows. Undo the six screws holding the battery pack together and open it carefully to avoid shorting the NiCad batteries. It would not hurt if the batteries were flat for this exercise but in any case carefully unsolder the five wires (W2, W4, W5, W6 and W7 – see Fig.1) connecting the NiCads to the printed circuit board. These points are screen printed on the board – note the colour code of the wires if it is not as shown in Fig. 1. Each wire is clamped by a stirrup on the circuit board but slides neatly out of this when heat is applied on the solder side of the board.

The next step is to lift the cathode end of D12 and cut the track of the PCB leading to the positive output contact on the centre of the top plate of the battery pack, in preparation for wiring to the new relay RL2.

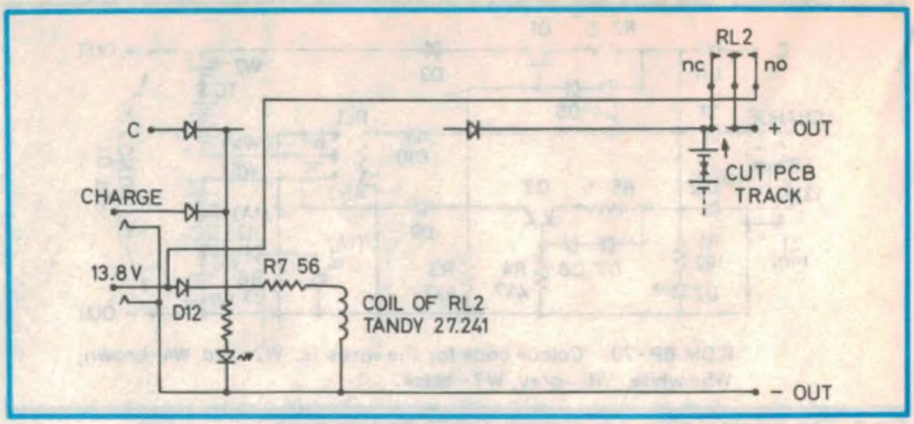


Fig.2: Lew Whitbourn's modifications, which allow one of the 13.8V input jacks to be used to run the transceiver directly.

The relay is positioned, on its side, on a bare patch of circuit board next to the 2.1mm 13.8V coaxial power socket. I glued it down with 'super glue', but silicone adhesive would be just as good. Glue the relay down with its pins pointing in a convenient direction for point-to-point wiring to other parts of the circuit board.

The pin connections of the relay are supplied on the back of its packaging. The moving contact, connected to the lone pin at one end of the relay, connects to the side of the previously cut PCB track connected to the top positive contact of the battery pack. The normally closed contact, which is connected to the pin diametrically opposite, connects to the other side of the cut PCB track. It is necessary to run short wires from the abovementioned relay contacts around one end of the PCB (i.e., from component side to solder side) to make these connections to the two sides of the cut PCB track.

The remaining connections can be made entirely on the component side of the board. The remaining relay contact, the normally open contact, is connected by a short wire to the anode of D12, to pick up 13.8V from the 2.1mm coaxial power socket.

One end of the 56-ohm resistor connects to the cathode of D12. Solder a short wire to the other end of the resistor and slide a piece of sleeving over the diode, resistor and solder connections. The other end of the wire goes to either end of the relay coil. Another short piece of wire connects the other end of the coil to ground, which can be conveniently picked up at the end of a number of components on the PCB.

The wiring is now complete, and all that remains is to reconnect the batteries and reassemble the pack. However, before doing this, check that the modified circuit agrees with Fig.2.

When resoldering the five wires connecting the NiCad batteries to the PCB, it is convenient to solder wires into the stirrups that previously supported these wires. Solder the wires carefully and reassemble the pack carefully, to avoid shorting the NiCads – which can pack a punch even when nominally flat!

Performance test

I am always interested in how the

TABLE 3

Supply volts	Current (A)	Output Power (W)	Overall Efficiency
14	1.8	7.2	0.29
13	1.75	7.1	0.31
12	1.7	6.6	0.32
11	1.6	5.9	0.34
10	1.45	5.0	0.34
9	1.3	4.1	0.35
8	1.2	3.2	0.33
7	1.0	2.3	0.33
6	0.8	1.5	0.31
5	0.6	0.5	0.2

output power and current drain of transceivers vary with supply voltage. This is never an easy thing to measure with a transceiver that has no provision for external power, but with the BP-70 modification done the measurement is easy!

The results for the IC-2GAT are shown in Table 3, by courtesy of Stirling, VK1EV.

Of course these measurements include the extra current of up to 32mA through the extra relay in the BP-70. On low power the radio draws a current of about 0.9A and delivers an output power of about 0.9W for all supply voltages between 6 and 14V, with corresponding efficiencies between 0.17 and 0.07.

Looking at these results, I can see little point in using supply voltages or battery packs giving more than 12V. Indeed a BP-5 pack (10.8V at 425mAh) would be expected to give 5W quite comfortably, and with a useful reduction in current drain. The 1.6dB drop in output power would be very difficult to perceive in practice. The only reason for using 11 cells in the BP-70 would appear to be to compensate for the large voltage drop of 270mAh cells at a load current of 1.8A, which seems to me to be a very bad case of 'catch 22!'

Summary

The modification to the BP-70 battery pack described above allows users of 5W Icom hand-helds to power their radios externally for indefinite periods, with transmit times infinitely longer than the 9 minutes or so afforded by the unmodified BP-70!

The modification still permits charging by all the normal methods. Note that this modification has its uses even with radios that have provision for external power. These radios, of which the IC-32AT is a prime example, all charge the BP-70 at its full 9-hour rate whenever external power is applied. This is not always desirable, and could lead to overcharging in some circumstances. (The same comments apply to the use of recent BP-3's with such radios.)

The solution is either to disconnect the battery pack while using external power when charging is not desired, or to plunge into the simple modification described here. The only caution to add is that you might want to wait until your radio is out of warranty.

It is a pleasure to acknowledge the assistance of Icom Australia, in providing some of the background information about Icom radios and battery packs used in this article.

NEW PRODUCTS

Digital LCR meter

Colourview Electronics of Brisbane has released an advanced hand-held digital LCR meter with the ability to measure very low resistance with a 2 ohm range (1 milliohm resolution), and high inductances with a 200H range, and high capacitances with the 20,000uF range. Also included is the ability to directly measure Dissipation factor.

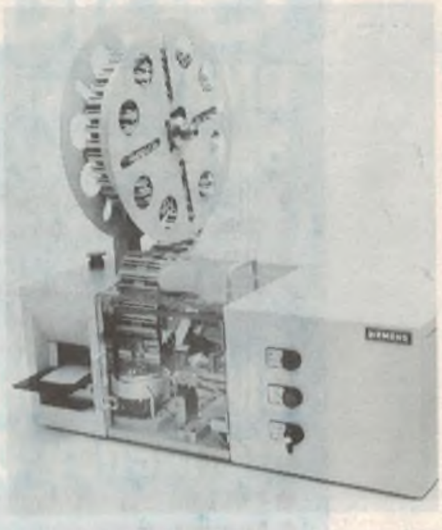
The Mic-4070D 3.5-digit LCR meter provides seven inductance ranges, covering from 200uH to 200H FSD with a minimum resolution of 0.1uH. There are also nine capacitance ranges, covering from 200pF to 20mF, (20,000uF) with a minimum resolution of 0.1pF; eight resistance ranges, covering from 2 ohms to 20M with a minimum resolution of 1 milliohm; and a separate dissipation factor/Q factor range.

The instrument is housed in a rugged plastic case and is fitted with a zero adjustment.

For further information circle 269 on the reader service coupon, or contact Colourview Electronics, 5 Commerce Street, Salisbury 4107; phone (07) 275 3188.

Connectors for flat cables

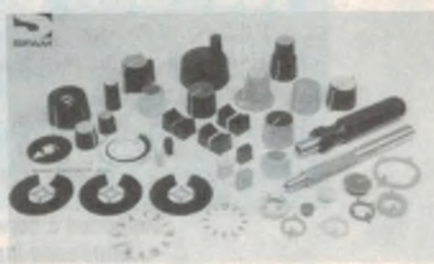
As a supplier of connectors, Siemens now offers a semi-automatic machine for the production of flat cables with connectors. The flat cable is inserted manually, then the connectors are fed



into the pneumatic press and attached automatically.

The process is suitable for medium to large quantities and is designed for 1200 attachments per hour (900 attachments per hour when the connector has to be turned). Ease of operation, user friendliness and secure attachment of female connectors per DIN 41651 and printed-circuit connectors increase the cost-effectiveness. An operationally identical version of the press with turret feed for stick packages is also available for the attachment of connectors with frequently changing pin counts.

For further details circle 246 on the reader service coupon or contact Siemens Ltd, 544 Church Street, Richmond 3121; phone (03) 420 7607.



'Soft touch' control knobs

Sifam Limited of England has produced a range of thermoplastic rubber, two colour, push on, 'soft touch', control knobs. The product is designed to provide an inherent tactility, which is pleasant for the user.

Like Sifam's range of two colour knobs, the 'soft touch' range is moulded with an integral polypropylene cap/pointer which eliminates subsequent assembly operations. Whilst the standard body colour of the knob is black, the integral cap/pointer may be moulded in any of the Sifam standard of pastel colours. Special custom colours for either knobs or cap/points can be manufactured, if required.

The standard shift configuration of the 'soft touch' is 6mm with 18 splines, but as with all Sifam's knobs, special orders can be accommodated.

For further information circle 245 on the reader service coupon or contact C&K Electronics, 1 Little Street, Parramatta 2150; phone (02) 635 0799.

Test clips and adaptors

Emulation Technology offers a large collection of VLSI surface-mount adaptors and accessories that enable quick debugging and connection of test equipment to high density packaging integrated circuits.

Emulation pods and adaptors designed for PGA, LCC, PLCC, PQFD and Slampack enable connection to test equipment supplied with just one type of pod. The cost of the adaptor is less than the cost of a new emulator pod to suit the various surface mount devices.

Bug Katchers enable test equipment to be connected easily to surface mount integrated circuits and can be supplied with generic or custom overlays to identify each pin's function. The design is such that no additional resistance or capacitive effects are introduced to distort readings.

A wide range of programming adaptors enables a standard DIL PROM programmer to program and read PLCC, LCC, SO SOJ and Flatpack devices from all major programmable logic suppliers. Gang modules are available to suit the data I/O PROM programmers.

Emulation Technology offers a free 100 page catalog detailing its surface mount products.

For more information circle 248 on the reader service coupon or contact PP Component Sales, PO Box 580, Bayswater 3153; phone (03) 720 7949.

Thickness gauges

CMI International has introduced a new line of microprocessor based, hand-held coating and plating thickness gauges. The gauges are compact and ruggedly constructed for shop floor and field use.

They provide a low cost alternative for accurate, efficient coating and plating thickness inspection for many applications.

These include: anodise on aluminium; cadmium, tin, zinc, nickel, copper, chrome, teflon or enamel on steel; paint on aluminium, brass or steel; and copper on non-conductives.

Basic and upgraded units offer full statistical summary on a 12.5mm LCD display. Upgraded units offer a variety of additional features, such as a more detailed keypad, 99 memory locations and an RS232 series port for downloading to a printer or computer. There are a total of nine models to choose from plus a wide variety of probes, probe guides and standards.

For further information circle 247 on the reader service coupon or contact Attar, 3/51 Cleeland Road, South Oakleigh 3167; phone (03) 543 5350.

Flexible ink jet

Another model has been added to the JAIME 1000 printhead series from Imaje Coding Technology. These ink jet printers are used in the production line of most manufacturing and packaging companies. They can be moved and mounted at any operation station.

The new S4 model still allows each head to be programmed for different character size, alphabets for 16 languages, bar codes and a wide range of independent messages. But its biggest advantage is its reliability when printing at an extremely high speed in hazardous factory temperatures.

The JAIME 1000 S4 maintains a high quality text by measuring its 'jet speed' directly at the gun nozzle. So it is reliable, irrespective of hot, cold, humid or dusty environments. By using one or two of its heads in each printer, a wide choice of marking is possible.

A special range of inks are available, including invisible ink and an ink for printing on glass.

For more information, circle 242 on the reader services coupon or contact Imaje Coding Technology, Communications and Public Relations Consultants, 226 Crown St, East Sydney 2010; phone (02) 332 3088.

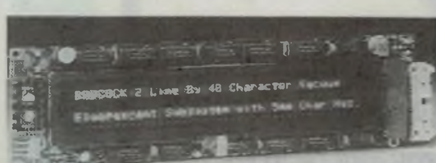
Portable CRO

The Hitachi V-212S portable oscilloscope is a dual channel, single timebase unit with delayed sweep and DC to 20MHz bandwidth.

The new model has vertical mode triggering to provide stable triggering for each channel, even when the input frequencies differ for channels 1 and 2.

Using a proven, high sensitivity design, the V-212S offers a 1mV/div vertical input sensitivity, coupled with an extremely low drift of 1mV – which occurs as soon as power is applied – and a TV sync separation circuit to allow convenient video signal measurement.

For further information circle 252 on the reader service coupon or contact Warburton-Franki, 32 Parramatta Road, Lidcombe 2141; phone (02) 648 5455.



Blinking fluoro display

Babcock has released its latest vacuum fluorescent display system VF-0240-01 featuring a two line x 40 character display with blinking character capability, which makes it ideal for uses where operator prompting is required. Thus this function no longer has to be performed by the host system.

The display comes with on-board microprocessor-controller, which performs display, refresh or control functions. A DC/DC converter generates the necessary voltage to drive the display.

The VF-0240-01 has a 5 x 7 dot matrix format and character height of 5mm. It operates on a single +5V power supply and accepts TTL level parallel or serial ASCII data. RS232 serial is optional.

For further information circle 251 on the reader service coupon or contact IRH Components, 32 Parramatta Road, Lidcombe 2141; phone (02) 748 4066.

Cable ties

A Mount Gambier company is marketing four sizes of cable ties (black only) in packets of 25 to suit the handyman market. Cable ties have been around for quite some time, but not in handyman quantities. The ties vary in size from 95mm to 300mm and can be used for a variety of applications. Prices range from 90 cents to $4.85 a packet.

For more information, circle 241 on the reader services coupon or contact A.C & N.E Zwar, 15 Tweed Crescent, Mount Gambier 5290; phone (087) 24 9194.

Low cost multimeters

Meter International has released five brand new low cost, high performance handheld 3-1/2 and 4-1/2 digit multimeters.

The new instruments are intended for professional use in maintenance and test and service situations. They represent a careful mix of quality manufacture, high accuracy, 33 functions including a frequency counter ranging up to 200kHz, conductance measurement and audible continuity check.

For further information circle 244 on the reader service coupon or contact Quiptek Australia, PO Box 335, Black Rock 3193; phone (03) 532 1328.

New fax machines

Voca Communications has released two new facsimile machines, model

numbers M-1400 and F-25. Both machines offer features found on higher priced units but are now available at prices designed to fit the small business, or home operator's budget.

Key features include a multi-age document feeder, 100 number auto-dialler, automatic redial, delayed dialling, 16 level greyscale, automatic page numbering, activity journals and confirmation reports, polling and database polling, automatic density and manual contrast control and automatic large document reduction. There's also a built-in handset, monitor speaker for on-hook dialling, automatic or manual answering, copier facility and a two line twenty-two character liquid crystal display of information and prompts.

A fully integrated voice/fax switch enables the M-1400 and F-25 to operate in conjunction with an answering machine or second telephone, sharing one common telephone line, solving the problem and expense of installing a second fax line.

Both new models also incorporate an optional closed network which effectively prevents 'junk' fax mail. Incoming transmissions can be limited to only those presenting the correct predetermined pass code – a code which can be modified as often as desired.

For further information circle 249 on the reader service coupon or contact Voca Communications, 11-29 Eastern Road, South Melbourne 3205; phone (03) 697 7000.

Microwave analysis system

Marconi has announced the launch of the model 6580 transmission line measurement system, a new system for precise fault location in microwave transmission lines.

Conventional scalar analysers display amplitude against frequency; the 6580 also displays amplitude against distance, using sophisticated time domain reflectometry techniques, enabling faults in microwave lines to be quickly identified with accuracy and resolution, long before they cause a system to fail.

The 6580 is entirely menu driven, provides on-screen help text and displays connection diagrams. The rugged compact test head incorporates all the detectors and directional devices required for insertion loss, reflection loss and fault location measurements. It also incorporates live referencing, reducing the common problem of flexible cables used before the test port which can cause poor source match.

The system provides full error correction for cable attenuation, multiple faults and relative velocity values of different cable types. It covers from 10MHz to 26.5GHz, a distance range of up to 300m and offers resolution down to just a few millimetres.

For further information circle 250 on the reader service coupon or contact Marconi Instruments, 15 Orion Road, Lane Cove 2066; phone (03) 418 6044.

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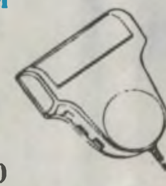

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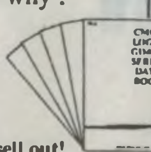

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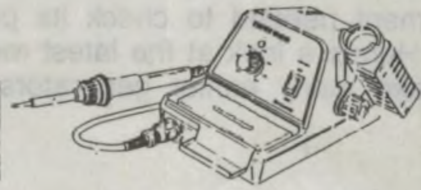

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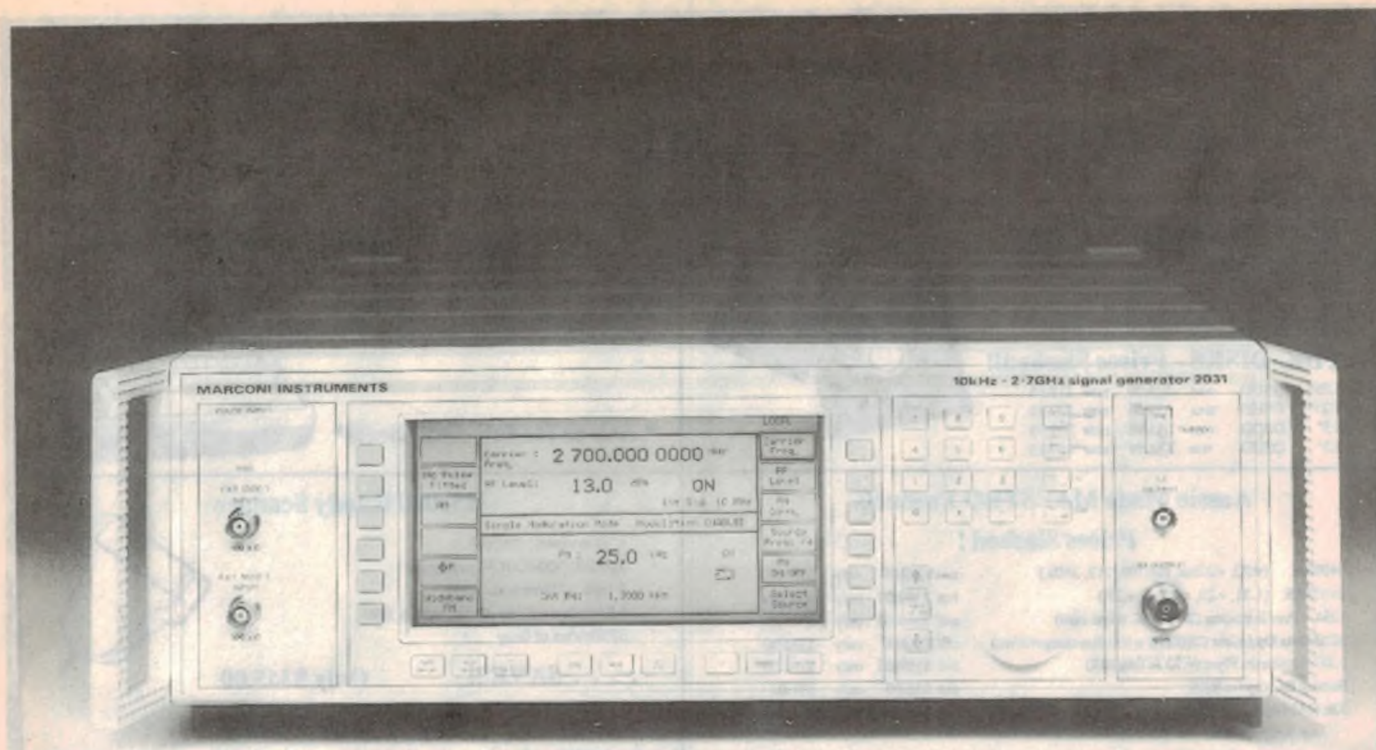


Test Equipment Review:

Marconi's new 2031 Signal Generator

As in so many other areas of electronics, RF technology is growing ever more capable. Needless to say the equipment needed to check its performance must also keep pace – including signal generators. Here's a look at the latest model from Marconi, with specifications so impressive that they make many earlier generators look like the proverbial 'modulated oscillator'.

by JIM ROWE

I have seen the future, I believe – at least as far as signal generators are concerned. And I can report that it looks pretty impressive.

