3-D MODELS FROM LASER

NEW CAMCORDERS ARE MORE 'FRIENDLY'

Electronics Australia

The Inside Story:

SOLAR RACE WINNER

- FLEXIBLE, LOW COST CAR ALARM
- BUILDING OUR NEW 2M TRANSCEIVER
- 'INTELLIGENT' BLINKER FOR YOUR CAR

9 312966 123633

Wide Band Receivers...

has broken the barriers with its new line of wideband receivers built to go the distance. Introducing the IC-R1 handheld receiver, the IC-R72 HF receiver and the IC-R100 multipurpose receiver.

The smallest wideband handheld available today, the IC-R1 continuously covers 100kHz - 1300MHz (Specifications Guaranteed 2-905MHz) with AM, FM and Wide FM modes. This tiny receiver measures just 241mmW x 94mmH x 229mmD.

Easy operation is a snap with the IC-R1's Dual Frequency Selection (direct keyboard and rotary tuning). 100 memories and a 24-hour clock completes the world's smallest full-featured handheld receiver.

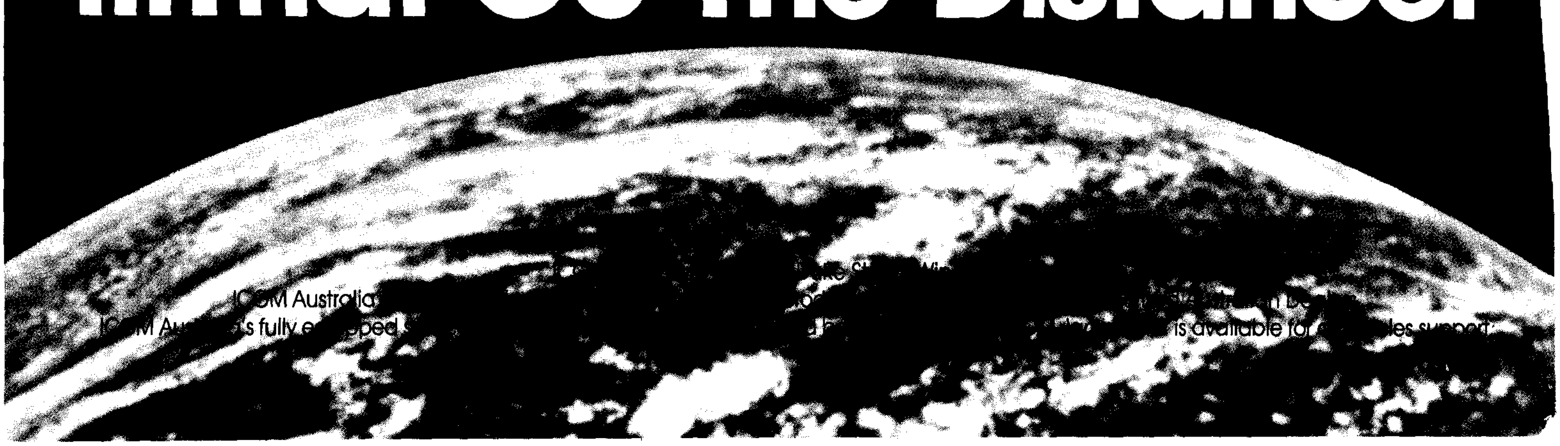
Install the IC-R100 at home or in your car. Listening pleasure is guaranteed with continuous coverage from 100kHz-1856MHz (Specification Guaranteed 500kHz - 1800MHz) in AM, FM and wide FM modes. Monitor VHF air and marine bands, emergency services, government as well as amateur stations. 121 fully programmable memory channels, multiple scanning system, an automatic noise limiter, built-in preamplifier and attenuator, clock with timer, and built-in backup lithium battery make the IC-R100 the perfect package for mobiling or base operation.

The IC-R72 continuously receives 100kHz - 30MHz in SSB, AM and CW modes with very high sensitivity. An optional UI-8 provides FM reception. Additional features include: Noise blanker, five scanning systems, AC/DC operation, internal backup battery, built-in clock and ICOM's DDS System. The IC-R72 boasts a 100dB wide dynamic range while an easy-to-access keyboard provides convenient programming versatility. The easy to operate IC-R72 is superb for short wave listeners.

The IC-R1, IC-R72 and IC-R100 join ICOM's current line of professional quality receivers. . . the IC-R71A, IC-R7000 and IC-R9000. ICOM. . . expanding the horizons to bring you better technology, today. See the complete line of quality ICOM receivers at your local authorized ICOM dealer today.

ICOM
First in Communications

...That Go The Distance.



Volume 52, No.2

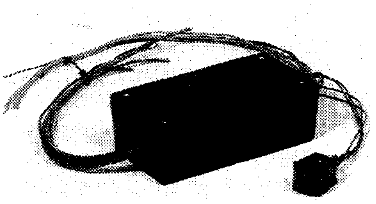
Electronics Australia

WITH eti

February 1991

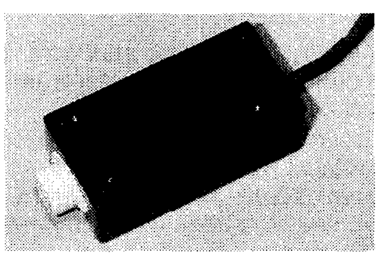
AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Versatile, low cost car alarm



Our new car burglar alarm is easy to build, easy to instal and easy to use. Easy on the pocket, too — yet it offers features that compare very well with expensive commercial units. See page 82.

Intelligent blinker unit



Tired of discovering that your turning blinkers are still operating, long after you turned that last corner? Here's a little unit that turns them off automatically, after you've turned the corner. See page 108.