When Marconi Instruments' Jeff Davies arranged to loan me one of his firm's new 2031 generators for a few days, he said "I think you're going to be impressed. One of the engineers at XXX (a large R&D organisation) has just tried it out, and told me that someday, all signal generators will be like this!"

After trying out the 2031 for myself, I know what he means – and I certainly hope he's right.

Like many modern digital-technology RF signal generators, the 2031 doesn't look much like the old analog generators of yore, in their massive cast aluminium or iron cases that were best described as 'two man transportable/one man hernia'. It looks more like a rackmount digital oscilloscope, with its large backlit LCD display screen and array of pushbutton controls.

It isn't exactly tiny, measuring 152mm

high by 425mm wide by 525mm deep, but the weight is quite reasonable at only 16.5kg.

So far, of course, it all sounds fairly familiar. Many modern test instruments are microprocessor based, and tend to have a similar looking front panel with either a CRT or LCD front panel display, and functional control via what is essentially a dedicated keyboard. What makes the 2031 so special?

Well for a start, its basic performance specification. The 2031 can produce an output anywhere from 10kHz in the audio range, right up to 2.7GHz in the upper UHF/microwave band. Tuning over this very wide range is continuous, and with a resolution of 0.1Hz even at the top end.

Thanks to the use of a frequency synthesiser system the stability is of a matching high order, being essentially that of the internal 10MHz standard: better than +/–5 parts in 10^8 over the operating range of 0 to 50°C, with an ageing rate of better than 2 in 10^7 per year, and 5 parts in 10^{10} per day after one month of continuous operation.

Incidentally the 2031 has no calibration adjustments in the normal sense of the word. All alignment is carried out via internal software, using either the keyboard or the built-in IEEE bus input/output port. In any case the rated calibration interval is two years, which should allow a significant reduction in ownership costs and downtime.

As well as being adjustable over a very wide range in terms of frequency, the 2031's output level is also adjustable over a particularly wide range. In fact it covers a range of no less than 157dB – from +13dBm right down to –144dBm, with an accuracy of +/–1dB to 1.35GHz, and +/–2dB up to 2.7GHz!

If this doesn't impress you, consider that this covers from 1 volt right down to a mere 14 *nanovolts* (0.014uV), across a 50-ohm load. With one of the old analog clunkers, we'd have been happy to be able to reduce the output to a known 1 microvolt...

By the way, the spectral purity of the output is also very impressive. Harmonically related and non-harmonic spurious outputs are rated at –30dBc and –70dBc respectively. Also the SSB phase noise level is typically at –122dBc/Hz at 470MHz (20kHz offset), making the 2031 suitable for both in-channel and adjacent channel receiver measurements.

How about modulation? The 2031 has an internal wide-range modulating source, with frequency programmable from 0.1Hz to 500kHz in 0.1Hz steps. As well as being available for external use as an 'audio' signal in its own right, the signal from this source can be used to modulate the main carrier with either AM, FM, wideband FM or phase modulation as desired. And needless to say the degree of modulation is always fully adjustable.

AM depth is adjustable from 0 to 99.9%; FM deviation from 0 to 1MHz, for carrier frequencies up to 21MHz, and from 0 to 1% of carrier frequency above 21MHz. For phase modulation the range is from 0 to 10 radians.

The modulation bandwidth for AM is from either DC or 10Hz to 50kHz (–1dB), depending upon whether you select DC or AC coupling. The corresponding figure for FM is DC/10Hz to 300kHz, while the –3dB bandwidth for wideband FM is typically 10MHz.

Incidentally the internal LF modulating source has a THD of less than 0.1% in sinewave mode (a choice of either sinewave or triangular wave outputs is available). Its front-panel external output level is also adjustable from 5V RMS down to 100uV, into 600-ohm loads (source impedance nominally 5.6 ohms). So the 2031 includes a very respectable audio signal generator, as well...

In addition to this primary modulation source, the 2031 has provision for an optional *second* modulation source to be fitted internally, allowing for two-tone testing. Quite apart from this there are two front-panel inputs for external modulation signals, giving the potential for simultaneous modulation with four different signals. There's also provision for a pulse modulation option, with rise and fall times of 5ns, for testing primary and secondary radar systems.

The main internal modulation source has six different programmable frequency 'channels', and can be arranged to switch between these as desired for testing equipment that responds to sequences of tones. As the source frequency can be set down to 0.1Hz, this makes the 2031 suitable for testing gear that uses sub-audible CTCSS signalling.

Not only that, but the modulation system allows four different modulation modes: single, dual tone, composite and dual composite. The 2031 can thus be used for testing with simultaneous AM and FM (each independently adjustable). In fact in the 'dual composite' mode it can have simultaneous AM and FM, each with two pairs of tones!

As noted earlier, the generator has an IEEE/GPIB communications port built in, so that it can be used as part of an automated test/measurement system. Virtually all generator parameters may be programmed via the IEEE port, which conforms to the IEEE 488.2 standard.

To make it easy to perform rapid testing of equipment and systems, the 2031 has a non-volatile memory system that can store 100 different control setting 'recipes'. These can then be recalled as desired, instantly reconfiguring the generator for a new output frequency, level, and set of modulation parameters.

Impressed yet? Never mind, there's still more to come. As well as being a standard signal generator, the 2031 can also be used as a *sweep* generator for analysis of circuit, system or filter response over a range of frequencies. And the maximum sweep range is as wide as the total tuning range: from 10kHz to 2.7GHz, if you really want.

The sweeping range is set simply by programming the start and stop frequencies. In addition you can select the number of frequency steps per sweep, and the time per step.

During sweeping the carrier may be either modulated or unmodulated as desired – with the full choice of modulation possibilities. Sweeping can also be either continuous or single shot, with triggering via either a key press, an external pulse or a GPIB command. A ramp signal output is provided at the rear of the generator for driving a scope display or an X-Y recorder.

A marker signal output is also provided, and the 2031 allows five different marker frequencies to be stored in its memory.

Now for some of the more subtle 'bells and whistles'. One very nice feature is that for output level, the 2031 offers a choice of measurement units: you can have the level indicated, and/or and make the adjustments in either dB or V/mV/uV. And you can flip between these modes at any time, merely by pressing a button – how's that for convenience!

But what is the dB reference level, I hear you ask – and is the voltage an EMF level, or a PD across a 50-ohm load? Very important points, of course; but don't forget that Marconi's engineers have been designing RF signal generators for a *long* time now.

So with the 2031 you get a choice of just about any of the standard reference levels or measurement conventions. For dB you can program it to use either 1mW, 1V, 1mV or 1uV as the reference level, so that the display reads in dBm, dBV, dBmV or dBuV respectively. Similarly for volts/mV/uV you can select indication in either EMF (unterminated

Marconi generator

output) or PD (terminated) – and of course the reference level for dB indications changes to match.

Now are you starting to get impressed? There's still more to come, though. For example, the 2031 has a 'delta' or relative mode facility, for convenient comparison of equipment performance against a reference unit, at a particular frequency or over a designated range.

You can set up the generator to a particular frequency, with designated output level and modulation parameters. Then you can switch to delta mode, and the 2031 allows you to change virtually any of the parameters as desired – using their preset values as reference. You can adjust the carrier frequency above or below (for checking selectivity, IF bandwidth, etc), the output level (for checking relative sensitivity, limiting, squelch threshold, etc), the modulation depth/deviation, and so on. All in relative terms, up or down from the preset levels; a very handy facility for acceptance testing and similar jobs...

Another nice feature is the ability to *offset* either the carrier frequency, or the output level absolute reference (or both), so that a group of 2031's in the same environment can be standardised to give exactly the same readings. The output level can be offset either up or down by up to 2dB, while the carrier frequency can be offset by whatever amount is desired, separately for the 10kHz-337.5MHz segment and for each octave above this.

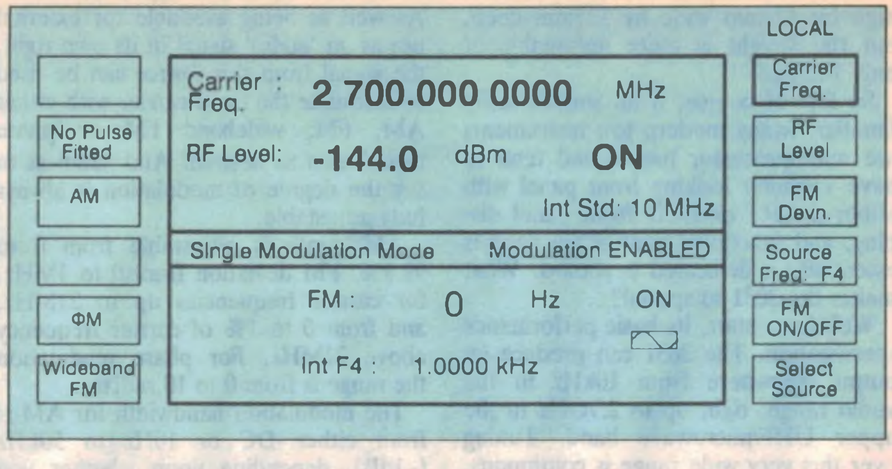
I should add that because this offsetting facility obviously alters the instrument's calibration, it can only be accessed by 'unlocking' the built-in microprocessor's software security system. This ensures that it can't be done accidentally.

I could go on, but you probably get the idea by now. The 2031 is very much a *users'* signal generator, with just about every possible facility for convenient RF measurements.

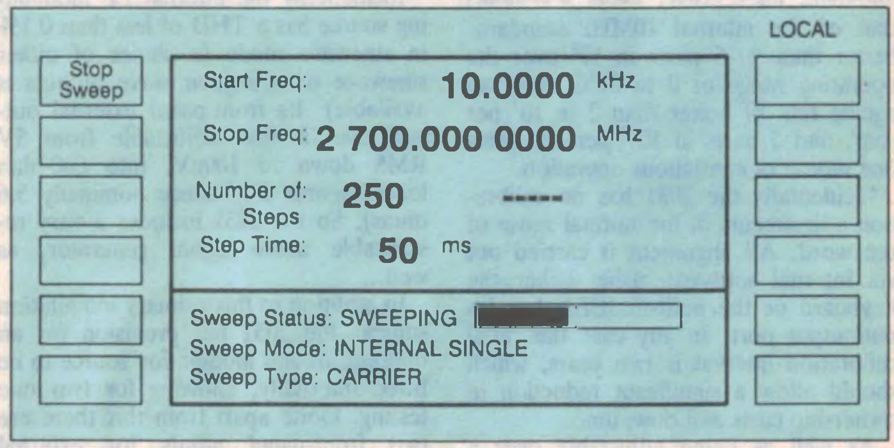
Operation

Despite this bewildering array of facilities, operating the instrument turns out to be much more straightforward than you'd think – thanks to the built-in micro and its firmware.

Not surprisingly, many of the functions and modes of the instrument are selected using a menu system and a set of 12 software-defined control buttons



A 'screen print' of the 2031's display in basic signal generator mode. The six small rectangles down each side carry the legends for the soft keys. The 'ON' near the top right of the main area indicates that the main carrier output is enabled.



And here's the kind of screen display you get when the 2031 is sweeping – in this case, from 10kHz right up to 2.7GHz! Note that only the top left-hand softkey is active, to stop sweeping. The black bar near the centre grows in length as each sweep proceeds.

or 'soft keys'. And for each menu, the large back-lit LCD screen displays the available choices in a clear and unambiguous fashion, down each side of the screen and immediately alongside the keys to make the selections. It couldn't be much simpler.

As well as the softkeys, there are nine 'hard' keys under the screen for primary instrument control functions. These deal with such things as carrier on/off, modulation on/off, LF output on/off, delta mode enable/disable and sweep mode enable.

Further to the right of the screen and its associated keys are the keypad for entering parameters in numeric fashion, the keys to select measurement units, and the rotary control. The latter can be used to adjust any selected parameter in incremental fashion, as an alternative to the keypad.

There are three keys alongside the control knob, used to select its operation. The centre key is an enable/disable toggle, while those above and below have functions which depend upon whether or not the knob is enabled. With the knob enabled, they adjust the knob's control sensitivity up or down in decade steps; on the other hand with the knob disabled, they directly increment or decrement the selected parameter. Very neat!

The RF output, LF output and power switch are over on the far right of the front panel. RF output is via a type N connector, and is provided with a high level of reverse power protection.

Trying it out

Needless to say we gave the sample 2031 generator a fairly extensive work-out while it was with us. This included using it to check out the performance of a couple of different VHF and UHF receivers, so that we could get a good idea of its ease of use.

I guess I should stress that it wasn't really feasible for us to check out the calibration of the 2031 – it's considerably better than anything else we have access to, making such an exercise pretty pointless. In fact you'd need a standards laboratory, to do so.

We used the 2031 largely in the opposite way, to check our existing counters and meters as well as receivers. it was an excellent opportunity to take advantage of such a 'Rolls-Royce' instrument, while we had access to it!

Using it turned out to be very straightforward indeed. The menu-driven operation is quite intuitive, making it largely unnecessary to refer to the manual except for the more esoteric operations. For all normal setting-up you merely select the parameter you wish to change using the appropriate softkey, punch in the desired value using the keypad, and finally press the appropriate units key.

All in all, the 2031 seems very close to the embodiment of every signal generator user's wish list. It has excellent performance, a very wide range of facilities, and is also very convenient to use. So much so that it has really 'spoiled' us, when it comes to using our existing instruments.

Of course the answer to all of our signal generator prayers doesn't exactly come cheap. But on the other hand, considering the class of instrument and its facilities, it isn't really expensive either. The 2031 in basic fitout will set you back around $19,000, which compares extremely well with competing generators.

There's also a very similar model 2030, with a frequency range extending to 1.35GHz instead of 2.7GHz, and an output level adjustable down to –138dB instead of –144dB. This sells for around $14,000, and would clearly be more than adequate for many applications.

Our thanks to Jeff Davies from Marconi Instruments, for the opportunity to try out the sample 2031 'dream machine'.

For further information on the 2031 or 2030 Signal Generators, circle 202 on our Reader Service Coupon or contact Marconi Instruments, Level 4, 15 Orion Road, Lane Cove 2066; phone (02) 418 6044.

Radio modem kit

Continued from page 95

the two, with virtually no errors registered – as you'd hope.

Of course things wouldn't be quite this good using transceivers, antennas and a typical link through the 'ether', but our impression is that the ATM25/31 combination is a neat and elegant one which should work at least as well as any other basic V23 modem. This being the case, using a protocol like X-modem should allow any errors due to noise, EMI or fading to be corrected, for reliable operation.

In short, AT&M seems to have come up with a very attractive little V23 modem kit, suitable for transmission of data at 1200bps over almost any reasonable radio link. Particularly when you compare the price, against a commercial unit. The ATM25 kit costs $66.60 ($55.50 + 20% sales tax), while the ATM31 costs only $46.20 ($38.50 + 20% ST).

For further information on the ATM25 and ATM31 you can either circle 201 on our Reader Service Coupon, or contact Australian Test and Measurement, 28 Hotham Parade (PO Box 732), Artarmon 2064; phone (02) 906 2333.

Vintage Radio

by PETER LANKSHEAR

Overhauling an AWA Radiolette

The AWA Radiolettes of the 1930's are uniquely Australian and very collectable. Recently a fellow collector rescued from oblivion one of the later versions, a dual wave R52G of 1938. He accepted my offer to overhaul it and it occurred to me that readers might be interested in the project.

This article is aimed primarily at newcomers to vintage radio work, describing methods that work for me. But I would emphasise that experienced workers will have their individual techniques, which could well differ from mine. Personally, I don't favour piecemeal fault location and testing. Another fault elsewhere can mask success in the area being worked on. My preference is to work systematically through a receiver, replacing all faulty or suspect components before even switching it on.

Servicing and restoration are related, but different. The serviceman who made his living repairing radios was usually expected to repair a specific fault only, and as economically as possible. Restoration has no such constraints, the aim being to get the set back to as close to original condition as possible. Many old time servicemen would have regarded this situation as Utopian.

Reflex complications

At first glance the circuit of the R52G appears to be that of a conventional five valve radio, but a closer look shows some complication around the 6G8G diode pentode valve.

Radiolettes made after 1933 used *reflexing*, a system originating early in radio history, when valves were very expensive. By careful separation, it is possible in one valve, to amplify radio frequency or intermediate frequency signals and then, after detection, simultaneously amplify the resulting audio signal. Although not as satisfactory as the use of separate valves, reflexing gives a valuable performance boost to small receivers.

In the case of the Radiolettes, the functions of the first audio and intermediate frequency amplifiers were combined in the pentode section of a diode pentode. The diodes were used for detection and automatic gain control. In fact this one valve performed no less than four functions! Naturally, the associated circuit is a bit more complex than that of conventional receivers.

First steps

With the receiver on the workbench, the first thing I did NOT do was to switch it on to see if it was operational. This is a natural, but unwise action. It can be dangerous if the power cord is perished or incorrectly wired, and it is possible for a short circuit to damage the power transformer.

There were some important checks to carry out before switching the set on. First the knobs and mounting bolts were removed and the bakelite cabinet stored in a safe place. This model has a back to the cabinet, with the result that the chassis was reasonably clean. The dust and dirt that had collected was removed with a small paint brush.

A careful inspection of the chassis showed no obvious problems, apart from a strange additional volume control potentiometer. Most importantly, the power transformer showed no signs of scorching or soot, indications of an expensive burnout.

Fig.1: AWA's 1938 R52G Radiolette has a nicely proportioned bakelite cabinet. At some stage this one has lost its badge, but chances are that it can be replaced.

The viability of the electrical restoration of a receiver of this type can well depend on the condition of the power transformer. Transformers can fail from shorted turns, open circuited windings or burnout from overloading. The only remedies are replacement — if a suitable transformer can be found — or rewinding, which can be expensive.

Open circuited windings are almost invariably found in HT secondary windings. Although sometimes a transformer burnout is all too obvious, an absence of external burns or melted wax is no guarantee that there is no problem. Fortunately, short circuited windings can be checked quite easily by removing all loads from the secondaries of the transformer and checking for overheating after a half hour or so of mains application to the primary.

As the power cord of the Radiolette was showing signs of perishing, I had no hesitation in first fitting a replacement. Frayed or perished cords are potentially dangerous and even if the cord looks OK, the plug connections should be checked as they may be incorrect. In the case of the 52G, to remove the back of the cabinet completely, the plug has to come off anyway.

Next all valves were carefully removed. To avoid loosening ageing adhesives, grid caps were eased off gently with the aid of sharp scriber, and valves were removed by levering under the bases. Despite my care, the grid cap of the 6U7G was loose and had to be glued with an epoxy resin as described in last April's column. Each valve had its location noted, and was checked to see if it was the type marked on the chassis. It is quite common to find valves in wrong sockets, or even unsuitable types fitted in a vain attempt to 'fix' a receiver.

With the valves removed, the trans-

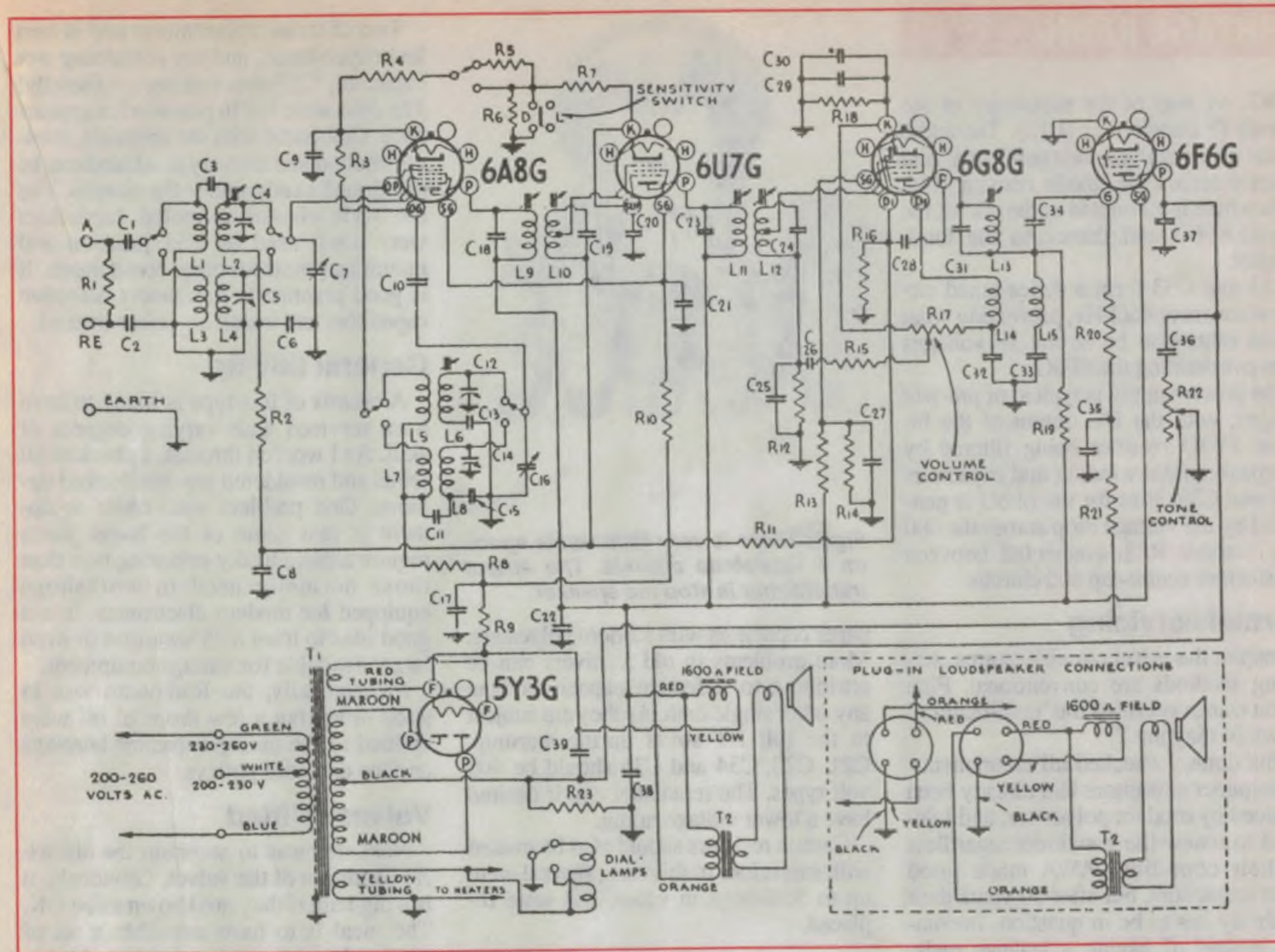


Diagram 1: The circuit of the set, drawn in somewhat unorthodox fashion with the valves upside down. Nevertheless it provides information essential for overhauling a set and correcting modifications such as that in Diagram 2.

former was tested. During normal operation, transformer cores can become hot enough to be uncomfortable to touch; but unloaded, a good transformer will not show any appreciable heating. In a defective power transformer, a shorted turn soon produces a runaway heating situation and eventually, smoke. In this case, after about half an hour, there were no signs of distress and heating of the core was barely detectable.

One very common fault to check in valve receivers is an open primary in the speaker transformer. Good windings have a resistance in the region of 400 ohms. An ohm meter check between the screen and anode pins of the 6F6G socket confirmed that the winding was intact.

So far so good. Physically the set was in good condition, and the power transformer was OK. Repairing the Radiolette seemed to be a viable proposition.

Further inspection

At this stage I like to sit down and compare an unfamiliar chassis with its circuit, locating and identifying each component. This is time well spent. Defective components may be spotted, unusual circuit features become apparent, and most importantly, any modifications can be identified. For example in this case I discovered in the process of checking that C30 was missing.

Be especially alert for unofficial modifications. Attempts to improve performance have often led to misguided experimentation, typified in this case by the extra volume control wrapped in friction tape and tucked under the chassis. This rather strange alteration is illustrated in diagram 2.

A bit of study helps to work out details of a set's operation. The first stage of the dual-wave Radiolettes is a pentagrid first detector, or frequency converter, in this case a 6A8G. RF Coils L1/2 and L3/4 along with oscillator coils L5/6 and L7/8 are switched to provide the coverage.

Next follows a conventional 6U7G IF amplifier stage. The cathode bias resistors of the first two valves are connected to a local/distance switch and a section of the wavechange switch. R4 is the 6A8G bias resistor, and R5 is added in series by the wavechange switch to reduce gain on the Medium Wave band. R7 is the bias resistor for the 6U7G. To reduce gain on strong signals, both stages have extra bias generated by an additional resistor R6, controlled by the sensitivity switch.

Reflex stage

So far, the circuit is quite conventional, but the stage incorporating the diode pentode valve, in this case the 6G8G, distinguishes AWA reflexes from 'run of the mill' receivers.

The 6G8G valve amplifies the signal from the second IF transformer L11/L12 and passes it on to the third IF transformer L13/L14. Diode 1 is the AGC source fed conventionally from the anode via C28, whilst diode 2 is a standard AM detector coupled to the volume control pot R17. The operation of the receiver to this point is quite typical, but now the reflexing introduces differences.

Normally, the volume control would feed a separate audio amplifier stage. Instead, here the volume control output is fed back into the control grid of the

6G8G, by way of the secondary of the second IF transformer (L12). The audio signal is amplified independently and appears across the anode resistor R19, from where it is coupled to the grid of the output 6F6G and thence to the loudspeaker.

L15 and C33 form a series-tuned circuit resonant at 460kHz, preventing what would otherwise be strong IF voltages from overloading the 6F6G.

The power supply is typical of pre-war designs, with the DC output of the biphase 5Y3G rectifier being filtered by the speaker field winding and capacitors C38 and C39. Bias for the 6F6G is generated by the voltage drop across the 300 ohm resistor R23, connected between transformer centre-tap and chassis.

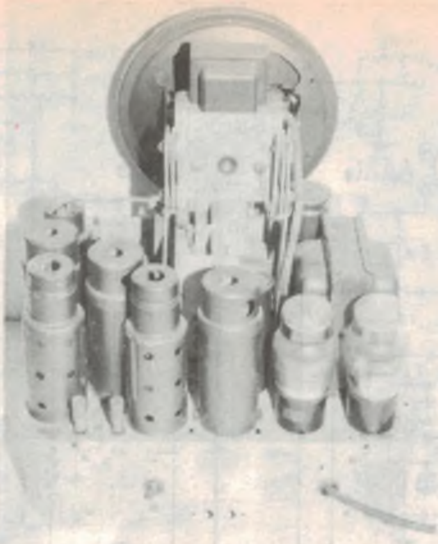


Fig.2: There is very little waste space on a Radiolette chassis. The output transformer is atop the speaker.

Normal servicing

Despite the novel circuit features, servicing methods are conventional. First action was to get rid of the 'modification' shown in diagram 2.

This done, I checked all components. Some paper capacitors had already been replaced by modern polyesters, and I decided to renew the remainder regardless of their condition. AWA made good paper capacitors, but after 50 years their reliability has to be in question. Inevitably, instead of having a leakage resistance of at least 100 megohms, moisture will have reduced this seriously. In this case, C35 was down to 50k ohms and C34 read only 1 megohm. Both would have had a disastrous effect on the bias of the 6F6G, creating distortion and high anode current.

Frankly, in cases like this I have no hesitation in ruthlessly replacing all paper capacitors with modern polyesters. More problems in old receivers can be attributed to defective capacitors than any other single item. As they are subject to the full HT stress during warmup, C21, C22, C34 and C36 should be 400 volt types. The remainder can if desired have a lower voltage rating.

Carbon resistors should also be treated with suspicion. In this case, several were up to 50% high in value, and were replaced.

Electrolytics renewed

In a receiver of this age, it is unlikely that the original electrolytic capacitors will have survived. I found that two of the three original chassis-mounted 8uF wet HT filters, and the 25uF dry electrolytic cathode bypass C29 had been replaced by more modern small tubular types.

Two of these replacements had in turn lost capacitance, and the remaining wet capacitor, C17 was leaking — literally! The cans were left in position for appearance. Compared with the originals, modern equivalents are very small and can be positioned neatly under the chassis. The old style chassis mounted capacitors were often used as lead junction and mounting points for other components. It is good practice to disconnect defective capacitors and install tie points instead.

General tidy up

A chassis of this type is likely to have been serviced with varying degrees of skill. As I worked through, I checked all joints and resoldered any that looked dubious. One problem with older equipment is that some of the larger joints require a more husky soldering iron than those normally used in workshops equipped for modern electronics. It is a good idea to have a 75 watt iron or even larger available for vintage equipment.

Mechanically, the Radiolette was in good order, but a few drops of oil were applied to the tuning capacitor bearings and the dial cord pulleys.

Valves refitted

Next step was to ascertain the electrical condition of the valves. Obviously, it is a big help if they are known to be OK. The ideal is to have available a set of new or known good examples. At one time the nearest service shop would have had a tester available, but this is no longer likely. This leaves the restorer with a bit of a problem. One practical solution is to try the valves in working radios using the same types. Contact with other collectors can often be of assistance.

When refitting the valves, care should be taken to make sure that they are all in their correct sockets. As in this case, when the one type of socket is used throughout a set, it is very easy to make a mistake. Make sure that the pins are clean and that valve shields do not contact grid leads or caps.

Switching on

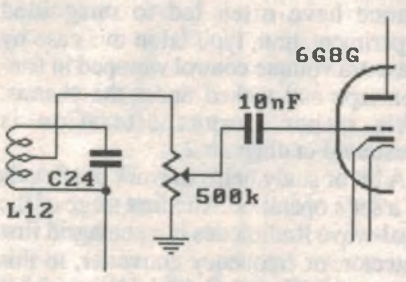
After a final look round, I connected the test meter set to the 500 volt range from the HT line to earth. The mains was switched on and I kept a close eye on the meter. Within a few seconds, the 5Y3G had heated up and the HT voltage quickly rose to about 350. As the other valves heated up, the voltage dropped to the expected 250 and by now the speaker was showing signs of life. A voltmeter check around the valve sockets showed that the voltages were reasonably close to those listed.

Strange modification

This somewhat puzzling modification, comprising a 0.5M pot and 10nF series capacitor could well be a candidate for a vintage 'Serviceman' column. Someone had gone to a lot of trouble when installing it, even using shielded wire for the connections.

Its purpose can only be guessed at, but the chances are that it was an attempt to get around a bothersome characteristic of these receivers. Due to the reflexing, it is impossible to silence the speaker completely — even with the volume control set at zero.

The modification would have been more successful without the 10nF capacitor. As it was, the grid of the valve had no return to earth and would have blocked up, completely cutting off the anode current.



Restorers should always be on guard for such 'improvements'. Without a circuit diagram, even experienced servicemen can be caught by traps set by experimenters. One of the usual benefits of belonging to a vintage radio society is gaining access to a pool of servicing data.

FISK RADIOLA 52G — Component Values

R1,2	100,000 ohms	C6,8,11	.05uF (50nF) paper
R3	40,000 ohms	C7,16	Tuning capacitor
R4	450 ohms	C9	0.1uF paper
R5	200 ohms	C10	110pF mica
R6	2000 ohms	C12	16-34pF air trimmer
R7	900 ohms	C13	440pF mica (padder)
R8	10,000 ohms 1W	C15	3.5nF mica (padder)
R9	15,000 ohms 2W	C17	8uF 450V electrolytic
R10	20,000 ohms 1W	C18,23	115pF mica
R11,12	1.75 megohms	C19,24	130pF mica
R13	1 megohm 1W	C20,21,22	0.1uF paper
R14	250,000 ohms 1W	C25,32	110pF mica
R15	500,000 ohms	C26,34	.01uF (10nF) paper
R16	1.75 megohms	C27	0.1uF paper
R17	500,000 ohm pot	C28	50pF mica
R18	2000 ohms	C29	25uF 25V electrolytic
R19	250,000 ohms 1W	C30	.02uF (20nF) paper
R20	500,000 ohms	C31	70pF mica
R22	100,000 ohm pot	C33	115pF mica
R23	300 ohms 3W	C35	.05uF (50nF) paper
C1,2	500pF mica	C36	.035uF (35nF) paper
C3	4pF mica	C37	.005uF (5nF) paper
C4,14	2-10pF air trimmer	C38	8uF 450V electrolytic
C5	2-20pF air trimmer	C39	8uF 500V electrolytic

On test the set seemed to be lively and dial readings were close to those listed. Realignment seemed to be unnecessary, as it often is if the original settings have never been disturbed. Unfortunately, this is not always the case. Alignment without the maker's instructions can sometimes be a complex and trap-ridden activity and will have to be covered in a future article. ■

Solid State Update

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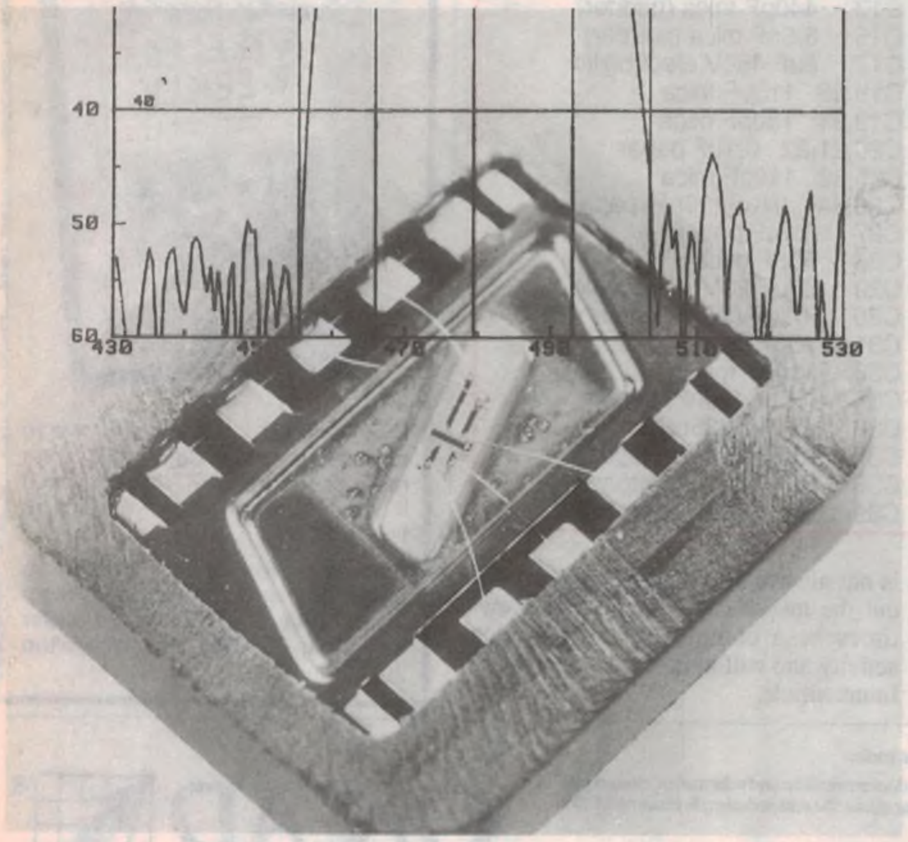


SAW filter for satellite TV

Siemens has developed a new surface acoustic SAW filter for bandpass use in receivers employed in direct satellite TV reception. The Y6901 is the successor to the Y6950 and distinguishes itself – aside from its space-saving design – by its low insertion loss, high attenuation values for the side lobes, and linear group delay.

The new bandpass filter is used for the second intermediate frequency of 480MHz in satellite receiving stations and has a 3dB bandwidth of 27MHz. Because of the insertion loss of typically 17dB, little preamplification is necessary. The side lobes for the frequency ranges of 379.0MHz to 455.5MHz and 503.5 to 579.0MHz are typically 43dB which minimises adjacent channel interference.

Group delay ripple is in the range of +/–4ns – one of the typical advantages of a SAW filter over a conventional coil filter.

After the satellite television signal has passed through the Y6901 filter, it can be demodulated and sent directly to the television tuner as a CVBS signal.

For further details circle 272 on the reader service coupon or contact Siemens, 544 Church Street, Richmond 3121; phone (03) 420 7313.

Fastest military DRAM

Electronic Designs Inc has introduced the fastest 1Mbit CMOS dynamic RAM, compliant to MIL-STD-883C, available to date. The device is available as either a page-mode 256Kx4 (EDI44256C) or 1Mx1 (EDI411024C). RAS access times available for both are 70, 80, 100, 120 and 150ns.

All inputs and outputs are fully TTL compatible and operate from a single 5 volt supply. Address inputs are multiplexed, allowing low pin count and facilitating greater system density.

The devices are manufactured using a triple-level polysilicon/silicide process. The use of silicides for low-resistivity on-chip interconnects and a design incorporating single-transistor dynamic storage cells provide a combination of high density and high performance. All circuitry, including sense amplifiers are designed for minimum power dissipation.

Three refresh modes are available for both device types: 'RAS only', 'CAS before RAS', and 'hidden refresh'. The 'CAS before RAS' mode allows refresh without requiring externally generated addresses. When the CAS pin is driven low before the RAS pin goes low and the two pins are toggled for 512 clock cycles, an internal counter is incremented and generates the required addresses. The 'hidden refresh' mode allows refresh during a read/write cycle.

The DIP-packaged version of the 1Mx1 EDI411024C also offers a means of reducing test time through the use of a TE (test enable) function that, when activated, allows the memory to be tested as 256K devices, allowing for test time reductions.

For more information circle 277 on the reader service coupon or contact KC Electronics, 3/1-7 Balaka Place, Bundoora 3083; phone (03) 467 4666.

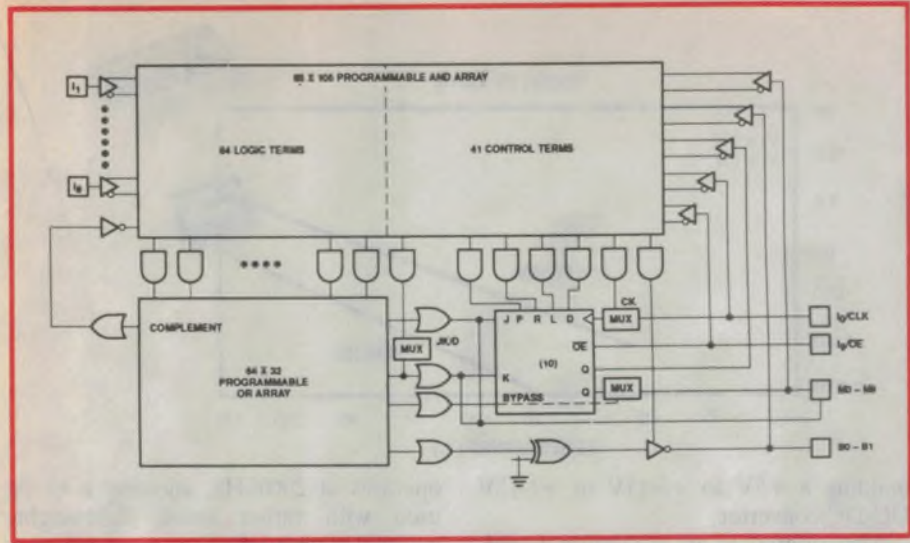
CdS photoconductor

The Tocos resin coated CdS photoconductor 2PBL-5X series is now available through Crusader Electronic Components.

This type of CdS cell is attracting special attention because, by removing its conventional enclosure, it is more compact and lightweight. Improved coating materials have improved its weather protection.

Because it is easily connected to a relay it has a wide range of applications such as exposure meters, light control, photo flashers, melody cards, etc.

For further information circle 271 on the reader service coupon or contact Crusader Electronic Components, 73-81 Princes Highway, St. Peters 2044; phone (02) 516 3855.



Super PLD

The Philips PLC42VA12 is described as a 'super' PLD because of its innovative superset architecture. It features an output macrocell register bypass which results in buried registers without wasted pins, as well as a fully programmable 'OP' array and configurable J-K flipflops.

The device lets users dedicate a pin to handle combined I/O while the bypassed register functions as a buried register. This feature allows the user to create a combined I/O path from the AND array to the output pin, while allowing the register to continue functioning. By combining two fully programmable arrays with the flexible output, the device represents a superset of the 22V10. With both sync and async clocking, the PLC42VA12 also incorporates the functions of the 20RA10 family.

With 42 inputs and 12 outputs, the EPROM-based CMOS device is well suited for sequencing. Its register outputs are bi-directional, making it possible to synchronise input signals to support a state sequence, such as generating and recognising bus protocols. Two fully programmable arrays make the device suitable for wide-gating applications.

At 14 to 40MHz it is suited for many applications including custom bus controllers, address decoders and arbitration devices.

For further information circle 280 on the reader service coupon or contact Philips Components, 11 Waltham Street, Artarmon 2064; phone (02) 439 3322.

CMOS transceivers for LAN market

Level One Communications has announced the development of a new family of three CMOS transceivers aimed at the twisted-pair Ethernet 10-base-T LAN marketplace.

The new devices will be small and cost effective because they focus exclusively on mixed analog/digital transceivers for twisted-pair applications.

The LXT902 incorporates all the functions of a media attachment unit (MAW) on a single chip. It can connect any PC with any LAN card to any 10-base-T twisted pair LAN network, through the existing drop cable connector at the back of a PC.

The LXT901 is similar to the LXT902 but it is more highly integrated. It includes physical layer signalling (PLS) as well as an attachment unit interface (AUI) and a MAW. It is pin-programmable for 10base-T or AUI interface and it is compatible with all Ethernet 10base-T controllers. An outstanding feature of the LXT901 is the inclusion of pre-equalisation and harmonic suppression filters on the transmit drivers, receive filters and a Manchester encoder/decoder.

The LXT904 is a quad transceiver intended for use in a wiring cabinet. It allows for more efficient and cost effective hub repeaters. It comes in a smaller package than equivalent single transceivers, permitting reduced parts handling, reduced test time and greater reliability.