On the cover

The Swiss Engineering School's solar race car 'Spirit of Biel Bienne' streaks down the centre of Australia, to win the 1990 World Solar Challenge. Brian Woodward reveals what went inside the winning car, in our feature starting on page 24. (Picture by Brian Woodward)

Entertainment Electronics

Features

Projects and Technical

Workstation

News and Comment

Departments

MANAGING EDITOR
Jamieson Rowe, B.A., B.Sc., SMIREE, VK2ZLO
PRODUCTION EDITOR
Milli Godden
TECHNICAL EDITOR
Rob Evans, CET (RMIT)
TECHNICAL CONSULTANT
Peter Phillips, B.ED., Dip.Ed., ECC
SECRETARY
Ana Marie Zamora
ADVERTISING MANAGER
Selwyn Sayers
CONTRIBUTORS
Neville Williams, FIREE, VK2XV
Jim Lawler, MTETIA
Arthur Cushen, MBE
Tom Moffatt
Peter Lankshear
DRAFTING
Karen Rowlands
GRAPHICS DESIGNER
Brian Jones
ART PRODUCTION
Ray Eirth, Michael Riley, Ron Farrell
PRODUCTION
Tracy Douglas, Mal Burgess
ADVERTISING PRODUCTION
Anthony Macarounas
CIRCULATION MANAGER
Michael Prior
PUBLISHER
Michael Hannan
HEAD OFFICE, EDITORIAL
180 Bourke Road, Alexandria, NSW 2015
P.O. Box 199, Alexandria 2015
Fax number: (02) 693 6613
Subscription enquiries: phone (02) 693 9517
Book Shop enquiries: phone (02) 693 4113
Reader Services: phone (02) 693 6620
ADVERTISING: phone (02) 693 9734
INTERSTATE ADVERTISING OFFICES
Melbourne: 221a Bay Street, Port Melbourne, Vic 3207. Phone: (03) 646 3111, Fax No: (03) 646 5494, Nikki Roche
Brisbane: 26 Chermside Street, Newstead, Qld 4006. Phone: (07) 854 1119, Fax No: (07) 252 3692, Bernie Summers
Adelaide: 98 Jervois Street, Torrensville, SA 5031. Phone: (08) 352 8666, Fax No: (08) 352 6033, Mike Mullins
Perth: 118 Forrest Street, Cottesloe, WA 6011. Phone: (09) 385 3332, Fax (09) 385 3700, Estelle de San Miguel
New Zealand: 63-73 View Road, Auckland, New Zealand. Phone: (09) 443 0954, Fax No: (09) 443 1326, Gordon Marr
United Kingdom: John Fairfax & Sons (Aust), 12 Norwich Street, London, EC4A 1BH. Phone: (71) 353 9321, Fax: (71) 583 0348
ELECTRONICS AUSTRALIA is published monthly by Federal Publishing Company Pty. Ltd. Incorporated in NSW, 180 Bourke Road, Alexandria, NSW 2015.

Typeset and printed by Hannanprint, 140 Bourke Road, Alexandria, NSW for the Federal Publishing Company Pty Ltd.
Distributed by Newsagents Direct Distribution Pty Ltd, 150 Bourke Road, Alexandria NSW 2015, (02) 693 4141.
ISSN 1036-0212
*Recommended and maximum Australian retail price only.

LETTERS TO THE EDITOR

Encouraging youth

I read with interest the comments made by John Coulson (Letters Aug 1990), regarding the need to encourage youngsters to pursue science and technology.

As an Electrical Engineer, I am sometimes asked to give career talks regarding engineering as a vocation. I have found that the vast majority of girls (99%) and a good proportion of the boys have a misconception about the profession. They perceive engineering to be about fixing mechanical equipment, and being covered with grease. They do not realise that a degree in engineering allows them to get into diverse areas involving the research, design and management of technology. A degree in electrical or electronics engineering, for instance, leads to a career in electronics, computers, communications, instrumentation and control, or electrical power systems. Popular TV shows like 'Beyond 2000' do little to clear up the misconception. If an inventor has an engineering background he is still called 'an inventor' or, in some cases, 'a researcher at X University'. While the public is familiar with the roles of scientists and medical professionals, the term 'engineer' still conjures up an image of a mechanic.

If we are serious about guiding our youngsters into science and technology then engineering must be perceived as a viable and practical career option.

Patricia Tong,
Albury, NSW.

Suggestions

I have found the recent editions of your magazine very rewarding, with the well written articles about the history of wireless and the high tech developments in todays electronics.

In the July 1990 issue, Jim Rowe has updated his VHF Powermatch. A well worthwhile project for the VHF/UHF experimenter. As with all test instruments this is simple and effective, but being battery powered, where is the 'battery good' indicator?

My solution is to add an extra position, BAT, to the function switch, SW1. This can be the same as SW2. Connect a 2.4 megohm resistor from the extra contact on SW1A, to the +4.5 volt supply. Connect the wiper of SW1A to the extra contact of SW1B. The sensitivity pot, VR3, and the 2.4 megohm resistor make a voltage divider which indicates the battery voltage directly on the 10 volt scale. The problem I see with battery equipment is the need to dismantle the case and disturb the wiring just to change the battery. This can be reduced in the VHF Powermatch by building the front panel into the base of the box and mount nothing on the cover plate or back. A bettery solution is to have a battery compartment so the battery can be changed without tools.

I have done some work on VHF aerials and discovered the usual VSWR indicator reads much lower at low power than on high power. I traced the cause to the hot carrier diode barrier potential. I used some bias to reduce the effect. With the amplified meter, it should be possible to use a sweep signal generator and 'scope to sweep a network or aerial for VSWR over the required band.

Keep up the good standard in Australia's top selling electronics magazine.

Graham Baker, ZL1TOF,
Auckland, NZ.

Comment: Thanks for those constructive suggestions, Graham —and also for the kind words about the magazine.

Misleading graphs

In a journal as devoted to accuracy and clarity as yours, it is disappointing to see one misleading graph, let alone two. I refer to the two comparison bar graphs at the foot of page 22 of your November 1990 edition.

Clearly Kodak's new Cinema Digital Sound (CSD) offers substantial improvements over existing systems. Both graphs exaggerate this by the simple expedient of representing frequency in one and sound pressure in the other as linear scales when their effect, as perceived by humans, is logarithmic.That is not all. The vertical frequency scale on the first graph has equally spaced markings of 0, 10, 12, 14, 16, 18 and 20kHz. What happened to 2, 4, 6 and 8kHz? The 20kHz upper limit of CDS is about two thirds of an octave about the 12.5kHz available from 35mm Dolby Stereo optical. A quick glance at the graph gives the impression that CDS is 2-1/2 times more extended than 35mm. Surely the whole point of a graph is to assist in the effective digestion of figures. There is not much point in doing this if the graph misleads.

Stephen Dawson,
Duffy, ACT.