For more details circle 275 on the reader service coupon or contact Multi Electronics, 47-53 Talavera Road, North Ryde 2113; phone (02) 805 1055.

Teletext decoder chip

GEC Plessey Semiconductors has announced what it claims is the world's first single chip teletext decoder. The MV1815 allows a complete teletext system to be built with just the addition of a single low cost DRAM IC.

Up to 254 pages of text can be stored, depending on the size of memory, for immediate access by the viewer.

The MV1815 has an on-board data slicer circuit and dual page acquisition circuits. This ensures that the viewed page can always be kept live while the second acquisition circuit stores linked or other pages.

The device is controlled using a low cost I^2C interface, allowing easy connection to a microprocessor. Multi language capability is a feature with 14 languages being supported. The device is manufactured on Plessey's 1.4uM CMOS process and operates from a 5V supply drawing typically 20mA.

For further information circle 278 on the reader service coupon or contact GEC Components Sales Office, North Ryde 2113; phone (02) 887 8222.

Audio chip for mobile radio

The FX506 from Consumer Microcircuits combines the essential circuits for audio processing in a mobile radio. The various elements are controlled with a 47-bit data word entered serially from a host uP.

The FX506's input multiplexer feeds signals to an input amplifier having a gain of 15dB, adjustable in 1dB steps. Next the signal passes through a compression circuit to speech-band filters preset to 300Hz and 3kHz. Finally, the signal goes to a fine gain-adjust amplifier with 0.25dB increments. For further processing pre- and de-emphasis filtering centred around 1kHz with a 20dB/-decade roll off may be selected.

A separate deviation limiter (2.55 to 3kHz) may be switched in to satisfy differing channel-spacing requirements. An output multiplexer feeds a VCO reference and VCO drive channel, which includes a programmable 48dB attenuator. Noise-squelch control follows separate path, sourced either from the input signal or the received signal-strength indicator in the radio. The control program can turn off unneeded functions to save power.

For further information circle 273 on the reader service coupon or contact VSI Electronics, 16 Dickson Avenue, Artarmon 2064; phone (02) 439 8622.

'No design required' DC-DC converter

The MAX743 is a 3 watt, dual output switching regulator which efficiently generates +/–15V at 100mA or +/–12V at 125mA from a single +/–5V supply. It contains two internal power MOSFETs and all the active circuitry needed to build small, dual output 3 watt power supplies. Relying on simple two-terminal inductors rather than transformers, the MAX743's laser-trimmed outputs are independently regulated to within +/–4% over all conditions of line voltage, temperature and load current.

Traditionally, the design of DC-DC converters has involved messy calculations and the difficult, time consuming task of component qualification. With the new MAX743, there are no calculations and Maxim provides the proper components and layout to ensure a successful design.

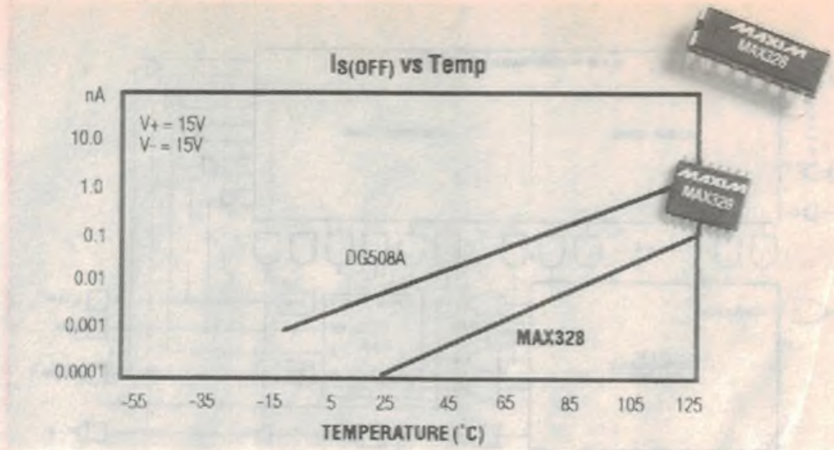
To make designing with the MAX743 as simple and reliable as plugging in a module, Maxim is offering production kits that contain the MAX743 IC and all the critical components necessary for building a +5V to +/–15V or +/–12V DC-DC converter.

Also offered is an evaluation board, which will considerably shorten the time required for bread-boarding the converter.

The MAX743 efficiently drives a wide range of loads. This is particularly useful in applications with varying power requirements, such as those containing circuitry that is used intermittently. It operates at 2000kHz, allowing it to be used with rather small, lightweight, external components.

Other features of the MAX743 include under-voltage lockout, thermal overload protection, cycle-by-cycle current limiting and soft-start.

For further information circle 276 on the reader service coupon or contact Veltek, 22 Harker Street, Burwood 3125; phone (03) 808 7511.



TTL compatible sub 50ns analog switch

Siliconix has released a TTL compatible analog switch which breaks the 50ns barrier. Rated at 45ns maximum, the new DG601 series boasts the fastest switching time of any monolithic analog switch. In addition, it offers TTL compatible 12V and 5V single-supply operation and +/–5V dual supply operation. Thus the DG601 meets both the speed and logic compatibility requirements for high-speed sampling in today's designs.

The DG601 is a quad single-pole, single-throw analog switch built on Siliconix' POLYMOS process. The thin gate oxide and small feature size (5uM) of this silicon-gate technology allows fast switching times (45ns max), low charge injection (13pC typical), low on-resistance (35 ohms maximum), low thresholds (0.8V), and very rugged ESD (electrostatic discharge tolerance greater than +/–4000V).

The benefit of the DG271 is ease of design where speed, guaranteed single-supply operation and high reliability are required in applications such as data acquisition (sample/hold amplifier and gain ranging), instrumentation sample/-hold amplifiers and signal routing along with hard disk drives and tactical weapons.

For further information circle 274 on the reader service coupon or contact IRH Components, 32 Parramatta Road, Lidcombe 2141; phone (02) 748 4066.

Triple 8-bit videoDAC

Brooktree Corporation's 80MHz, triple 8-bit video digital-to-analog converter (videoDAC) is designed for use in high-resolution colour graphics, CAE/CAD/CAM applications, video reconstruction and instrumentation applications.

Implemented in a +5V monolithic CMOS process, the Bt121 supports 50 and 80Mhz conversion rates. On chip analog output comparators have been included to simplify diagnostics and debugging. The Bt121 also contains an on-chip voltage reference to simplify device operation, but an external voltage reference may also be used. Typical power dissipation is 600mW.

The new videoDAC is similar in function to the Bt101, 102, 103 and 106 series, yet offers a higher level of integration than these previous designs. The BT121 generates RS-343A compatible video signals into a doubly terminated 75-ohm load, and RS-170 compatible video signals into a singly terminated 75-ohm laod, without requiring external buffering.

For further information circle 279 on the reader service coupon or contact Energy Control, 26 Boron Street, Sumner Park 4074; phone (07) 376-2955.

Amateur Radio News

Appliance operation and its effects

Not long ago, *EA's* editor made reference to what they saw as unreasonable criticism and 'ham bashing'. There's nothing wrong with using commercial gear, they said; in any case, the technology is now so complex that home brewing is getting too hard.

Fair enough; but all the same, the trend away from home brewing and experimentation does have its worrying side – including, it would appear, a role in the unfortunate demise of *Ham Radio* magazine. Writing in October's issue of the RSGB (UK) journal *Radio Communication*, well known amateur Pat Hawker G3VA notes:

The closure of HAM RADIO following the June 1990 issue is a matter of deep personal regret but also, I feel, a sad reflection on the changing role of our hobby – from a basically technical and scientific hobby recognised as such in influential, regulatory circles, moving increasingly in the direction of a purely fun hobby for appliance operators, with little interest in the technology unless this arises from their professional work.

Dick Ross, K2MGA, publisher of CQ (which has taken over unexpired subscriptions and which will in future feature articles by some of the regular HAM RADIO contributors, without adopting its technical-only approach) puts it thus: "The true ham technician – the person who actually dug into the innards of a radio and made it work, the person who experimented with novel antenna designs and new modes of communications in amateur radio, was becoming a smaller and smaller minority. The technicians among us no longer provide the numbers needed to support a monthly magazine of the calibre of HAM RADIO. Those who question that statement need only examine the contents of QST over the past few years, as it relentlessly moves further away from its traditional role as a technical journal, in response to the changing needs of its readers... Let's get on with the world as it is, not as we'd like it to be."

Similarly CQ's editor, Alan Dorhoffer, K2EEK writes: "Today's amateurs are operator orientated and somewhat less technically geared... in a shrinking technological society. Amateurs like things to remain the same forever. Things change, people change and most certainly the hobby has changed. It may not be what everyone likes or wants, but this is reality."

Personally I find these opinions, while realistic, deeply depressing. I have always believed that the operator of a radio station (whether or not it is composed entirely out of commercially-manufactured equipment) can be – should be – keenly interested in the technology. Contests, awards, DX-peditions, QSL cards etc were intended to act as spurs to developing better, more reliable, more portable/transportable low cost equipment, and enabling us to understand better the capabilities of the radio spectrum. Yes, Amateur Radio is an interesting fun hobby – but it is (or was) also basically a technical and scientific hobby held in high regard in professional and regulatory circles, serving as a valuable form of self-training and contributing to the art of radio communication.

Pat Hawker might well have added a further question. Radio amateurs have always used their experimental activities as justification for their 'special status' spectrum allocations. How much longer will this work, with the gradual trend towards appliance operation?

WIA'S 1991 CALL BOOK

The new 1991 WIA *Amateur Call Book* has been released, with a listing of 18,707 Australian amateur stations, 600 registered SWLs and many pages of essential reference information. Copies are available from Dick Smith Electronics stores and leading bookstores for $11.00 each, while WIA members can purchase it from Divisional Bookshops for $9.50 including postage and handling. But hurry – last year's edition sold out very quickly!

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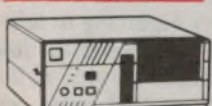

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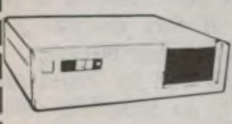

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256K bytes	424256 x 2
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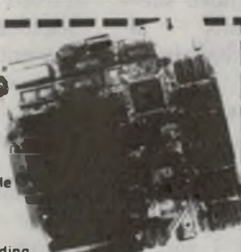

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IBM XT											
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Information centre

Conducted by Peter Phillips

Back to basics...

Basic things like power supplies and audio matters get quite a mention this month. There's some trivia that could be useful as a conversation item at a Christmas party, and a What?? question that's bound to cause angst among those of you that are theoreticians.

With the 'silly season' and the attendant (and rather welcome) holidays approaching, I thought it appropriate this month to feature those letters that tackle basic issues. For most of us, December marks the end of yet another frantic year, so we'll leave any high power technical questions for 1991.

And as the century draws on, reminders are coming thick and fast that today's technology is becoming more awesome. For example a recent news item featured a politician asserting that if 'certain measurements' on a 'certain sporting complex' had been made today, different results would have been obtained compared to those taken in 1982. 'Our technology today is so much more sophisticated' he confirmed.

Frankly, I'm still catching up on some of the technology developed in the 80's, let alone (choke!) the current decade. The problem of being technically out of date is something all technicians need to cope with, and my admission may strike a chord of relief among those who thought they were the only one. Of course, not knowing about megaflops, double sized oversampling and fast look-ahead minority totrons doesn't really faze me, as we get very few letters seeking clarification on these and related issues.

But it worries me somewhat when I have to admit that 'I don't know', when perhaps I should. The first letter asks a question about which I can only speculate, so we'll start with it, then move to the letters on basic issues promised in the header. Perhaps after the holidays and the associated heavy reading (kids permitting) I'll be more up to date...

Digital TV

Several TV manufacturers are now offering digital circuitry in the larger models, usually at a much higher price. Sales personnel seem unable to explain any advantage of the trend.

I would appreciate it if you could advise whether the additional expenditure is warranted in terms of picture quality, particularly where ABC reception is somewhat weak. (J.D., Kingscote SA).

I recently attended the launching of an all new digital audio amplifier, and asked the question 'why digital?' The answer was simply 'because that's what everyone is doing now.' I didn't admit to having a crummy old valve amplifier, and left the proceedings wondering whether hype had taken over from reality. To me, it seemed that digitising an audio signal then converting it back to analog seemed unnecessarily complex, particularly if the original input signal is analog in the first place.

Adding digital technology to a TV set is probably somewhat different, and my understanding is that a single line, or perhaps even the whole frame is captured in digital memory for subsequent display on the screen. Apparently this improves the display when an extra large screen is used. I doubt however, if any processing is used to remove snow and other reception problems – although, as per my previous admission, I don't really know.

I have viewed quite a few 'digitally enhanced' TV sets, and have to admit that the picture quality is excellent. Whether this is due to the digital circuitry or the large screen is something I have yet to determine, but I suspect that a comparison between a non-digital large screen TV and its digitised counterpart would show that the latter is superior.

If any readers can help me with this one, I (and J.D.) would be most grateful. Now back to basics..

Which direction?

I refer to your Basic Electronics article in the September edition. The eighth and ninth paragraphs are arrant b... s....!

Surely you must know that EA is read by many youngsters beginning to take an interest in radio. I was teethed on Radio and Hobbies, and built my first radio in 1924. Kids can be mislead easily, especially if they believe the writer knows his subject!

I believe it is long overdue that writers in electronic magazines should teach beginners that electric current consists of a movement of electrons. If you don't believe me, ask Jim Rowe or Neville Williams, who are both qualified to give correct answers. If they disagree with me, I'll dob them into their institutes.

Well, good luck, but for Pete's sake (forgive the pun), do something about those mistakes. (B.F., Glenroy Vic).

Well! The age-old question raises its anomaly again. Yes B.F., current certainly is a movement of electrons, as discovered at the turn of the century. With this I (and Jim and Neville *et al*) fully agree, and which I also fully described at the start of the series. The question is, should I use the direction of conventional current flow or electron flow, in the series.

As you can see, I am using conventional current flow, which is from positive to negative. Years ago, when valves were all the rage, I taught electron flow where everything flows from negative to positive. Then when transistors caught on, we all swapped back to good old positive to negative flow, as somehow electrons as such didn't seem to be quite as important any more.

To be honest, I am quite happy with either direction, but most of today's texts on the subject still use conventional current flow, as this direction fits in with the component symbols. It looks as if I'm in a no-win situation with this one, as if I had used electron flow, I would have alienated other readers. But from your letter, B.F., I don't think you are all that upset anyway. Thanks for raising the issue.

On the subject of the Basic Electronics series, a correspondent asks for more information concerning current rating of a transformer. I've condensed the letter for the purposes of publication, but the sentiments are hopefully intact:

Transformer ratings

I have been following your Basic Electronics series and Part 7 is approaching a matter of interest to me, as for some time I have been researching the issue of current rating for the secondary of a transformer. Most transformers are given either a secondary current rating or a VA rating, but this doesn't help when the transformer is being used in a power supply feeding a three-terminal regulator.

Because a large filter capacitor is required at the output of the rectifier, the current taken from the secondary has a non-sinusoidal shape, and the transformer ratings given are usually incorrect for this type of application. I have been advised that the rating must be increased by a particular factor, and my sources variously give factors of 1.11, 1.41 and 1.6. The latter was from a transformer manufacturer, by the way.

It seems there is some confusion on the issue, and I wonder if you could address the matter in the not too distant future, perhaps in a feature article. (B.H., Heathmont Vic).

I certainly agree B.H., the issue of transformer rating is a complex one, particularly when the secondary load contains a whopping big capacitor at the output of a rectifier.

Firstly, the multiplier that can be applied to calculate the secondary current rating depends on the type of rectifier circuit, and on how the transformer is being used. In some situations, the secondary current is limited by the size of the wire in the winding, in others by the amount of iron in the core.

In the first case, if the core VA rating has enough 'headroom' so that it doesn't saturate, the short duration/high amplitude current pulses taken by a rectifier-filter combination are less likely to cause problems. The average value of the waveform in the secondary is fairly close to the DC load current from the supply, and the heating effect would therefore be similar. This circumstance might occur if a section rather than the entire secondary is being used.

This means that a DC power supply with a 1-amp load could probably be operated with a transformer rated with a secondary current of around 1.1A (using the 1.1 multiplier). But if the transformer's *core* sets the VA rating, then saturation will occur at every half cycle if the peak value of the current exceeds the VA rating.

My understanding of transformer VA ratings is that if a bridge rectifier is used, the current rating of the transformer needs to be 1.66 times the load current of the supply. If a centre-tapped full wave circuit is being used, the rating is 1.4 times the DC load current.

The ideal situation would be transformer specifications that give a peak current and an RMS value. Even then, this doesn't take into account the resistive losses, the iron losses and all the other factors that make transformer ratings and power supply design rather complex anyway.

Yes, B.H., I agree that an article on transformer ratings would be most welcomed by readers. Perhaps a transformer manufacturer might assist. How about it, folks?

Some trivia

The next letter is offered in response to my admission that I like technical trivia. I can't verify or deny the truth of the story, but it's too good not to share. It comes from a reader who spotted it in *Byte* magazine, some time ago:

Back in the good old days all floppy disks were 8", and the drives were correspondingly large to suit. The minifloppy was about to be invented.

Why then is the minifloppy disk 5.25", rather than 5" in diameter? Was it the result of careful scientific study – the eventual compromise reached after all aspects had been weighed in conjunction with the technology of the day? Not on your nellie!

It so transpired that an unnamed computer manufacturer was having lunch with an engineer from Shugart Associates, when he complained that his desktop computers were now smaller than a set of 8" disk drives. Couldn't Shugart produce a smaller floppy disk?

The engineer asked how small the disk should be, whereupon the manufacturer picked up a cocktail napkin from the table and said 'about that size'. The engineer pocketed the napkin and left to produce the 5.25" minifloppy.

No prize for guessing the size of the napkin! (C.P., Boulia, Qld).

Thanks C.P. for sending me this story – I've often wondered why this dimension was chosen. What I would also like to know is how the length of a metre was established. Perhaps there was once a race of people with feet 39 inches long!

(Jim Rowe interjects: Wasn't the metre originally supposed to be 1/10,000th of the distance from the Equator to the North pole?)

Better sound

The next letter proposes a method of getting around the problem of speaker cables. Readers of Forum could hardly forget the arguments that have raged on the topic of grain orientated, molecularly linear phase matched totron-enhanced speaker cables that give 'transparent' sound!

The recent Pro-Series hifi amplifier project published in EA prompts me to write. With modern technology, the weakest link in the hifi chain is surely the loudspeaker and the associated heavy cabling. I suggest that considerable improvements could be achieved if the power amplifier in a sound system was broken into sections, giving an arrangement as shown in the diagram (Fig.1).

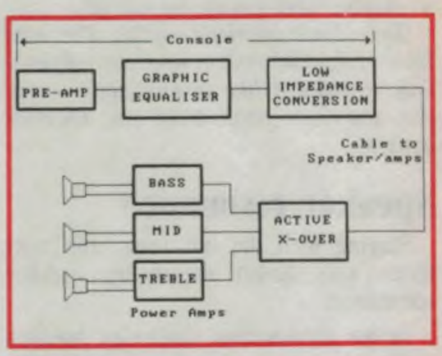


Fig.1

The main advantage would be that the speaker cable could be very short, giving a good damping factor. The active crossover would eliminate the problems of passive crossovers, and the only long cable would be the cable from the preamplifier to the main amplifier. This could perhaps be run using 300-ohm ribbon, which would tuck neatly under the carpet.

Although my proposed system would be more expensive than a single large amplifier, because the main cost in an amplifier is the power transformer, using three smaller transformers would probably not cost much more. (B.P., Port Macquarie NSW).

INFORMATION CENTRE

Good idea, B.P., although it's one that has been used in the past, albeit not exactly as you suggest. Older readers may recall the British manufacturer Quad, made famous for their electrostatic speakers. Years ago, this firm produced a system that used two separate power amplifier modules connected to a common preamplifier. The power modules were intended to fit out of sight, as close to the speakers as possible. I also have vague memories of other manufacturers producing speakers with the power amplifier built in, but the details elude me.

I must admit to skepticism when it comes to the problem of cabling, be it the speaker wires or the signal leads. To me, the greatest difficulty is caused by the listening environment, not the system. I enjoy fine sound, and have striven over the years for the 'perfect' system. But when I discovered live concerts, I gave up spending money on my hifi, as no amount of money could make my living room take on the acoustics of a concert hall.

These days amplifiers that feature surround sound and acoustic delay are within the price range of mere mortals, so maybe there's hope for me yet.

(Jim Rowe interjects again: The new Bose 'Lifestyle' system uses a configuration very much like that of Fig.1 – see our story on page 6 of the October issue.)

Speaker resonance

Staying with the hifi topic, the next letter asks about measuring speaker resonance:

In the Information Centre of January 1990, you mentioned that the Altronics C3055, 150mm speakers used in the September 1989 subwoofer design are now being produced with a 50Hz resonance instead of the specified 37Hz.

I purchased quite a few of these units, so I am concerned that the batch I received may have the incorrect resonance. Could you please tell me how I can measure the resonance, as the first set of speakers I built sound fantastic and I want to build some more. (F.F., Mount Evelyn Vic.)

Measuring speaker resonance is reasonably easy, providing you have an audio signal generator. An excellent book on the subject is one by Vance Dickason, titled *Loud Speaker Design Cookbook* and sold by Dick Smith Electronics. I'll briefly describe the process, but for more details you might like to refer to this book or others on the topic.

To measure the open air resonance of a speaker, first place the speaker in the centre of an uncluttered room. Ideally the speaker should be suspended in the air, to prevent the surroundings from affecting the resonance. The speaker is connected to a power amplifier in series with a 1k resistor, and the signal generator should be connected to the input of the amplifier. Then connect a 'scope or a sensitive AC voltmeter across the speaker. As the frequency of the signal generator approaches the resonance of the speaker, the voltage reading across the speaker will rise, as a result of the increase in the impedance of the speaker.

You should find that a peak reading occurs at one frequency only, which is the open air resonance of the speaker. It's that simple. Higher frequencies (above a few hundred hertz) will also cause the impedance of the speaker (and hence the voltage across it) to rise, but it will be obvious that this is not due to resonance as it will rise more slowly.

What??

As transformers and power supplies have been discussed this month, here's a question on the topic. The question was supplied by Wen Liang Soong, from Fullarton SA, who asks:

The circuit shown in the diagram (Fig.2) contains a 'real' transformer with a half-wave rectifier load on the secondary winding. The meters M1 and M2 are both DC ammeters, monitoring the primary and secondary currents of

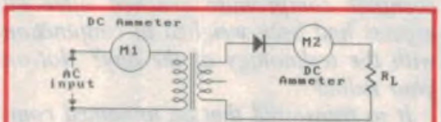


Fig.2

the transformer respectively. Meter M2 will register a value, as the current in the secondary circuit is unidirectional – due to the diode.

The question is, what will the DC ammeter M1 show? Will it give a reading, or simply remain at zero? Also, what is the shape of the primary current waveform?

Answer to last month's What??

To solve last month's What?? question, let's first do away with the kilo, and let R1 be 1 ohm. The kilo can be then put back into the final answer. Because there are two unknowns, two equations need to be developed.

For the condition where R1 is connected to 0V (or ground) and the voltage Vx is –1V, the current (I) in both resistors can be defined as I = 1/R1, giving 1A. The voltage across R2 will equal R2 (or 1 x R2) and also equal V – Vx or V-1. That is R2 = V-1. (Note how I'm ignoring polarities, as this will sort itself out later).

When R1 is connected to +5V, the current in the resistors will equal 4A and the voltage across R2 will now be V+1, as Vx is now +1V. By Ohm's law, the voltage across R2 also equals 4 times R2, giving 4 x R2 = V+1 which can be rearranged to R2 =(V+1)/4.

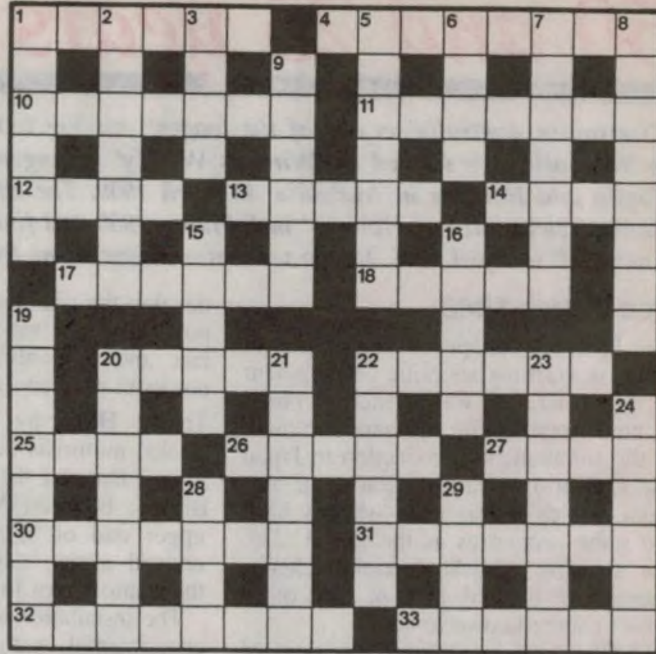
Taking the two equations for R2, we can get rid of R2 and end up with V-1 = (V+1)/4. Solving for V gives 5/3 or 1.67V. R2 can also be found from one of the above equations, giving 0.666 ohms which becomes 666 ohms when the kilo is returned.

The unknown voltage V needs to be negative, as otherwise the –1V value for Vx could not be achieved; meaning V is actually – 1.67V. It is also possible to come up with a general equation for this problem, but that was not the original question. Perhaps that may be for another time!

NOTES & ERRATA

VHF Powermatch 2 - Power Detector (September 1990): On page 127, the calibration voltage given for the 10W range is the peak value rather than the RMS value as stated. The corresponding RMS value is 22.361V. The values given for the 100mW and 1W ranges are correct.

EA CROSSWORD



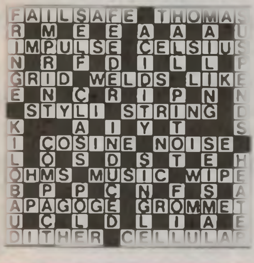
Across

1. Type of battery. (6)
4. Type of battery. (4-4)
10. Unit quantity of power. (3,4)
11. Nuclear generator. (7)
12. Plural of torus. (4)
13. Hobbyist's machine. (5)
14. Nobel prizewinner in quantum physics, Max ----. (4)
17. Incorporate in structure. (6)
18. Computer's motive unit, the disk ---. (5)
20. Connect terminals temporarily. (5)
22. Computer malfunction. (6)
25. Previously operated. (4)
26. First American to orbit the Earth. (5)
27. Activate a button switch. (4)
30. Pulsating by interference. (7)
31. Display of extracted data. (7)
32. Type of battery. (8)
33. Electrode in a cell. (6)

Down

1. Increases power, potential, etc. (6)
2. Logically deduced proposition. (7)
3. Word signifying satisfactory functioning. (4)
5. Connected to ground. (7)
6. Electronic device. (4)
7. Electrode. (7)
8. This is seen in a black hole. (8)
9. Unwavering. (6)
15. Electrical units named after Italian scientist. (5)
16. Mathematical or physical maximum. (5)
19. Partial shadow. (8)
20. Marketing form for small items. (7)
21. Type of substance in certain electric lamps. (7)
22. Support at space-rocket launch pad. (6)
23. Inventor of the torsion balance. (7)
24. Quantity of electromagnetic radiation. (6)
28. Plate referred to in tuning a radio. (4)
29. Information in alphanumeric form. (4)

NOVEMBER SOLUTION



Electronics Australia with ETI

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'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 1940

New Uranium Isotope: A new chapter in the most startling scientific development of this generation was opened in Philadelphia recently with the announcement of the simultaneous production in Japan and California of a new isotope of uranium, which theoretically should have the same properties as the rare U-235, the splitting of whose atom releases energy far beyond that of any other power source known to man.

U-235 exists in nature in a ratio of one atom to 139 of ordinary uranium, an abundant mineral which costs only about two dollars a pound. U-237, the new isotope, is made by the giant cyclotrons such as are now being set up by the Carnegie Institution in Washington.

At the same time it was learned that a world-wide race is now in progress to develop the uranium fissure process to a point where it will be practical in warfare and probably constitute the most powerful weapon ever known.

Traffic Hints by Radio: For several weeks, motorists travelling on the west-to-east lanes of the George Washington Bridge, between New Jersey and the upper end of Manhattan Island, have noticed a sign advising them to tune their auto radios to 550kc.

The installation is of a temporary and experimental nature, but if surveys show that a sufficient number of motorists are using the transmissions, it may go into permanent service as a highway aid.

December 1965

Carnarvon Tracking Station: The major aim of the tracking station situated at Carnarvon is to form a vital link between the spacecraft and Mission Control Centre in the US during the manned spaceflight programs. With both voice and teletype communication channels, the station can transmit ground radar tracking and telemetry in "real time." It also provides voice communication and command capability directly to the spacecraft.

Valuable tracking support is also given to special missions such as Ranger, whose object was to relay close-up pictures of the moon to earth, and the now famous Mariner mission which gave the first close-up pictures of Mars. New launch vehicles and experimental satellites are also accorded this support.

Special Radar for RAN: The Royal Australian Navy is to be equipped with the latest ground control approach radar equipment and associated electronics by a US affiliate of Standard Telephones and Cables Pty Ltd.

Known as Quadradar, the system is a complete four-in-one terminal area air traffic control system providing surveillance, final approach, height finding, and air traffic taxi information. It requires only one operator who can easily select any one of the four functions.

EA with ETI marketplace

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HOVERSPEED
SeaCat

Tasmania's new 'SeaCats': bristling with electronics

Most modern vessels have a reasonable array of electronic equipment aboard, but some of the systems fitted to the new Australian-designed and built SeaCats are claimed as world firsts. One system allows the Captain to manouvre the 74m jet-powered catamarans with a joystick, while another is an 'intelligent' radar which tracks all nearby vessels for speed and bearing...

by JIM LAWLER

A Tasmanian shipbuilder has recently completed the world's largest and fastest jet-powered vehicular ferry, then broken the trans-Tasman speed record for a vessel of any size – on just the first leg of its delivery voyage to England. If that statement appears to have too many 'firsts' for a local product, then think again.

The *Hoverspeed Great Britain*, a 74 metre, 600 ton aluminium wave-piercing catamaran is now carrying 400 passengers and 80 cars at more than 35 knots across the English Channel, between Portsmouth and Cherbourg. Powered by four 5000hp 16-cylinder Ruston diesel engines driving Italian designed hydrojets, the vessel is the first of several intended to take over from the vehicular hovercraft presently plying across the Channel.

The big Cat was built in Hobart by International Catamarans (Tasmania), to a design developed by InCat(Tas) Managing Director Robert Clifford and his former partner, marine architect Phil Hercus. Clifford has been building boats in Hobart for 20 years and has become well known for his innovative designs. He first got a taste for catamarans when he built a twin-hulled ferry for service on the Derwent River during the Tasman Bridge crisis in 1973.

Known then as the 'bushranger' because all of his ferries carried the names of famous Tasmanian bushrangers, Clifford continued building ferries after the bridge was restored and found a ready market interstate and overseas for his unusual but very speedy designs.

Some five years ago he came up with the idea of the wave-piercer, a twin hulled vessel that would go *through* the waves rather than over them. He built an eight-metre model from plywood, and spent months chasing the roughest seas he could find on the Derwent River and nearby waters.

The concept showed great promise, so he moved on to bigger things with a 19-metre aluminium version. This proved that the idea was sound and superbly seaworthy. It was the first of a series of boats that culminated in the *Hoverspeed Great Britain*.

The 74 metre vessel was built on the banks of the Derwent River a few miles upstream from the Tasman Bridge. It was constructed in two pieces, in a vast purpose designed shed that covers about 10 hectares. The entire ship was built under cover, allowing precise control of the welding that is the key to success in building large aluminium vessels.

The *'HGB'* is the first of what is likely to be a long series of similar vessels. Already six are ordered for the English Channel service and one for the local Bass Strait service. InCat has had to refuse an order for seven vessels from the USSR, because there is no gap in the production schedule for some years ahead.

Plans have been prepared for a new shipyard alongside the present site, which will allow the construction of six ships a year. At $25 million apiece, InCat has become a big operation in anyone's terms. And what's more, plans are underway to build a 100-metre version of the wave piercer which could become the future standard.

Just what is it that makes *HGB* and its future sister-ships so remarkable?

For starters, it's the space-age styling. The twin displacement hulls are long and lean, and built low down on the waterline. They are designed to cut through waves rather than ride up over them. As a result, passengers enjoy a much more stable ride.

HGB is the first vehicular ferry in which an aerodynamically shaped superstructure is an important design feature. At full speed the ship is butting into an 80kph wind, and streamlining is vital to its performance and fuel economy. (Passengers on the after-deck, the only 'outside' space available to them, are subjected to a continuous slipstream roar that drowns out the sound of the massive engines!)

Then, the ship is jet powered, just like the fast runabouts that ply our lakes and rivers. Only thing is, of course, that it's much bigger. Very much bigger.

When it was decided to jet-power the big Cat, a search began for someone to supply the impellors. In fact, there were few companies in the world who had the expertise to construct a 5000hp hydro-jet. Most jets were in the 100-200hp range, although one company had built a 3000hp unit.

An experienced Italian company was asked to look at the project and after some careful consideration, decided to give it a try. They took their largest unit and multiplied all the figures by 10. Then they built the result.

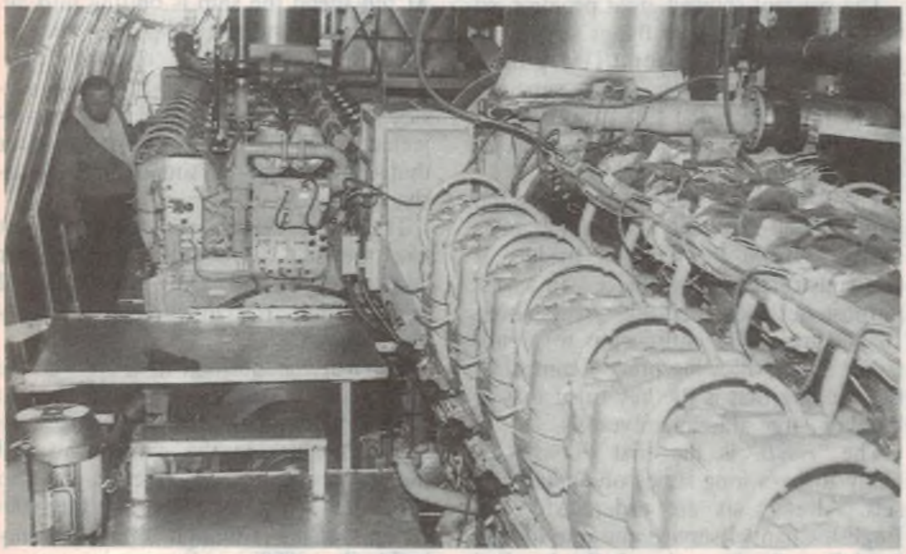
There was no way such enormous impellors could be tested without being fitted to a ship and driven through the water. So the big jets were completely untried before the *HGB* left her berth for the first time.

Likewise, the control systems for the 4 x 5000hp Ruston diesels had never been operated for real before the maiden voyage. Yet on that first day everything worked perfectly, and *HGB* did some high speed trials on the Derwent River under the approving eye of its (then) future owner – James Sherwood, Managing Director of Seatainers Ltd of Great Britain.

But with so much new technology

SeaCat electronics

The Hoverspeed Great Britain at anchor in the Derwent. At 74m long, it's the largest catamaran yet – as well as the fastest.



The somewhat cramped and crowded starboard engine room on the HGB. It houses two of the 5000hp 16-cylinder diesels, with the others on the port side.

aboard, it's understandable that things went wrong the next afternoon. One of the engines stopped just as the ship left its berth and without steerage, the big Cat ran up on the beach across the river. Fortunately, little damage was done other than to the skipper's pride.

Electronic systems

In keeping with its next-century styling (the first 29m version of the wave-piercing Cat was named *2001*, simply because it looked like something out of science fiction), *HGB* is filled with the latest electronic technology. Control, monitoring, communications and navigation are completely 'state of the art', and one system at least is believed to be a world first. This is the new English 'GPS' or Global Position System.

Until now, satellite navigation systems have been very accurate but dumb. The navigator has had to ask the system for a position check. Then he had to mark the postion on his chart. The GPS continually monitors the ship's position and records every change of direction and speed. This 'electronic dead-reckoning' is checked against a satellite report every few minutes and any corrections needed are entered into the electronic log.

Thus the navigator has a constant and immediate check on his position. He can also play back the GPS log to see exactly where he's been over the past several hours.

The GPS readout appears on a colour monitor as a grid of latitude and longitude lines in blue, with the ship's position and track shown in orange. Information about local hazards can be taken from the radar scan and incorporated into the GPS display.

Another new piece of equipment is the 'Lipstick' controller. The quaint name comes from the builders, the Lips Corporation of Norway, and the joystick form of the controls. The Lipstick consoles, one on each wing of the bridge, are intended to give the Captain precision control of the ship while berthing.

The Lipstick has been used on conventional ferries in Europe for some time, but this is the first time it has been fitted to a jet-powered Cat. The controller links the electronic engine management system, the hydraulic manoeuvering controls and the ships gyro compass, to enable the ship to be moved into and out of its berth with a single joystick control.

The Lipstick computer balances engine power against jet thrust to keep the ship's heading lined up to the gyro compass. The thrust can be applied in any direction, to move the ship bodily sideways into or out of the dock.

Although the Lipstick works well in other ships, its computer programme has taken a long time to develop for the big Cat. The new ship's handling characteristics were so much better than estimated that the Lipstick constantly over-corrected, and it had to be disconnected during the ship's initial sea trials. Now that the computer has been re-programmed the Captain has incredibly delicate control of the ship during berthing manoeuvres.

As mentioned earlier, the *HGB* is powered by four 16-cylinder diesels built by the Ruston company in England. The engines are V-16's, each about four metres long, and there are two of them in each hull.

Only two of the engines are linked to fully manoeuvreable jets. These are the inboard pair and are used at all times for berthing and steering the ship. The outboard engines are labelled 'Boost Engines' and are only started once the ship has cleared harbour. It is these latter engines that give the ship its phenomenal speed. Without them, it would be just a 'fast Cat'; with them it's a real 'screamin' demon'.

As with almost every other function on the ship, each of the 64 cylinders in the eight banks of eight is fitted with a sensor – in this case for temperature, and is linked to the ISIS Systems Monitor computer. The ISIS watches over about 380 different functions on the ship, from engine and bearing temperatures to hydraulic oil levels and pressures and the state of the auxiliary power generators.

The ISIS system is in constant communication with the bridge, and the Engineer has available a continuous computer printout of the status of every important system aboard. The computer prints out an ALarm whenever any of the monitored parameters goes out of tolerance, and a RETurn as it goes back to normal.

If any parameter goes too far out of tolerance, or remains out for too long, the system sounds an audible alarm that calls for immediate attention. Finally, if a dangerous situation arises, the ISIS computer has the ability to shut down the system before serious damage can be caused.

Because ISIS is so comprehensive, *HGB* can be run with only 10 crew aboard, most of whom will attend to passenger requirements. It's not expected that any crew will be needed in the engineroom at sea. In port, engineroom staff will only be needed to oversee the operation of the computer. All engine controls will be operated from the bridge, so crew will only be needed in the engine room if the computer fails – a most unlikely event.

One of the most exciting electronic devices on the new SeaCats is ARPA, (Automatic Radar Plotting Aid) a radar scanner and computer of exquisite complexity.

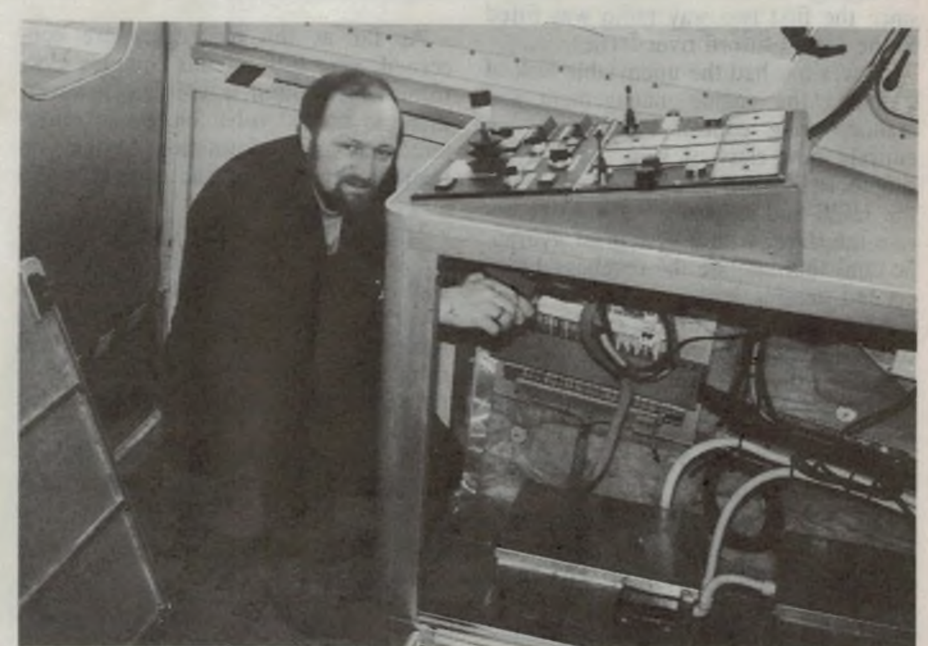
For over 50 years, radar has given observers no more than an obscure view of the area around them, and interpretation of that view has relied on the skill and training of the operators.