Comment: The curves were reproduced directly as supplied by Kodak, Stephen. It's not unusual to have an 'offset zero' in comparison charts, while the second chart shows dynamic range in decibels —and it's usual to plot these linearly as they are already logarithmic units.

Supplier response

When I bought a 16 channel UHF remote control kit from Oatley Electronics at a Melbourne retail store, it came with a broken coil. I wroteto Oatley Electronics in Sydney to get a replacement. To my surprise, I did not hear from them nor receive the replacement coil. I waited 14 days then I rang Oatley. They assured me that two spare coils had been sent — no charge. Presumbably they'd been lost in the mail, so OE said they'd send me another — sorry for the delay. Eight days later, a padded bag 'Postpak size 1' arrived. Eight days from Sydney to Melbourne — and postage A$.90!

But then, after another eight days — you probably guessed it — the first mail bag arrived. Australia Post hardly loses anything — but nearly four weeks from Sydney (2223) to Melbourne (3122) tells another story. We should send our mail with Cliff Young — he beats Australia Post any time!

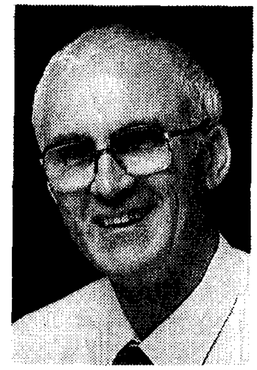
I still had the problems with the kit. The transmitter and receiver were working, but not the decoder. I sent a fax this time to ask for advice. Next day I had the answer and an explicit errata note (which I had not received when I bought the kit in Melbourne). Following the technical advice there were no more problems — the kit worked perfectly, thanks to the prompt technical service of Oatley Electronics. Well done!

K.H. Weichselfelder,
Hawthorn, Vic.

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



Lots of informative technical reading

One of the most important functions of a technical magazine like *Electronics Australia with ETI* is to provide timely information on the latest developments, to help our readers keep abreast of what's happening. In this month's issue you'll find a lot of this kind of reading.

For example in the video and audio section, we have an interesting article by Barrie Smith explaining how Japan's latest generation of video camcorders is taking advantage of 'fuzzy logic' to provide better auto focussing and auto exposure — making them more 'friendly' and easy to use. Then in the general features there's our cover story by Brian Woodward, looking inside the Swiss-made *Spirit of Biel Bienne*, the solar car that won the 1990 World Solar Challenge. Did you know that its solar cell array was based on pioneering Australian technology?

In the Workstation section, our focus this month is on CAD, and we have a story on a fascinating new system which uses a UV-laser to 'create' three-dimensional models directly from a CAD file, by 'slicing' the file and producing each slice of the model by scanning across the surface of an optical polymer liquid. Many of the big US manufacturers are using this system to produce their product prototypes, faster and more cheaply than even before!

Of course these features are in addition to our usual 'updating' columns like News Highlights, What's New in Video & Audio, New Products, New Computer Products, Solid State Update, Spectrum and Silicon Valley Newsletter. Not forgetting the normal construction project articles, technical articles and discussion columns. Your only problem may be to read it all, before the arrival of next month's issue!

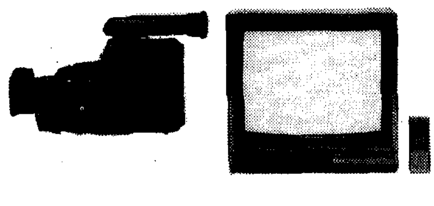
By the way, on behalf of both *EA* and Icom Australia, I'd like to extend a big 'THANKS!' to everyone who sent in an entry to our 'Win an Icom IC-R100 Receiver' competition. We were almost swamped with funny antenna stories — it was great that so many readers decided to share their experiences with us.

Sad to say, only one IC-R100 was available as the competition prize. You'll find the lucky winner announced on page 34, along with his winning entry. But there were so many other entries that were *almost* as funny, that we've decided to publish the best of these in the magazine next month. This will bring their authors a small publication fee, as a consolation prize...

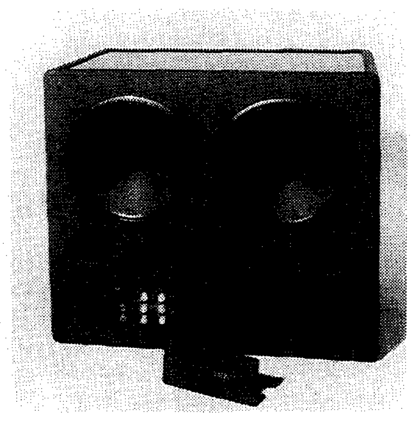
Thanks again to everyone who entered and joined in the spirit of fun. Hopefully we'll be able to run another competition of this kind again soon — we all need a few laughs in these days of doom and gloom, wouldn't you say?

Jim Rowe

What's New in VIDEO and AUDIO



New studio monitor speakers from Tannoy



Representing the flagship of Tannoy's new Monitor series, the System 215 DMT is designed to be free standing or flush mounted and features the application of Differential Material Technology (DMT).

DMT is the study of different materials and their relative behaviour when in intimate contact.

The system 215 DMT is based on an all new 15" PcQ full range point source, phase coherent Dual Concentric DMT transducer, with a vented diehard chassis and cabinet/drive unit diffraction ring, supplemented by a 15" bass transducer handling all frequencies below 500Hz.

Both 15" transducers may be driven in parallel for increased bass response and maximum SPL. The PcQ driver features a user servicable, self centering high frequency diaphragm assembly with an HF waveguide for a spherical wavefront and provides user adjustable HF response.

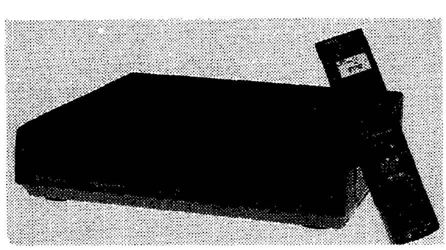
The crossover is constructed of high grade air cored inductors and film capacitors, and are all hard wired without the use of printed circuit boards.

A new terminal panel features gold plated contacts and terminals with provision for bi-amplification and permits adjustment of the high frequency shelving from 2kHz to 25kHz with +/-1.5dB adjustment. All internal wiring is Van den Hul, claimed to provide greater clarity and accurate image placement.