A radar installation was able to give only the range and direction of an object. The observer had to watch and interpret the movements on screen, bearing in mind his own speed and direction in relation to that of the object.

For slow moving targets, this might have required 15 minutes of observation to ensure an accurate decision. And that when there were only a few points of interest on the screen. With a really fast craft like the *HGB* and in a busy waterway like the English Channel, there was just not enough time for even the best observers to calculate the speed and bearings of all the targets in range.

ARPA displays the usual radar pattern, with blips of light representing the objects of concern. The operator uses a joystick controller to move a cursor over the target and then presses the 'Acquire' button.

The communications bay is the key to onboard supervision. The computer printer is at left, with the weather fax on the wall behind.



Electronics technician Bob Geeves making adjustments to the Lipstick controller on the Hoverspeed France.

Within about half a minute, ARPA will calculate all the details of the target. These include speed and bearing of both ships, the range at nearest approach, the time to nearest approach, and whether or not the combined courses amount to a collision course.

In just a few minutes, ARPA can track and report on 20 or more targets, at any range up to 96 nautical miles, and under any weather conditions. It can call attention on the bridge to possible dangers, and will sound an alarm if those dangers become real.

During a recent voyage from Sydney to Hobart on the second Seacat *Hoverspeed France*, the Helmsman found himself, at night, in the midst of a large fleet of squid fishing boats.

The brilliant lighting on the boats' decks masked their navigation lights, and he had no idea of which way they were heading. He only knew they were there, and a possible danger.

Using ARPA, he was able to keep track of each of the boats, and to determine that several of them were on near-collision courses. By changing the Seacat's course by only a degree or two, he was able to dodge the collision. (I can't help wondering about the fishermen's thoughts, as the giant cat went roaring past them at 40 knots on a dark and windy night!)

SeaCat electronics

In ships as fast as the SeaCats, ARPA takes a lot of the strain off the bridge crew. The ultimate responsibility remains with the ship's Captain, but ARPA gives him advance warning of possible dangers.

With the exception of the Global Positioning System, most of the electronics in *HGB* has been used in other ships, mostly in and around Europe. But it has never been brought together in one ship, and never in one of this type or sophistication.

The task of fitting all of these electronic black-boxes into the new ship fell to Hobart technician Bob Geeves. Geeves has worked closely with InCat Managing Director Robert Clifford since the first two way radio was fitted to the early Clifford river ferries.

Geeves has had the unenviable task of installing the engine management and manoeuvering control systems for an entirely new class of ship. Unlike the simple rudder on a conventional ship, the *HGB* and its sisters have an elaborate interface, with a system of hydraulic rams that operate the reversing buckets and steering jets.

All of this had to be electronically controlled and monitored, and the final system involved the fitting and connection of some 27,000 metres of cable (in a ship only 74 metres long!) The electronics were designed by Antelope Engineering, of Sydney.

Bob Geeves worked closely with Antelope to devise ways to make the autopilot talk to the hydraulics. The autopilot is normally in control of steering, except when docking or under Lipstick control.

The complications arise from the fact that it is necessary for the Captain to know exactly where the reversing buckets and steering jets are directed, before he applies power. This information is returned to the bridge from a series of sensors attached to the hydraulic system.

The propulsion system has no clutch or gear box between the engines and impellors, and if one of the 5000hp engines was started with any degree of forward angle on the buckets, the Captain would find himself in mid-channel with half of the jetty still tied on behind. In fact, if either of the manoeuvring jets is not at 'Bucket Zero' (or propulsion vertically downward), then that engine will not start until it is manually put at zero.

Bob Geeves again, shown checking out the control console of Hoverspeed France's ARPA (Automatic Radar Plotting Aid).

Video facilities

As far as the passengers are concerned, very little of this complex electronics installation is visible. However, there is an extensive electronic entertainment and information system on board, comprising public address, radio and video services.

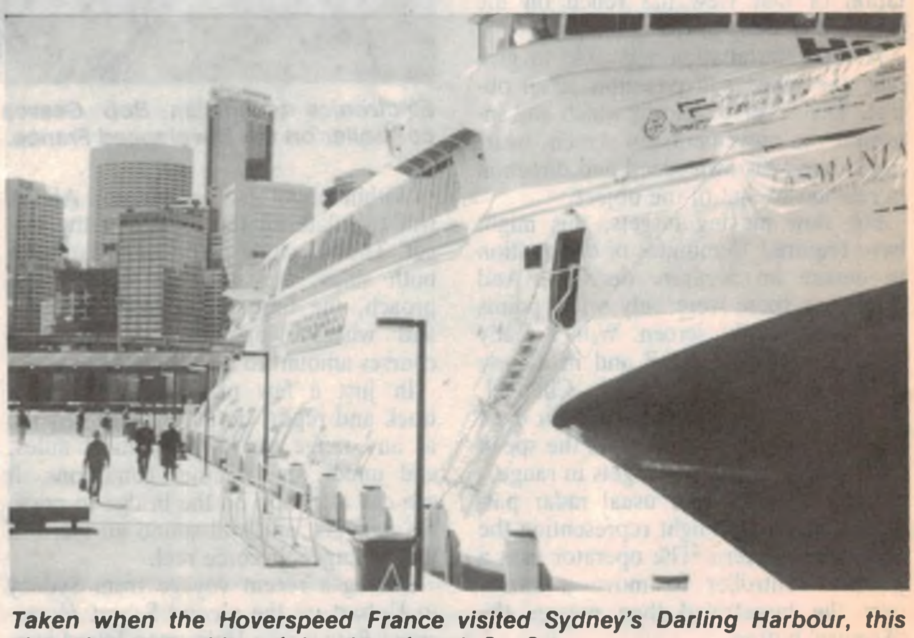
The video material is displayed on six 28" colour monitors, four on the front wall of the passenger lounge and two on the rear wall. A multi-standard video recorder is installed on the bridge and can be used as either a TV tuner or to play information or entertainment video tapes.

(A videotape detailing safety procedures will be shown at the start of each voyage. This will be similar to, but far more graphic, than the safety lectures delivered by cabin staff in airliners!)

The sound portion of the video display, as well as radio broadcasts and general announcements are carried by an elaborate public address system. This comprises three 120-watt amplifiers and a network of nearly 100 speakers.

One amplifier and 10 horn speakers are used exclusively for PA announcements on the vehicle deck. Another amp and 60-odd speakers carry the video sound in the main passenger saloon, while the third amplifier provides radio or taped music in the bar and on the afterdeck. Whenever an announcement is to be made from the bridge, all three amps are automatically linked, switched on and turned up to full volume.

The PA system was initially to be supplied by a Norwegian firm with wide ex-



Taken when the Hoverspeed France visited Sydney's Darling Harbour, this shot gives some idea of the size of each SeaCat.

perience in marine PA work. However, their quote of $95,000 led to a serious rethink of the requirements. In the end, AWA in Sydney provided a complete design and supply service for only $8700. The equipment was installed by Bob Geeves and his team and has worked perfectly from the day it was first switched on.

I had the pleasure of taking a trip on the *HGB* during her sea trials, before departure for the UK. The nine-hour trip began with dozens of runs over the measured mile, just outside the Derwent River.

The tests were made on two, three and four engines, at quarter, half, three quarter and full power. As these tests proceeded, the smiles on the faces of the engineers grew rosier and rosier. Obviously, the ship was out-performing her design parameters and those responsible were walking on air.

Then came the fuel consumption tests, a series of one hour runs at half, three quarters and full power. For this part of the trials, we headed southeast toward Tasman Island, then around the corner to Triabunna and back again.

This is a part of the world renowned for the troubles it deals out to Sydney-Hobart yachtsmen, but on this day it was considered to be 'dead calm'. Nevertheless, there was a two-metre swell running and driving a big ship into that at more than 40 knots is not advisable for passenger comfort.

Bob Geeves had little time to admire the scenery during this part of the trip. He had many checks to complete, including fine tuning the electronic Log that records the ship's speed through the water. This involved 10 minutes spent in one of the voids below the waterline, amid the rush and roar of the 80kph water just outside the 10mm aluminium skin.

Another check that relied heavily on state of the art electronics was the testing of engine power. This was done by measuring the torque on the drive shafts, at each different speed setting. Carefully aligned markers were attached to each end of each drive shaft and these were monitored by sensors that sent an impulse to the measuring equipment each time the shaft rotated.

As engine power was applied, the drive shaft twisted and the markers were no longer in alignment. The angular displacement of the markers represented the power being applied to the shaft and this was easily related to the rotational speed of the shaft.

These two parameters were then compared to the 'through the water' speed of the big Cat, and the resulting figures were responsible for the even happier faces on the engineers aboard that day.

Everything about the big Cat is breaking new design ground. No ship like this had ever been built before and no data existed about its likely performance.

Another problem with the new ship is that, following the *Herald of Free Enterprise* disaster at Zeebrugge a couple of years ago, the British maritime authorities have demanded that all new ships meet very stringent safety requirements.

It hasn't been possible to predict how these new requirements will affect ship handling and operations, but the designers of *HGB* and her sister ships have done their best to integrate extreme safety with speed, passenger comfort and operating economy.

It remains to be seen how well they have succeeded, but Australia can be pleased that a local company has taken the lead in high tech ship design and construction.

Maiden voyage

It's one thing to build in Southern Tasmania a ship for UK service. It's another thing to deliver it to its future owners. *HGB* left Hobart in early May and sailed by way of New Zealand, Tahiti, Panama, Curaco, New York and Portsmouth.

The first leg of the trip, from Hobart to Bluff in NZ, was taken at high speed, to iron out any bugs that might trouble the ship on the much longer second leg, to Tahiti. By covering the distance in less than 24 hours, *HGB* has created a new record for crossing the Tasman Sea, on the very first leg of her maiden voyage.

Later, the ship attempted a record crossing of the Atlantic, for the Atlantic Blue Riband and the Hales Trophy, currently held by the USA. The trophy has been held in turn by *RMS Queen Mary*, *RMS Queen Elizabeth* and the USS United States.

Several attempts have been made on the trophy in recent years, but only by dedicated power boats, not by regular passenger vessels and certainly not by any kind of vehicular ferry. *Hoverspeed Great Britain* covered the distance in some two hours less than the three days, ten hours and forty minutes record of the *USS United States*, putting Australian shipbuilding firmly on the world stage.

SeaCats are expected to become common on ferry routes around the world – something for which Australia's shipbuilding and electronics industries can be justly proud. EA

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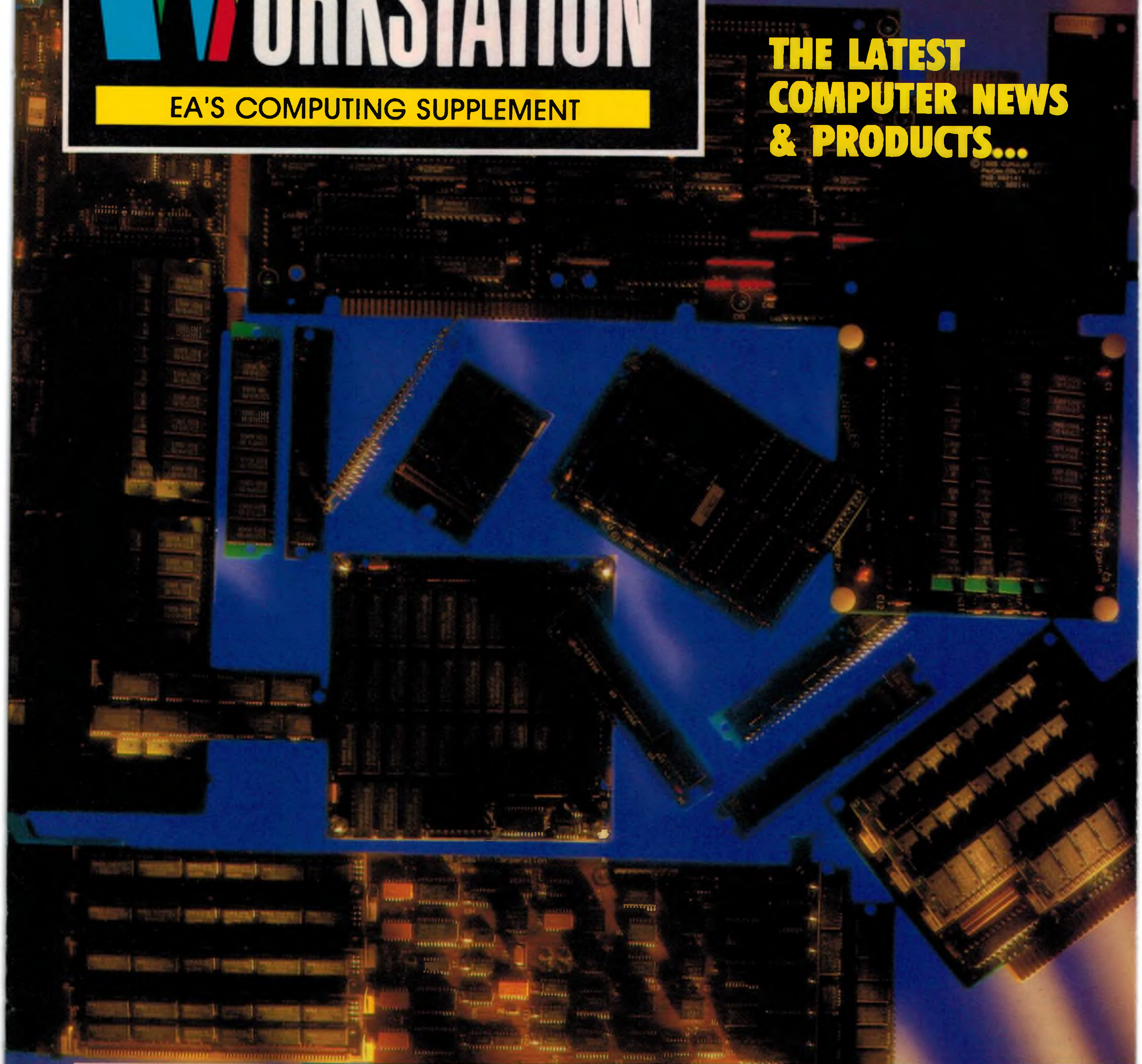


MEMORY UPGRADE MODULES: TO 32MB

WHAT'S INSIDE A LAPTOP...

SIMPLE DECODER FOR 'IBM' KEYBOARDS

Easy way into computers – 3:

Using 'laptops' in electronics

In this third and final article in his short series on using personal computers for electronics, the author explains the basics of laptop computers.

by TOM MOFFAT

If you've been into a computer store lately, you may have noticed that laptops are the latest craze. They're quickly superseding the big desk-bound monsters of a couple of years ago. But the laptops – some now down to the size of a book – have nearly all the capabilities of their bigger brothers.

For the electronics designer or experimenter, this is a great development, because now you can carry the computer to the work instead of trying to organize the work around the computer. I remember perhaps 10 years ago at a university physics department; laboratories with a PDP-8 computer as the centrepiece, and wires radiating everywhere to experimental apparatus placed carefully around the machine. That's all gone now, and a laptop computer becomes simply another piece of test or control equipment.

Within the lab environment, computers are usually used as programmable controllers, or as data loggers to collect the results of experiments. I've also seen them used as simple 'dumb terminals', using serial communications to communicate with some purpose-built 'black box' computer which is a permanent part of the experiment.

In other areas of university study, laptops are being promoted as 'electronic notebooks'. A battery-powered laptop, running a simple word processing or editing program, can be used to take notes in a lecture. The same machine can be used later to prepare complete assignments, essays, or papers. One would wonder about 100 laptop keyboards in a lecture theatre all going clickety-clack at once, but many of the smaller machines have very quiet keyboards. Perhaps the designers were thinking of a lecture theatre environment when they designed them!

Some of the best-known laptop computer makers are now engaging in a big sales push to get their machines into the hands of individual university students, and they're discounting their prices up to 40% for uni buyers. Perhaps laptops will soon be 'must-have' items, just like pocket calculators are today. A recent newspaper report says the Methodist Ladies College in Melbourne has just equipped the 82 students in year five with Toshiba T1000SE laptops – bought, or hired, by their parents.

For those who haven't really studied the laptop scene yet, perhaps we should look at a few characteristics of these machines that set them apart from their

Tom Moffat's own Toshiba 1200 doesn't always stay in the workshop, as you can see. Here it's displaying a weather fax, on a friend's boat.

One of the good things about a laptop is that you can use them anywhere – aboard a boat, in your car, on an international flight or sitting in the park.

big brothers. With such a small size there's obviously got to be some give and take, but any disadvantages are minor compared with the laptop's usefulness as a handy, carry-around tool.

Laptop screens

The usual screen arrangement in a laptop is a flat panel that folds down to cover the keyboard when the machine is put away, and folds up during use. Screen technology is going in leaps and bounds, and some of the latest types match the resolution of the very highest IBM 'VGA' spec. Colour screens are just nudging around the corner, but these screens are really aimed at high-powered corporate and government users – not uni students and electronics experimenters.

The laptops most likely to wind up in the hands of private owners almost always have a liquid crystal display screen, with resolution to match the IBM 'CGA' standard. This can produce a matrix of 640 x 200 dots as black and white, or 320 x 200 for 'colour'. An ordinary laptop LCD screen can't actually produce colour, but it can come up with a pretty impressive gray-scale shading effect by reproducing 'colours' as different dot patterns.

'Power users' of computers will tell you the CGA standard is dead, but ordinary people still use it every day. Particularly in a laptop, CGA is quite good enough for word processing and straightforward graphics. And it costs only a fraction of the more up-market EGA and VGA standards.

Most CGA laptop screens are slightly 'squashed'; their shape isn't quite as high as their width would suggest. Circles become footballs, but this is really of no consequence. And when the screen is displaying text, you forget all about the fact that the screen is slightly short. Some of the newer systems, such as the latest Toshiba T1000SE and the Zenith and Amstrad models, have screens that are the proper height for their width.

LCD screens produce their displays in one of two ways: by reflected light, or by an artificial light placed behind the screen. The backlit screen gives by far the best image in indoor situations, but the reflective system wins outdoors and in other bright locations. A disadvantage of the backlit screen is that it takes a fair bit of battery power to supply the light energy. In general, a computer with a reflective screen will run more than twice as long on a battery charge as a machine with a backlit screen.

The 'classic' Toshiba T1000, which is probably the most popular laptop yet produced, has a reflective screen which is quite flattened in shape. The bigger T1200 comes in two versions, reflective and backlit, but you're stuck with one or another once you've made your choice. It is possible to upgrade a reflective T1200 to a backlit screen, but it's expensive. The latest Toshiba T1000SE comes with a backlit screen only, so its battery life will never approach that of the earlier T1000.

Many laptops also let you dispense with the LCD screen altogether if you're working indoors with mains power. You can instead connect a proper computer monitor, even a colour one, to a socket on the back. So you can use your little machine to do something like multi-colour CAD work sitting at your dining room table at home. For some reason Toshiba decided to dispense with

Tom's daughter also borrows it occasionally, so she can write her essays down at the beach.

Laptop basics

the external monitor feature on its latest T1000SE model, which is sad. I use an external monitor with my own T1200 all the time, particularly at night.

Keyboards

Laptop keyboards range from absolutely horrid to spectacularly good. Some of them have that 'rubbery' feel, and the keyboards on the smallest laptops will have their keys squashed much closer together than on a full-side computer or a typewriter (remember typewriters?). If you're a hunt-and-peck typist, just about any old keyboard will do. But if you touch type, you MUST have a decent keyboard. Anything else will produce frustration for the lifetime of the computer.

I feel that any computer user nowadays should learn to touch type. In schools it's called 'keyboard skills', but it's still learning to touch type. I've been trying to talk my own kids into 'keyboard skills', but so far they've resisted. I suspect they think it's the first step into secretarial school. But they're wrong; ALL students will have to learn it sooner or later. There are many computer programs around, some from the public domain, which will teach you to touch type.

The point of this is that you may not be a touch typist now, but there's a very good chance you will be a touch typist sometime in the future. You should keep this in mind when assessing a keyboard. It should be just as good, if not better, than the keyboard on a full-sized computer.

The keyboard on the Toshiba T1200 is recognized as being the best in the laptop industry. Its only downfall is that it clickety-clacks a lot, and I don't know if I'd be game to use it in a lecture theatre.

A full-sized IBM keyboard has a numeric keypad on the right, as well as the normal QWERTY keys in the middle. On the left there are usually a couple of rows of function keys. The Amstrad laptops keep this arrangement pretty well intact by making the keyboard much wider than the screen. Other laptops leave out the numeric keypad and make some of the QWERTY keys take the place of it by first pressing a function key. Toshibas have an optional external numeric keypad which can sit next to the computer in the usual place. The function keys are normally strung out along the top of the keyboard.

Sharp's PC-5500 laptop, which features built-in floppy disk and hard disk drives, together with a screen offering VGA-level resolution.