The System 215 DMT is claimed to provide a frequency response one metre on axis of 35Hz to 25kHz, +/-3dB; sensitivity of at least 101dB for one watt at one metre, with a peak handling power of 750 watts, and is recommended for use with amplifiers of 150 to 500 watts.

For further information circle 182 on the reader service coupon or contact Amber Technology, 5 Skyline Place, Frenchs Forest 2085; phone (02) 975 1211.

Hitachi VCR has auto head cleaning



The new Hitachi VT-M728E video cassette recorder automatically cleans its video heads every time a videotape is loaded or unloaded. During the loading/unloading operation, a special cleaning roller is engaged to wipe the rotating head cylinder and remove any dust or oxide deposits.

The system operates when either the play or record modes are selected. Should a faulty tape cause the heads to become clogged during operation, the cleaning function can also be initiated manually via a button located on the front panel. Other features of the VT-F728E include digital automatic tracking and LCD remote control, full on-screen display menu and remote control programming of the inbuilt TV tuner.

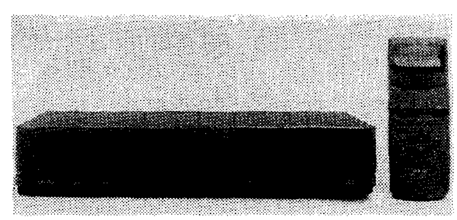
Other new Hitachi VCRs also offer the auto head-cleaning function, including the VT-M838E, the VT-F778E and the VT-M748E which recently won the CESA 'VCR of the Year' award for 1990.

'Intelligent HQ' VCR from Akai

Akai has introduced what is claimed as the world's first (patent pending) automatic tape tuning facility to be incorporated in a consumer VCR.

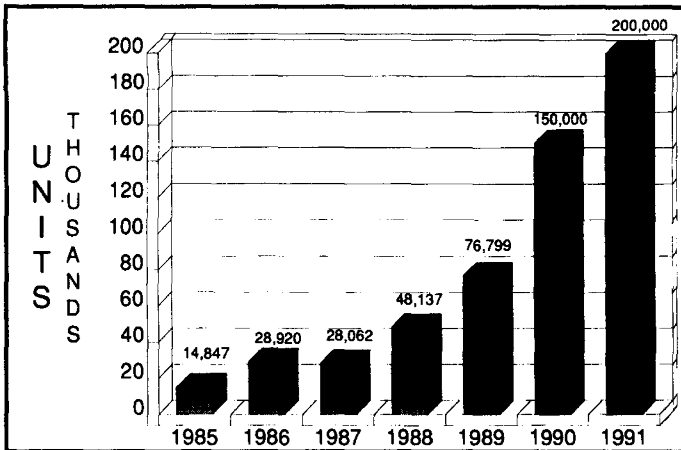
The 'Intelligent HQ' technology has been introduced in the two latest Akai VCRs, the VS-F600 and VS-A650, and is designed to operate in both recording and playback modes. 'Auto tuning' has long been used by Akai and other audio tape deck manufacturers to achieve optimum performance with different types of tape, but until now, equalisation and bias parameters for VCR have been fixed and set by the manufacturer at the factory.

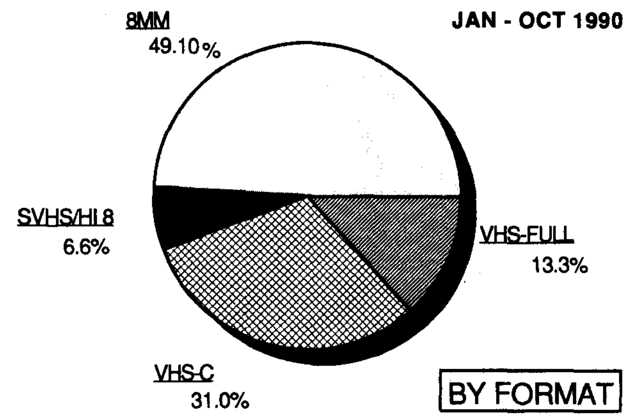
Akai's new technology enables these VCRs to achieve optimal video quality from any video tape. The auto tuning system is compatible with standard VHS format tapes; however, when used



with high quality S-VHS tapes, Akai claims the end result is picture quality and detail comparable with S-VHS recordings made direct from TV broadcasts. The auto tuning feature takes about 15 seconds to optimise the characteristics of each tape. These parameters then remain in memory until the tape is either ejected or the main supply disconnected. Both new models boast full hi-fi stereo, the DX4 head system for improved clarity, particularly in slow, still and frame-advance play operation, and a quick response system. The VS-A650 further boasts a true digital Dolby B surround sound decoder for full surround sound from Dolby B encoded videos.

Available at Akai dealers and selected department stores, both models are covered by a twelve month warranty. The VS-F600 has a recommended retail price of $999 and the VS-A650 $1099.





Camcorders surge ahead

Recently released figures from the Consumer Electronic Suppliers Association (CESA) show that portable video cameras (camcorders) emerged as the 'in product' of 1990. The CESA figures reveal that in 1985 when portable video first hit the Australian market, under 15,000 units were sold. Yet last year, sales topped 150,000. This is an increase of nearly 100% on the 1989 figures. A closer examination of CESA statistics shows that the Video 8 system marketed by Sony, Canon and Sanyo, holds approximately 50% of the market, with the VHS-C system having under 30% of the market. This dominant position has been at the expense of the more cumbersome full size VHS units, with sales of approximately 15% of the market. The remainder of the sales cake is shared with the more advanced S-VHS and Hi-8 systems.

Harman Kardon cassette decks have Dolby S

Harman Kardon has introduced five new cassette decks to replace all of its earlier models. All models incorporate new industrial designs, featuring fresh looking front panels with curved display windows for the new large fluorescent display in keeping with the highly acclaimed cosmetics of Harman Kardon's Bit Stream CD players. In addition the TD4600/4800 incorporate the new Dolby S Noise Reduction system.

Harman Kardon says that the benefits of Dolby S are improved dynamic sound, 10dB of noise reduction in the low bands and 20dB in the high frequency bands. In addition Dolby S offers improved compatibility between different machines.

Harman Kardon is also using its newly developed isotropic heads, said to give better performance and longer life. To make the decks easier to use all decks incorporate 'CD like' forward and reverse skip buttons.

The range of cassette decks also features discrete playback amplifiers and the decks all provide 1 volt outputs for added convenience.

The new cassette decks also link to Harman Kardon's remote control system. This allows remote control of the cassette decks functions from other Harman Kardon components via a serial data port, located on the rear of each deck.

The new Harman Kardon cassette decks are available now and they comprise: TD4200 - $499, TD4400 $999, TD4600 - $1500 and top of the line three head deck TD4800 - $2500. All decks are covered by a five year parts and labour warranty (heads and rubber based parts one year).

Additional information and specifications are available by circling 183 on the reader service coupon or by contacting the Australian distributor, Convoy International, 400 Botany Road, Alexandria, 2015; phone (02) 698 7300.

New Sharp camcorder has colour viewfinder

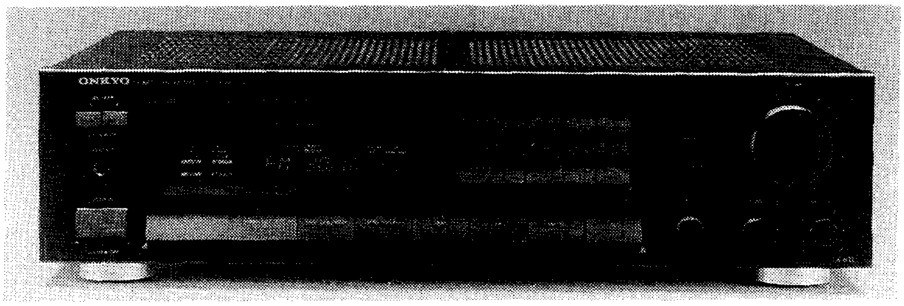
Now, for the first time, a video camera has been released with a full colour viewfinder. The 'world first' product is the latest addition to the range of camcorders released by Sharp Corporation — the Sharp LCD colour camcorder, VLC-7950X.

The breakthrough has been achieved by using the latest liquid crystal display (LCD) technology, in which Sharp claims to be world leader.

The Sharp VLC-7950X also has three other great features to offer. It has a 12x variable zoom lens claimed to be the most powerful optical zoom lens available in Australia. It also has a quick zoom feature which can jump-zoom in and out (1.5 magnification), for example from 8x to 12x, instantly, to let you get right in on the action. Finally a 3 lux low-light capability enables shooting in very low light.

The new camcorder uses the VHS-C format which is compatible with VHS, the most popular form of VCR achines in Australia today. It has a recommended retail price of $1999.

Synthesised-tuning receivers from Onkyo



Onkyo has announced the TX-822 and TX-811 quarter synthesised tuner amplifiers, with numerous features at a lower price point and boasting substantial increased power over previous Onkyo tuner amplifiers. Claiming 40 watts RMS per channel into 8 ohms, the receivers are designed for medium to large living environments and are compatible with most medium to high efficiency speaker systems.

Both models have provision to accept six input sources, including FM, AM, phono (MM/MC), CD player, tape I/video and tape II. Access to their operation is simply by addressing the large logic controlled feather touch keys placed evenly along the front panel. Onkyo claims the advantages of logic control switches over rotary type controls is that they mute the signal between switching from one source to another, eliminating loud clicks and plops. Both employ the latest quartz synthesised tuning technology for greater stability and drift-free characteristics. Tuning facilities provide memory pre-sets for up to 30 stations in any combination.

Both models are covered by a five year parts and labour warranty and are available at selected Onkyo dealers. The TX-822 has a recommended retail price of $599 and the TX-811 of $499.

New auto head cleaner prevents video damage

Australians are becoming increasingly aware of the problems suffered by VCR machines due to unclean or damaged heads caused by old video tapes.

Keeping a video recording machine's heads in good, clean condition, has, until now, involved special equipment or service. As some 70% of Australian homes now have a video, the problem needed to be solved.

The Sharp Corporation has just introduced a new product to reduce this kind of damage on recorders and tapes.It is a range of Sharp video recorders with an Auto Head Cleaner built into the unit.

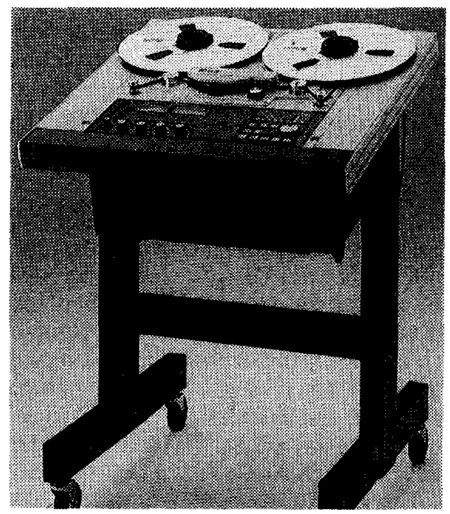
With the new Sharp Auto-Head Cleaner, each time a cassette is inserted or ejected, a specially-designed polyurethane roller automatically wipes across the heads of the VCR for one second, cleaning off any dust or dirt. These new Sharp VCRs also include the Digital Programme Search System, an LCD remote control with easy step-by-step instructions and long-play facility which gives eight hours play on a four hour tape. Other Sharp features in these VCR machines are the Random Repeat facility and Child Lock which stops anyone accidentally interrupting your recording.

High performance mastering recorder

The MTR-15 high performance two track recorder is claimed to be the most sophisticated recorder ever developed by Otari. It was specially designed to meet the growing interest in high performance analog recording systems.

Microprocessor control is used extensively in the MTR-15. Automatic alignment of the record and reproduce parameters is provided, with data for four different tape formulations at each speed and equalisation setting able to be stored in battery backed memory.

The microprocessor controlled tape transport includes a four point locator,



featuring three 'one touch' cut points — search to zero, last play search and a repeat mode — while a large, bright LED tape counter displays tape speed in ips or cps and tape position in hours/minutes/seconds or hours/-minutes/seconds/frames. Other standard features include: Dolby HX Prof headroom extension circuitry; built in test oscillator; internal monitor speaker; 12.5" reel capacity; four crystal-locked tape speeds of 3.75, 7.5, 15 and 30ips; +/-50% varispeed; switchable balanced/unbalanced inputs and outputs; cue wheels for shuttle/job operation; and AES/NAB/IEC equalisation presets. The recorder may be configured as a free standing console, table top or 19" rack mounting format.