Disk drives

The most popular disk drive for laptops is the 3-1/2" format used on some of the bigger IBM's, as well as other machines such as Microbee and Applix. The disks are quite common, and although expensive at first, they've come down nicely in price. Each disk, which is enclosed in a rigid plastic sleeve, can hold 720K of information. There is a metal cover in the sleeve which is pushed back when the disk is inserted into the computer, allowing the magnetic heads to reach the disk. These disks can be carried around in the shirt pocket (that was the specification for the size in the first place) and because of the plastic cover they are very rugged.

Another variation has just come on the market; disks much like the 3-1/2" variety, but only 2" in diameter. These are used in the latest Zenith laptop, the MinisPort. Because they are so new and only used in the one machine, these disks are very expensive; at time of writing, around $19 each. But they are sure to come down as they become more popular. The MinisPort is being strongly promoted into the uni student market, so there should soon be plenty of them around. Some people feel the 2" disks will eventually replace 3-1/2" size.

The Poquet laptop, recently released in the USA, does away with disks altogether. Instead it has a removable 'memory card' that looks much like a credit card – a method of storing data with no moving parts. But you pay for it; something like a dollar a kilobyte, in the USA. However with the disk drives eliminated, they've shrunk the Poquet to pocket size (I'm sure their pun is indended) and made it run for something like 100 hours on a couple of AA cells. It would interesting to try touch-typing on such a tiny keyboard.

Some laptops, including the Toshiba T1200, are available with a miniature version of the type of hard disk found on big desktop PCs. Although convenient, these drives must be kept spinning all the time to be of any use – so they

eat up battery power like it's going out of style. Most laptops have a means of turning off the motor, but then you can't use the hard drive. So why have it in the first place?

Some of the gigantic software packages for the business world are so big they must have a couple of megabytes on a hard drive to operate at all. You MUST then have a hard drive if you want to use this stuff. But they're not really the type of software electronics people like us would have any use for.

The most useful disk drive development for laptops is a big fake – it's not a disk drive at all. Many of these machines have a megabyte of memory, and you can set aside everything above 640K as a 'hard RAM'. This is a software simulation of a small hard disk, called 'drive C' in the usual way. It will contain around 360K of space and will behave in every way like a hard disk, even to retaining its contents when the computer is reset or turned off. Since it's done solely in memory, the thing is lightning fast. And of course there is no power-hungry motor.

On my Toshiba I have stored programs and data on the hard RAM for months at a time. It has proved very reliable, except for one time when I managed to completely crash the whole computer with an errant 'C' program. In another instance the directory got trashed – this time by an out-of-control machine code program I was writing. But I was able to recover the files OK.

A hard RAM is a valuable accessory, and once you've used one you won't be able to live without it. You may even want to add another megabyte of memory to your laptop, to provide a 1.4 megabyte hard RAM. But you must not store one-only copies of valuable stuff on the hard RAM; you MUST make sure there are other copies elsewhere. Of course this applies to any disk, not just a hard RAM.

How many disk drives do you need? As mentioned before, I think you can do without a hard drive and its added expense and power consumption. My laptop has two 3-1/2" floppies and the hard RAM. I seldom use both drives and could get along quite well with only one, since the hard RAM is really my 'working disk'. The Toshiba T1000SE has only the one floppy, but it has the hard RAM system, as well as its entire DOS disk in ROMs. That sounds like an ideal arrangement.

One exception to all this disk miniaturization is the Chendai laptop, which uses a good old 5-1/4" floppy. If you own a traditional desktop PC you can use its disks in the laptop, and the Chendai's disks in the PC.

The Chendai's only downfall is that it's mains powered only. But many people would never use a laptop outdoors, anyhow, so it could be a machine worth looking at. Which brings us to the next subject...

Batteries

This is really a difficult subject to get any straight facts on. Every battery-powered laptop claims this capacity or that running time, and then some magazine reviewer will come along and say Machine X carked it after two hours, instead of the four hours claimed. What goes wrong?

I think part of the trouble is that they are given brand new laptops, with brand new batteries. Electronics people will know that a NiCad battery needs to be cycled up and down a few times before it develops a decent capacity. As well, these reviewers run the machines with screen backlights blazing away and hard disks spinning continuously, and then wonder why the batteries go flat.

Despite what you read, a battery-powered laptop should give you a very useful time between charges, providing you operate it with a bit of thought. If you can do without a backlit screen, that's a big help. Some screens can have their lights turned off, but then they look a bit yucky. You should avoid using a hard disk if you can. And if the laptop has switchable clock speeds, the slower one usually uses less power.

A useful trick is to avoid using anything with a motor, meaning hard disks or floppies, when on batteries. While running on mains power you can copy the software you intend to use onto the hard RAM, and then put your floppy disks away before firing up on battery power. An exception to this is to copy important work onto a floppy from time to time, in case you manage to crash the hard RAM. But this only means a few seconds of motor operation every half hour or so.

A recent review I read on the Toshiba T1200, the very same model I'm using, complained that the batteries went flat in an hour. Yet I use this machine on batteries day after day, and if I can't get seven or eight hours out of it on each charge I want to know the reason why. Hard typing for that much time should produce a magazine article of 7000 or 8000 words, certainly more than I'm capable of writing in one sitting. So you'll know your battery life is sufficient if you run out of puff before your laptop does!

Mini Construction Project:

ASCII Decoder for 'IBM' keyboards

Do you have an elderly computer with a grotty old keyboard, that you'd like to replace with one of those attractively-priced 'IBM PC-AT' type keyboards? Then this keyboard decoder project is for you, as it solves all the interface problems.

by PETER BAXTER

The introduction of '101 key' keyboards for IBM 'AT' personal computers and their clones prompted some people to throw out their old 84-key keyboards and replace them with the larger, more advanced units. I was the lucky recipient of an unwanted 84-key version, and felt it was time to get rid of my CP/M system's old problem-plagued keyboard. Having two similar keyboard layouts would also make life just that little bit easier.

Unfortunately, the IBM PC type of keyboard has a serial output that can't be put through a UART to give an ASCII output as required by many earlier computers and terminals. It sends out keycodes, which must be decoded via a lookup table to get the required ASCII code. What I needed was an adapter that converts the serial keycode output from the keyboard into parallel ASCII data.

I decided to base the project on the Intel 8749 microcomputer chip from the Intel 8048 family, because I had devices and development software available. These devices contain 2K bytes of ROM, 128 bytes of RAM, one timer, 27 I/O port pins and the CPU, all within one 40-pin DIP package.

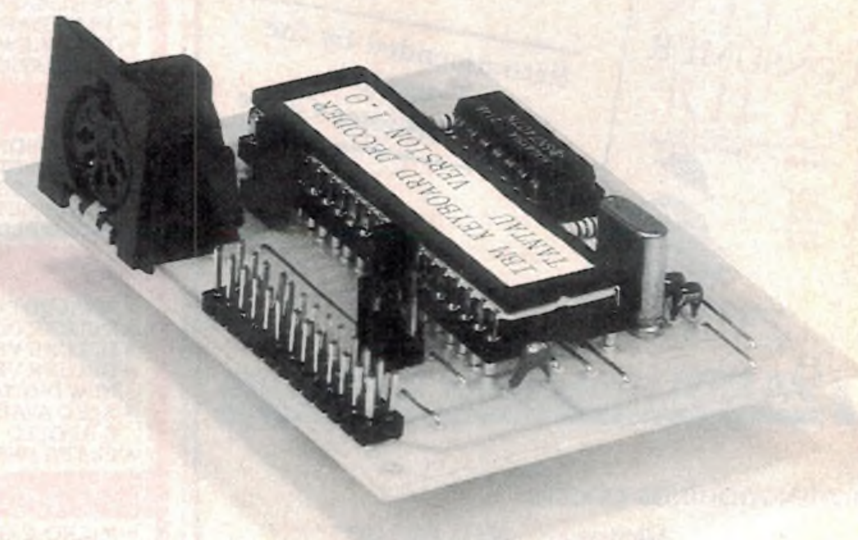
While the 8048 family (8048, 8049, 8050, 8748, 8749, 8039) may not be familiar to you, it is more than likely that one is present inside your keyboard (converting keystrokes into codes) and another is inside your mouse converting movement into codes. In fact, the 8049 from Intel is one of the most widely used microcomputer chips around. The 8749 is a user programmable/reprogrammable EPROM version of the 8049 factory masked (programmed) version. The 8749 costs about $20 (incl tax) in single quantities and the 8049 with a program burned in, about $4 in 10k quantities.

Using a microcontroller chip reduces the size, complexity, construction time and cost of a project like this. Only two ICs are required with a few discrete support components. The drawback is that unless you have an 8048 Cross Assembler (around $90), you can't modify the program. However, this shouldn't be a concern for most people as it already does the job required.

I estimate that currently the PCB version of this decoder, using the 8749 device should only cost you around $50.

Theory of operation

Most of the work done by the decoder is handled by the software. The codes coming from the IBM keyboard are in serial format. Each serial data bit is clocked into the 8749 computer chip



All of the components fit on a small PCB, measuring 76 x 60mm, with a 5-pin DIN socket to receive the standard keyboard cable plug.

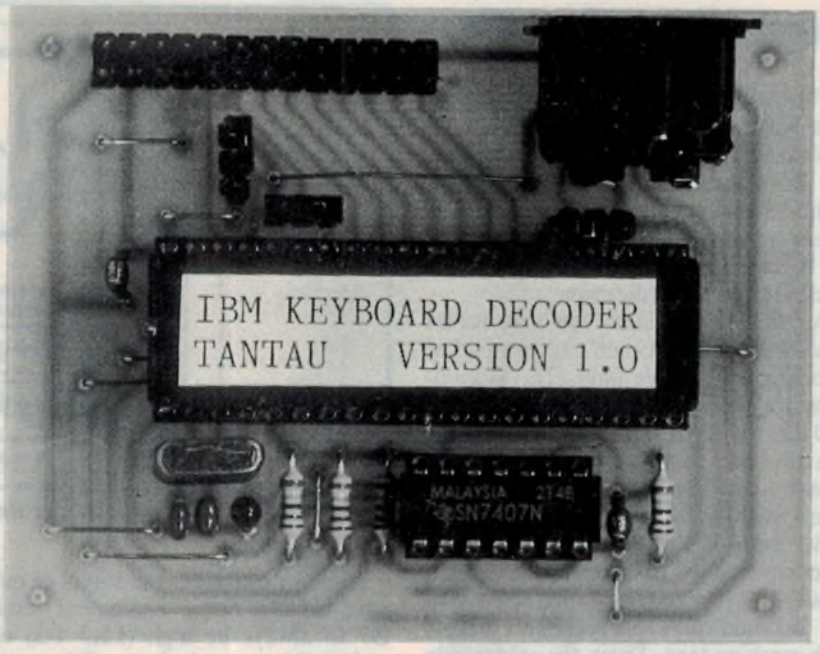
when the clock line goes low. This serial data consists of a start bit, 8 data bits, a parity bit and one stop bit.

While all of this sounds fairly straightforward, the challenge comes in decoding these codes into parallel ASCII. Each keypress gives a 'make' code and each release, two 'break' codes. While these make and break codes have no relationship to ASCII, they do allow flexibility in key assignment within different IBM-DOS programs.

Once the relevant key code is converted to ASCII via a lookup table, it is strobed out. It may seem simple, but it's not. Readers wanting additional information will find the IBM AT Technical Reference manual helpful. The entire program, including two lookup tables, is less than 2K bytes long and therefore fits comfortably in the 8749's internal EPROM.

The decoder's hardware is very simple due to the use of the microcomputer. Earlier, I discussed what was inside the microcomputer U1; what remains to be discussed is the second chip U2, which provides the buffer/line drivers for the keyboard interface.

The 7407 has open-collector outputs which enable it to be used at either end of the data and clock lines. The keyboard or the decoder can take control of the lines to pull them low. Pullup resistors are used at each end to allow high levels. Inside the keyboard, there are 4.7k resistors on both the data and clock lines. The decoder uses 150k resistors on these lines to reduce loading.



Here's a plan view of the assembled PCB, to guide you in assembly. Thanks to the use of an 8749, the parts count is very low.

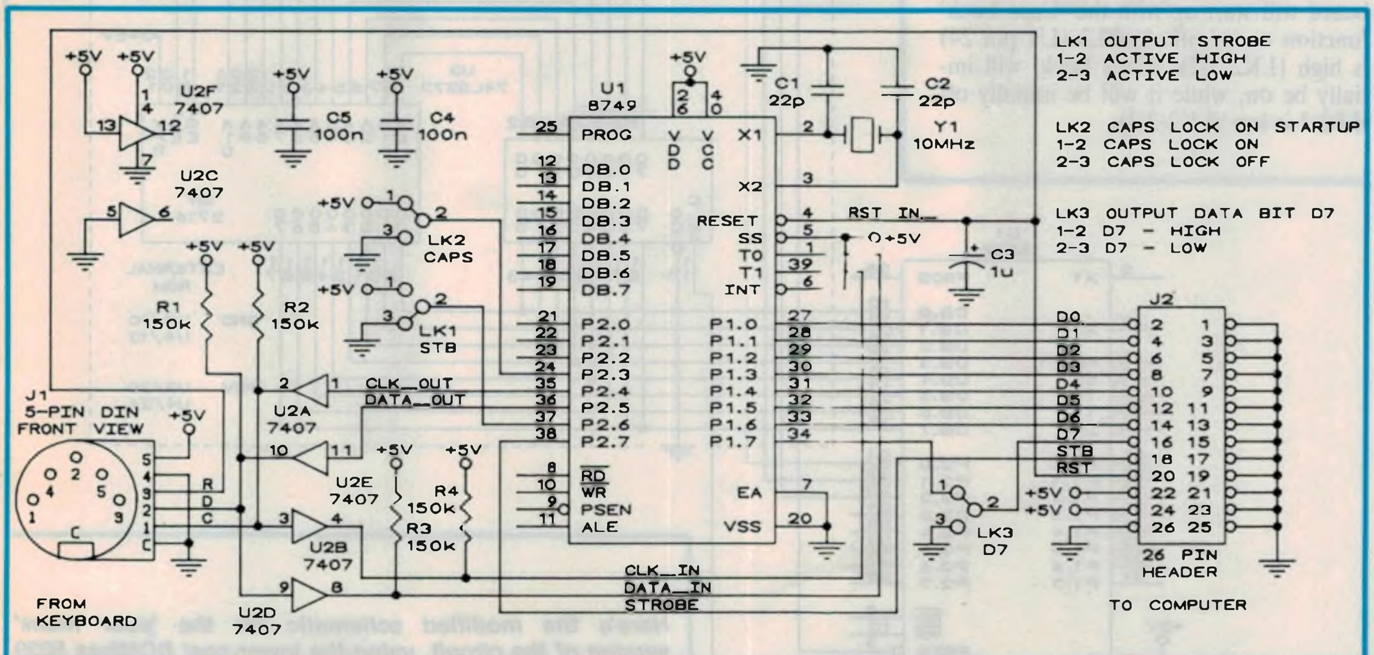
Assembly

The decoder will typically be used inside another piece of equipment such as a terminal or computer, therefore it is up to the user to select the appropriate construction method.

My first two prototypes were wire-wrapped on Veroboard. This is the easiest method. Layout is not critical except for keeping the 10MHz crystal close to the microcomputer. Use IC sockets for both ICs, as you may need to remove either at a later date.

I have also produced a simple printed circuit board pattern, for those who wish to take advantage of this.

Assuming you're using the PCB approach, install all of the wire jumpers before soldering in any components. The reset line wire jumpers are set up to allow a variety of options. Normally, none of the reset jumpers need be installed. If you want your main terminal or computer to control the decoder's reset line (and it functions 'active low'), delete C3 and install all jumpers.



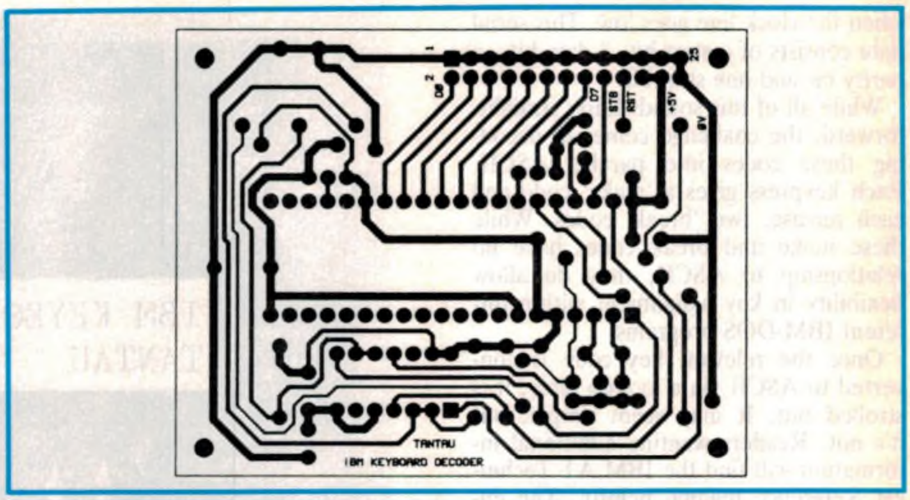
Although decoding the keyboard's output codes is fairly complex, using a single-chip microcomputer allows all of the real work to be done by the 8749's internal firmware. The author can supply pre-programmed chips.

Keyboard decoder

The reset connection to the keyboard is available should you want it to be controlled by your terminal or computer. Normally, there is no connection within the keyboard for reset, so it doesn't matter anyway. The reset line on the PCB is thinner than any other track for easy identification.

For the link options, you may prefer to solder a wire between pads instead of installing replaceable links. The link options are explained in the setup section.

Once the PCB is tested, you might like to seal it in a conformal coating. Remove any flux first by cleaning the board with a PCB spray cleaner. Remove both ICs and replaceable links, then cover the DIN connector, 26 pin header, any replaceable link pins and the exposed pins of both IC sockets with masking tape. Spray the solder side of the board first, then after it has dried, spray the component side – ensuring all covered contacts remain uncoated.



An actual-size PCB pattern, for those who like to etch their own.

Setup

Three link options should be set during the assembly stage. Link 1 determines the polarity of the circuit's output strobe pulse. If P2.6 (U1 pin 37) is high (LK1 1-2), the strobe pulse will be active high. If P2.6 is low (LK1 2-3), it will be active low.

Link 2 determines whether the keyboard will start up with the 'Caps Lock' function on or off. If P2.3 (U1 pin 24) is high (LK2 1-2), 'Caps Lock' will initially be on, while it will be initially off if P2.3 is low (LK2 2-3).

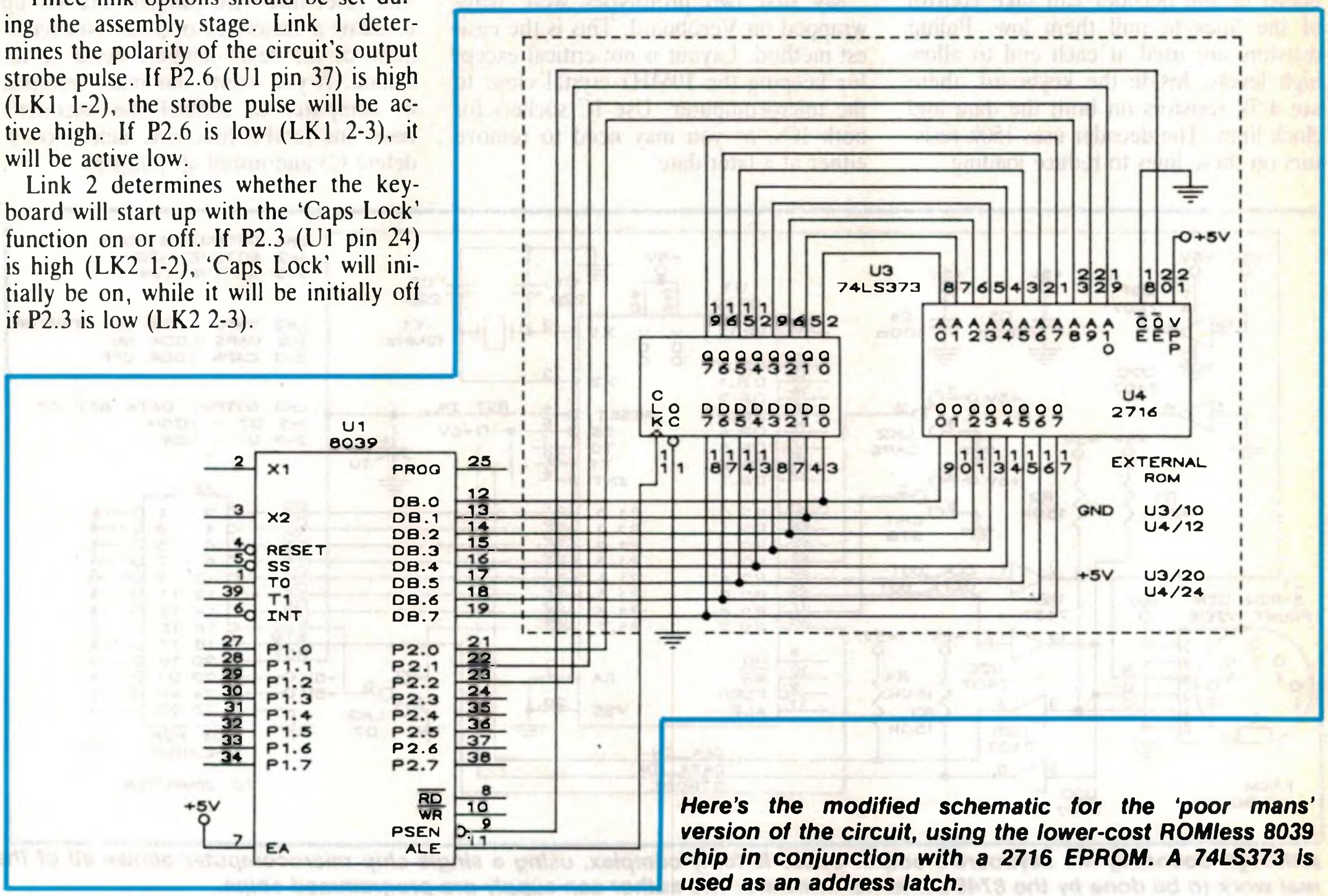
Link 3 determines the status of output data bit D7. Some equipment requires D7 to always be high (LK3 1-2) especially with numeric keys. Other equipment may require it to be low (LK3 2-3). I suggest you experiment to get the right result.