For further information circle 190 on the reader service coupon or contact Amber Technology, 5 Skyline Place, Frenchs Forest 2085; phone (02) 975 1211. ■

Making camcorders more 'friendly'

Are we witnessing the arrival of the 'friendly' video camcorder? It seems we are, as two manufacturers bring these electronic picture makers down from their pedestals, allowing them to show a little 'user friendliness'.

by BARRIE SMITH

One never thinks a video camcorder could be anything but 'user friendly' — with focus, exposure and colour balance carefully monitored by automatic systems.

But enthusiasts are finding flaws in the armour of these high tech, high cost items, which are now becoming a near-necessity in the pursuance of the Australian life-style.

Auto focus is often 'Fight Focus', with the automatic system homing on everything in the frame but the all-important subject. Auto exposure often becomes heavily over-, or under-exposure, with a bright sky or dense bush taking precedence over the light tones of a person's face.

Similarly colour balance is frequently 'Colour Unbalance', with the camera noting the colour of the light in the environs of the camcorder — and not the subject. The high speed shutters which were introduced to cancel out the smear artefacts to which CCDs are so prone — and, in the process soften the shakes so many camcorder operators exhibit — also carry the burden of speeds of 1/4,000th or 1/10,000th of a second, and at times can't image a picture in anything less than bright sunlight.

Now, two Japanese camcorder manufacturers — Sanyo and Panasonic — are attacking the problems, in two very different ways.

Sanyo are the first camcorder makers to introduce 'fuzzy logic' to this country — with fuzzy logic used in focus and exposure control, plus the adoption of a different approach to colour balancing, using a 64-section matrix for its appraisal.

Sanyo's model is called Zeema — an odd name, perhaps, but it's Sanyo's way of killing the nomenclature 'numbies' — after all, who can ever remember model numbers like the GXYZ11EA?

Panasonic's answer is the NV-S1. Their auto focus system takes no more than one second for the lens to move from one point to another.

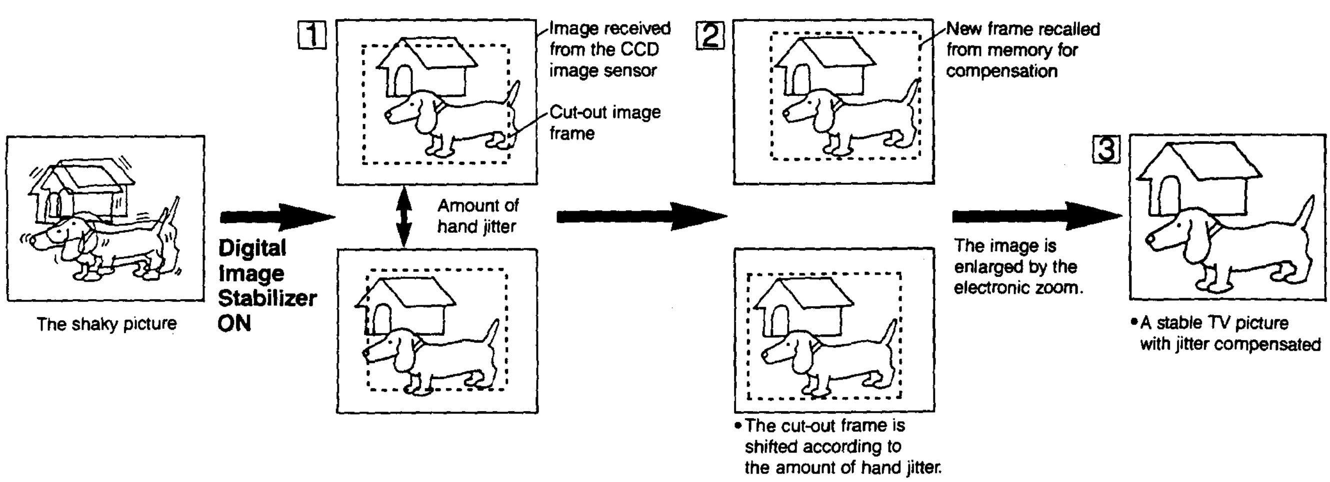
It also works out whether a transient object crossing the subject's path is important or not.

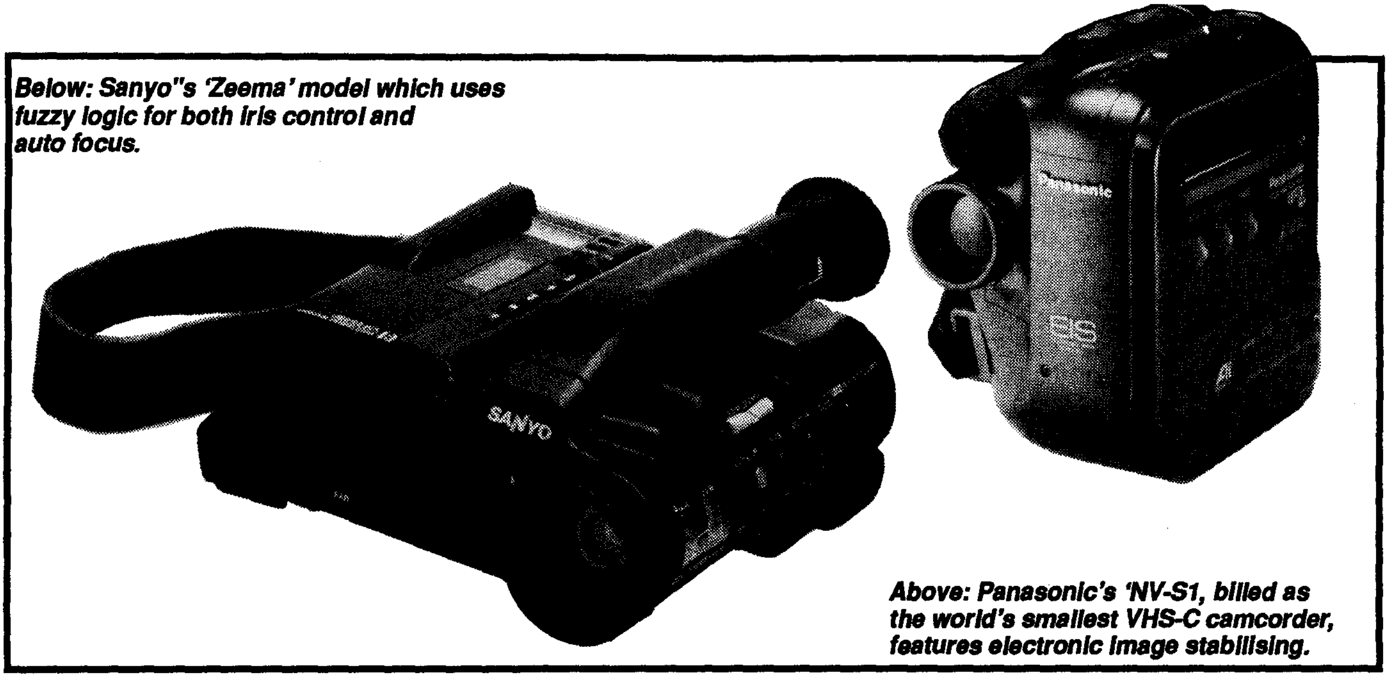
In the 'shakes' department, their Electronic Image Stabiliser (EIS) is designed to prevent picture jitter during shooting, caused by unstable hand movement.