Obviously the keyboard plugs into the 5-pin DIN connector. It is up to you to determine how to wire the output data, strobe and power lines from J2 to your computer or terminal.

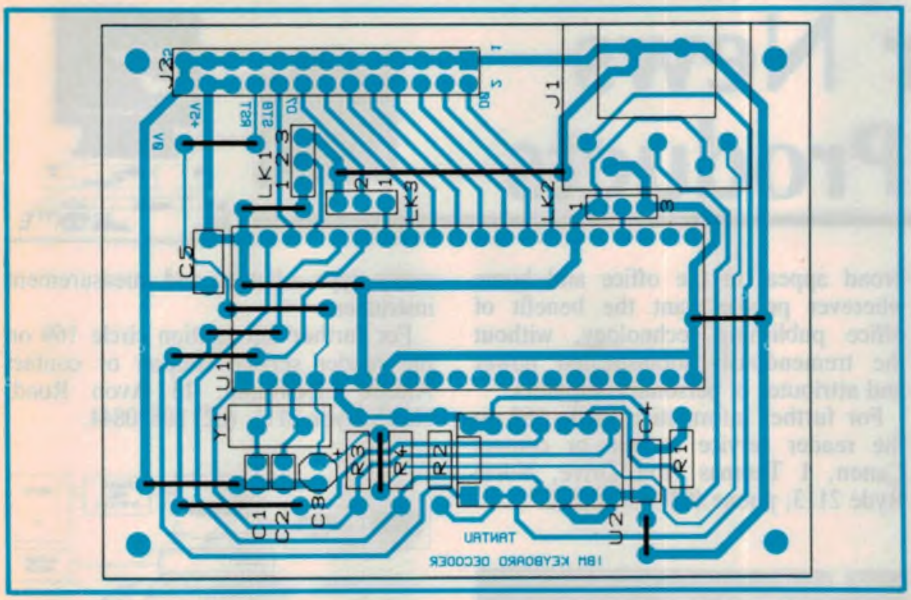
Incidentally the PCB-mounting 5-pin DIN socket used for J1 may not be widely available, but Geoff Wood Electronics certainly stocks them.

Wordstar option

As the decoder accesses a lookup table to get the ASCII data, I was able to add another table that includes the Wordstar control codes. Pressing the keyboard's 'Num Lock' (or 'Pause') keys toggles or untoggles the Wordstar



Here's the modified schematic for the 'poor mans' version of the circuit, using the lower-cost ROMless 8039 chip in conjunction with a 2716 EPROM. A 74LS373 is used as an address latch.



To assist you in mounting everything correctly on the PCB, here's an overlay diagram. Use it together with the pictures.

mode. This mode is active if the keyboard's 'Num Lock' LED is lit.

The following specifications for the decoder should cover most applications. The circuit is designed to accept serial input data from a standard 'IBM AT' keyboard (not XT or PC) set to 286 mode (not 86). Check the switch on the bottom of the keyboard. The parallel output data is standard ASCII with the MSB (D7) set by link 3 to either high or low. The output strobe signal can be either active high or active low, depending on the setting of link 1.

When *not* in Wordstar mode, the function keys, Alt, arrows, Print Screen, Scroll Lock, Insert, Home, Page up, Page Down, End, Delete, and Num Lock keys do not output data. All numeric keypad keys work in the numeric mode only except for the '.' which works as Delete.

In Wordstar mode, all arrows, Page up, Page down, Home (left one word), End (right one word), Insert and Delete keys function. All of the qwerty keyboard keys (except Alt) work. There is no ASCII 'Back Tab' code, so 'Shift Tab' is the same as back space. Essentially, all ASCII keys perform their normal functions and any non-ASCII keys do not. The 'Caps Lock' LED also functions.

I have tested the decoder on eight types of keyboards. Only one, a 'BasicTime' brand would not work. However, this keyboard would not work on any AT computer other than the BasicTime itself, anyway.

Poor man's version

The 8048 microcomputer family has another device called the 8039, which is the same as the 8749 except that it doesn't contain any ROM. All program memory is external to the device. This enables developers to burn their programs into familiar standard EPROMs such as the 2716, eliminating the need for special 8749 EPROM programmers. What's more, the price of an 8039 is less than $5.

I have included a diagram showing the additional connections required to use this device. I have built a few prototypes this way, as it eliminates the possibility of damaging the pins of an more costly 8749 during the endless erase, program, insert and test cycles. Any 8749, 8049 or 8039 will work in this circuit as long as the EA or 'External Access' input (pin 7) is held high.

PARTS LIST

Y1	10MHz crystal
J1	5-pin DIN socket, PCB mount
J2	26-pin DIL header
LK1,2,3	3-pin Bergstrip and link

Resistors

R1,2,3,4	150k 1/4W 20%

Capacitors

C1,2	22pF NPO ceramic (0.1")
C3	1uF 6V tantalum (0.1")
C4,5	0.1uF ceramic (0.2")

Semiconductors

U1	8749H microcomputer
U2	7407 or 74LS07 hex buffer

Miscellaneous

PC board, 76 x 60mm; 40-pin DIL IC socket; 14-pin DIL IC socket; tin-plated copper wire for jumper links.

NOTE: To enable people to build this project, the author is happy to supply the program in whichever format the builder prefers:

Program (please add media cost) .. $15
8749 .... $20 ($35)
2716 (used) $5 ($20)
DOS disk (5.25", DD) $5 ($20)

He can also supply the following parts:

8039 .... $10
Drilled PCB (simple) $10

Postage and handling cost for all orders will be an additional $5.

To minimise your outlay, supplying a blank 8749/EPROM/formatted disk plus a stamped, addressed jiffy bag for return postage will eliminate the respective costs.

Send all orders to Peter Baxter, Tantau Australia, PO Box 206, Gordon 2072.

Computer News and New Products

Canon typewriter

Canon will be releasing a most unexpected technology innovation early in the new year to revitalise the typewriter market.

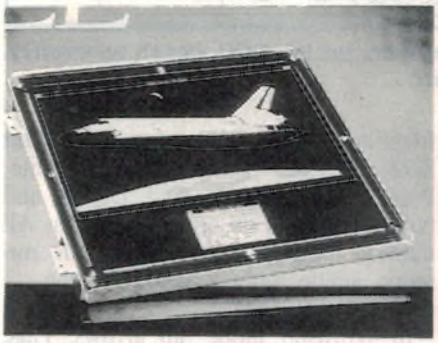
The StarWriter 80 personal publisher makes two revolutionary departures from traditional typewriter architecture. It is a portable combination word processor and electronic typewriter weighing only 7.4kg, and it uses Canon's Bubble Jet process for high resolution printing at 360dpi – superior to laser printer output.

With 60KB text memory and five inbuilt fonts, the StarWriter offers variable type size in bold, italic and outline, built-in spell checker/corrector and thesaurus, backlit LCD screen, and through the Bubble Jet process, silent, high-resolution, high-speed printing. For storage, it contains a built-in 3.5" floppy disk drive with 720KB capacity.

Word processing features include full cursor and correction functions, block editing, mail list-merge, automatic page numbering and label print, among many familiar WP key functions.

Canon claims that research has shown that 70% of word processors are underutilised. The StarWriter should have broad appeal in the office and home wherever people want the benefit of office publishing technology, without the tremendously sophisticated power and attributes of personal computers.

For further information circle 168 on the reader service coupon or contact Canon, 1 Thomas Holt Drive, North Ryde 2113; phone (02) 887 0166.



Electroluminescent display

Designed to replace the bulky 19" diagonal CRT display, a new 1024 x 864 pixel, compact, high resolution electroluminescent (EL) display from Planar Systems is claimed to be the largest of its type currently available. The EL7512114MS is a complete monitor, consisting of the display and built-in power supply. It is designed to fit into a 17" x 15.5" x 3" enclosure, minimising the overall desktop footprint and system power requirements.

The high quality display emits an amber light with a contrast ratio of 60:1 and a viewing angle exceeding 120°. Each of its 884,736 pixels is individually addressable, allowing high resolution graphics and text.

Planar EL displays are compact, lightweight, rugged and very readable, making them ideally suited to nearly every type of test and measurement instrument.

For further information circle 169 on the reader service coupon or contact Amtex Electronics, 13 Avon Road, North Ryde 2113; (02) 805 0844.

DESKTOP VIDEO SOLUTION

Video-computer animation

A Melbourne company has launched what it believes is a breakthrough in high quality, low cost PC-AT based live video image capture, manipulation and application. The system can capture images from any still image or video source and displays them on a VGA PC screen, allowing them to be animated and manipulated.

Lake Vision provides and supports the complete system which includes a Canon ION (image on/line network) still video camera, a hyperframe digiting system and VCN Concorde and Autodesk Animator software, which are used in conjunction with each other to allow the user to create and manipulate a limitless range of image presentations. The output can also be gen-locked over a live video source.

For further information circle 171 on the reader service coupon or contact Lake Vision, 45 Wellington Street, Windsor 3181; phone (03) 522 2788.

32-bit laptop from Twinhead

Twinhead's new Superlap-386SX laptop, available from Dick Smith, uses the features of the 80386SX microprocessor to offer very fast performance. At 16MHz it executes even the most complex programs very quickly. Because it uses 32-bit operations internally, it will run all the new software developed for the 32-bit 386 chip.

The computer uses the latest surface mount technology to give improved reliability. A single, tiny motherboard contains all the components usually mounted on adapter cards, plus video adapter, hard and floppy disk controllers and even sockets to add an extra 4MB of memory.

Superlap's onboard VGA graphics chipset and 256K of video memory provide up to 32 shades of grey. The advanced cold cathode fluorescent tube (CCFT) backlighting provides long life screen clarity. You can also use a software support package to switch the screen to an external monitor like a standard VGA monitor, or mode switching to other video standards.

The package supports other useful features such as inverse video and high resolution drivers.

The laptop weighs 5.5kg, has a battery life of 2 hours and is equipped with standard I/O ports for printers, mouse or modem. With monochrome VGA compatible LCD screen, 1.44MB 3.5" floppy disk drive, 40MB hard disk and 1MB of memory, the Superlap costs $4995.

For more information, circle 166 on the reader services coupon or contact Dick Smith Electronics, PO Box 321, North Ryde 2113; phone (02) 888 3200.

New high volume HP LaserJet

Hewlett-Packard has released the HP LaserJet IIID printer for high-volume users and shared printing environments. Featuring automatic duplex (two-sided) printing, the printer comes standard with two 200-sheet letter-size paper trays and an automatic 50 envelope feeder as an accessory.

The IIID printer is compatible with the HP LaserJet IID printers which it replaces. It features two internal scalable-typeface families, CG Times and Univers, in four treatments: regular, bold, italic and bold italic. It also contains the Courier and Line Printer bit-mapped typefaces.

Two slots allow upgrading of the standard 1MB memory to an additional 4MB. HP recommend that Macintosh users add 2MB for one sided and 4MB for double-sided printing. To be configured to be Macintosh compatible, the Postscript printer cartridge and Appletalk interface kit are required.

HP's resolution enhancement technology adjusts the position and size of dots to smooth the stair-step effect inherent in 300dpi printing. The result is text and graphics with smooth edges, sharper points and cleaner line intersections.

The printer's typefaces can be scaled in quarter-point increments from .25 point to 999.75 points. Vector-graphics capabilities allow arbitrary rotation of text or graphics and page-layout flexibility.

For more information, circle 165 on the Reader Services Coupon or contact Hewlett-Packard, 31-41 Joseph St, Blackburn 3130; phone (008) 033 821.

Handheld data entry

The Mobile Data Communications Terminal (MCT) was designed for remote data entry, control and messaging and is compact enough to be operated in portable applications or easily mounted in any vehicle for ready access by the driver. The unit can be used to interact with a central computer system, using any standard VHF/UHF radio network.

A tactile keypad with a mylar decal and a fully sealed construction ensures that it is easy to operate and yet will continue to work reliably in the often dusty environment of mobile vehicles.

The LCD display is a four line by 16 character format with an automatic scroll facility for 'long' lines of data.

There are two models of the MCT. The MCT 3/R can be connected directly to a radio with its own internal modem, while the MCT 3/S has an RS232 serial interface so that it can be used as a simple terminal for any application or with a radio data interface unit (RDI) for more complex radio communications systems.

For further information circle 175 on the reader service coupon or contact Expertech, PO Box 248, North Ryde 2113; phone (02) 809 4458.

High capacity IDE, SCSI disk drives

Plus Development is adding larger capacity Plus Impulse AT Series and SCSI Series drives to its range. The Impulse product family now includes drives with 40, 80, 105, 120, 170 and 210 megabyte capacities, with built-in IDE-AT or SCSI controllers. Even higher capacity drives are currently in development, for introduction in 1991.

With the Impulse AT Series, Plus claims to be in an excellent position to take advantage of the growing trend away from the standard ST506 to the high performance IDE-AT drives that connect directly to the motherboard. System manufacturers such as Compaq, AST, Dell, Acer, Lanier, Data General and AT&T are now including IDE connectors on the motherboard of their newer systems.

The new drives offer high performance, with effective access time as low as 9ms, sustained transfer rate of 1.4MB per second and DisCache, a 64KB dual-ported, look-ahead cache, which increases throughput by as much as 50%. Unmatched reliability, a 2-year warranty, and defect free interface all ensure years of error-free use and eliminate the need for user defect mapping. They also feature Airlock, which automatically locks heads in a dedicated landing zone and a drive microprocessor which constantly monitors the position of the heads enabling reliable operation over a wide range of environment conditions.

Plus also offers an AT adaptor (for those systems without an IDE-AT connector built in to the motherboard). The Impulse AT adaptor supports up to two IDE-AT drives and up to two floppy drives.

For further information circle 172 on our reader service coupon or contact Tech Pacific, 5-15 Epsom Road, Rosebery 2018.

COMPUTER NEWS

New TI microLaser

Texas Instruments has announced the launch of the PS17 microLaser, an affordable entry level PostScript printer offering improved fonts and faster processing for under $4000.

Significantly, the new model from TI uses Adode's new 'ATM' font rendering technology, which improves the print quality of PostScript fonts and prints them at more than twice the speed of the previous version. All TI microLaser printers with the PostScript language will now use this new version of PostScript firmware.

Tests conducted using the PostScript Benchmark Test Program developed by LaserTools Inc and comparing the current TI microLaser PostScript v1.7 with a microLaser using the new Adobe PostScript showed a 55% faster printing speed. The same test, using HP's Laserjet 8 page per minute Series IID for comparison, showed the microLaser printing at 140% faster than the IID.

The new member of TI's family of printers offers the same features as the company's other two microLaser models – the basic microLaser and the PS35.

For further information circle 174 on the reader service coupon or contact Texas Instruments Australia, 6-10 Talavera Road, North Ryde 2113; phone (02) 878 9000.

Memory upgrades

NJS Electronics can provide a variety of high quality memory upgrade modules at a competitive price. The modules range from 256K to 32Mb with access time of 100ns down to 60ns. Also available are a range of memory expansion boards, all designed to ensure optimum life:

- EPROM (eraseable programmable read-only memory)
- SRAM (static random access memory)
- DRAM (dynamic random access memory)
- Static column SIMM and SIPP modules
- Genuine Intel math coprocessors.

The boards are completely compatible with 32-bit memory bus architecture of CPUs such as 68020, 68030 and 80386. They are also fully compatible with 16-bit machines designed around CPUs such as 60810, 60286 and 8086.

For more information circle 170 on the reader service coupon or contact NJS Electronics on (03) 887 0577.

Advanced autorouter for Protel

Quest International Computers has been appointed exclusive distributor in Australia and New Zealand, for the Maxroute autorouters from Masstek. Part of the Masstek range is a cost effective, cut down version of Maxroute specifically for use with the Australian designed Protel CAD system.

Called Double-Route, the autorouter has all the advanced batch mode algorithms of the full version including heuristic, maze, shove, bus route, rip up, via reduction etc.

Particularly powerful is the 'shove' algorithm. This allows the autorouter to shove previously laid down traces out of the way, to free up routing channels.

READER INFO No. 41

Double-Route will route all but the most extreme designs to 100% with a fraction of the number of vias used by traditional routers.

The software uses the advanced user interface features of Microsoft Windows, and is supplied complete with a run-time version of Windows as part of the package.

Available directly from Quest International Computers or selected dealers and priced at $2850, Double-Route is said to pay for itself after only a few designs.

For further information circle 163 on the reader service coupon or contact Quest International Computers, 1 Hamilton Place, Mount Waverley 3149; phone (03) 807 7444.

386SX laptop has gas plasma VGA

The Chicony LT5300 is a powerful 386SX VGA laptop with a gas plasma screen which provides the user with all the power and convenience expected from a 386 computer but with the ability of a 'go anywhere' laptop.

Featuring 640 x 480 resolution with a 16 gray scale gas plasma screen, the LT5300 is suited for running complex graphic programmes such as AutoCAD or Lotus 1-2-3. The built-in VGA is full compatible with VGA/EGA/CGA/MDA modes. On-board RAM is 1MB, expandable up to 4MB, plus 64KB on-board ROM capabilities.

Packaged in a stylish carry bag, the laptop comes with standard accessories such as a user's manual, external 5.25" FDD case and cable, and a numeric keypad. The gas plasma display tilts through 135° for easy viewing, and displays razor sharp images without the eye strain that can result from use of inferior display screens.

The LT5300 (with accessories) will retail at $5995 including sales tax and is covered by a one year warranty.

For further information circle 164 on the reader service coupon or contact Teco Australia, 335-337 Woodpark Road, Smithfield 2164: phone (02) 725 1233.

Brisbane computer show

Queenslanders have an opportunity this month to see the latest advances in computer and software technology, when the 1990 Computer Expo opens at the Brisbane RNA Showgrounds, 7th - 10th November.

Now in its eighth year, the Expo has attracted over 120 exhibitors from all parts of Australia, with this year's event set to be the biggest in the Show's history.

Products on display include Apple, Hewlett Packard, Unisys, Epson, NEC, Toshiba, Sharp, Star, Netcomm, Blue Chip, Datamini, Commodore, Atari, Amstrad and many others.

Highlights of the Expo include demonstrations of the new breed of 486 machines (many incorporating EISA architecture), laptop and notebook computers, advanced laser printers and new release software packages from leading suppliers.

EA Directory of suppliers

Which of our many advertisers is most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also some are wholesalers and don't sell to the public. The table below is published as a special service to EA reades, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

Supplier	State	A	B	C	D	E	F	G
All Electronic Components	Vic	•	•	•	•	•		
Altronics	WA,NSW	•	•	•	•	•	•	•
Acetronics	NSW			•				
Dick Smith Electronics	All	•	•	•	•	•	•	•
Electronic Brokers	Vic						•	
Electronic Component Shop	Vic	•		•	•	•	•	
Emona Instruments	NSW						•	
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George Brown Group	All		•		•	•	•	
Jaycar Electronics	Eastern	•	•	•	•	•	•	•
Pre-Pak Electronics	NSW		•		•	•		
Preston Electronics	Vic	•	•	•		•		•
RCS Radio	NSW			•				
Rod Irving Electronics	Vic	•	•	•	•	•	•	•
Scientific Devices	Vic						•	
Sheridan Electronics	NSW		•	•	•	•		
Tandy Electronics	All		•		•	•	•	•
Wagner Electronics	NSW		•		•	•	•	

KEY TO CODING
A Kits & modules
B Tools
C PC boards and supplies
D Components
E IC chips & semiconductors
F Test & measuring instruments
G Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

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PCB PATTERNS: High contrast, actual size transparencies for printed circuit boards and front panels are available. Price: $5 for boards up to 100 square centimetres; $10 for larger boards. Please specify positive or negative.
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