The NV-S1's head design has also been improved to kill the video noise component in red tones, improving colour fidelity.

Digital Image Stabilizer

The Digital Image Stabilizer — a Panasonic world's first — assures good shooting results by eliminating picture shakiness caused by hand jitter. It electronically detects and compensates for jitter by digitally processing video signals picked up by the CCD. The Digital Image Stabilizer guarantees stable pictures every time you shoot — even when you're walking, using the zoom or holding a long shot.





Below: Sanyo"s 'Zeema' model which uses fuzzy logic for both iris control and auto focus.

Above: Panasonic's 'NV-S1, billed as the world's smallest VHS-C camcorder, features electronic image stabilising.

Sanyo's Zeema

Sanyo's pioneering model employs the Video-8 format, fast becoming the most popular in many parts of the world.

Fuzzy logic is used in two main functions of the camcorder: Iris control and AF (auto focus) — probably the two most troublesome areas of camcorder operation, for both novices and experts.

Shots of a subject against a contrasting shade of background can fool the camcorder.

The subject often becomes either too dark or too light, due to the exposure system reading the high or low key background as the main subject, and altering its intensity. The result is that the background looks fine, but the subject becomes either a silhouette, or is too washed out.

The Zeema's fuzzy logic system divides the exposure zone into six sections.

When you're shooting a subject standing in front of a very brightly lit background, it assesses the relative brightness of the different — and adjacent — sections and allows the main subject to be recorded with adequate exposure.

Many camcorders use a digital form of AF, while some rely on a single focus zone, and one or two employ three user-selectable focus zones.

Sanyo claims their fuzzy logic approach is an update on all of these methods. It also adds speed, and makes use of not only contrast and brightness data, but alters the actual size of the AF zone according to 21 fixed rules of behaviour.

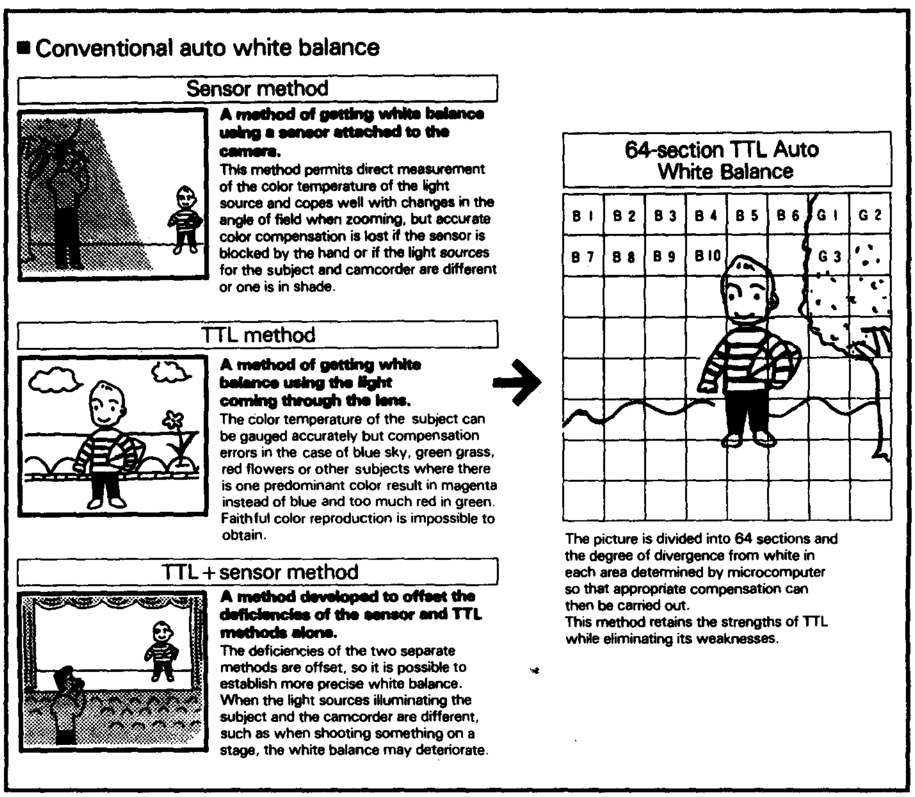
Conventional AF looks at the central part of the screen, but often has difficulty following moving figures.

Fuzzy logic AF also gives preference to the centre, but if there is no obvious subject it expands the central focus zone, and allows the system to watch for moving figures, simply by tapping information from adjacent zones. And it allows for shooting in low light interiors or bright exteriors.

The Zeema's AF system takes the central portion of the frame, and breaks it into 16 small sections, making precise assessment possible. It begins by checking the first two sections — in the centre, and a slightly wider area. If no action is detected the zones are widened, and inspected.

Conventional digital AF focus systems work on contrast information alone. Fuzzy logic uses not only contrast, but brightness as well to make a guess-like assessment.

Although fuzzy logic was not used in the colour balance circuits of the Zeema, the designers adopted a related approach to the determination of the white balance. Again, a matrix of the scene is



used to assess the colour temperature of the whole scene.

The picture is divided into 64 sections, and the degree of divergence from pure white is determined by a microcomputer. This information is used to adjust the white balance, from daylight at 5,500K (Kelvins) to Tungsten at 2,500K — depending on the colour of the subject detail, and its illumination.

And a latitude is incorporated — such as where there are a large numbers of sectors with the same colour (like a large area of brightness or darkness) and the effect of compensation is reduced (20 areas of the same colour are counted as one) to ensure correct white balance.

The camcorder also has a number of other features which are new to the field. It's the world's first horizontal unit.

The drum head axis has a diameter of only 26.7mm (instead of 40mm), with a bearing diameter of 3mm, allowing the head assembly to be mounted horizontally.

Surveys show that most operators prefer to use both hands when shooting. With Zeema's horizontal layout the two hands hold the camcorder like a pair of binoculars, with the two elbows braced against the body.

But ergonomics were not the only reason for the swing over. Current camcorders accept the tape cassette in a vertical mode; with this there is always the chance of the tape being knocked off the guide cylinder if the camcorder is bumped whilst shooting.

This can cause the tape to float off the cylinder and give a distorted picture.

Turning the entire tape path onto its side ensures rotational evenness, and picture stability is improved.

Panasonic's NV-S1

If you've been under the electronic equivalent of a rock, you may not have noticed the scuffle going on between the rival Video-8 and VHS-C compact formats.

Various manufacturers in both gauges have pushed up models in ever smaller dimensions to please a public who, presumably, lust passionately for a camcorder you can (almost) conceal in an average-sized palm of the hand, or slip (almost) unnoticeably into a jacket pocket.

But, along with diminution of the size of these machines goes a highly competitive thrust to cram in all the features of the 'normal' size units. So, it was no surprise to witness the official announcement in May last year of The World's Smallest VHS-C Video Camera — for 'camera' read camcorder, the Panasonic NV-S1.

Panasonic claim their new camcorder's smallness and lightness assists single-handed operation. Which is probably quite a valid claim.

But, up until now one thing militated against single- handers — camera shake. Smaller units were considered difficult to grip and hold steady while shooting, resulting in 'jittery video'.

Enter EIS

The 'Electronic Image Stabiliser' or EIS system prevents picture jitter. It detects and corrects displacement of the picture caused by unstable hand movement.

What happens? During processing, video signals captured by the CCD are digitally analysed, then put into a field store.

The 'caught' picture is then divided into four quadrants, each containing 30 representative points. This point data is stored in memory.

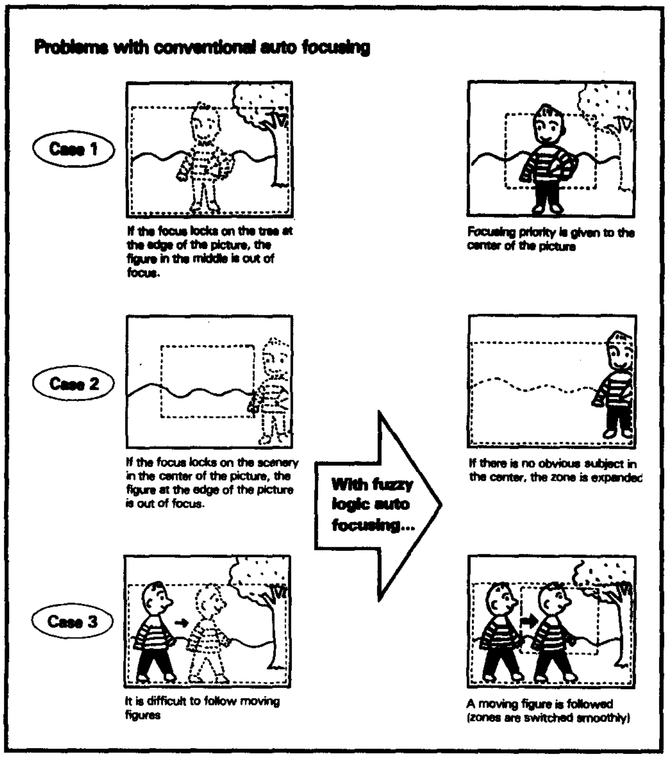
When camera instability causes the image on the CCD to move, the displacement vector, which shows the movement of each representative point, is quickly determined and analysed by comparing with the signal in the frame store.

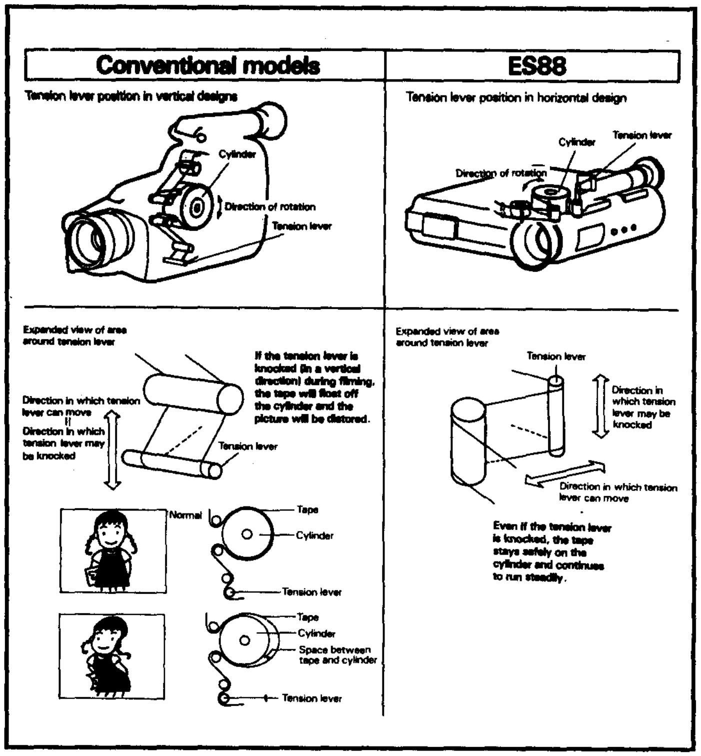
Based on this adjudication, the signals which should be sent to the record head to produce a stable picture are recalled from the field store. The 'trimmed' image is enlarged to full screen size, yielding a stable picture.

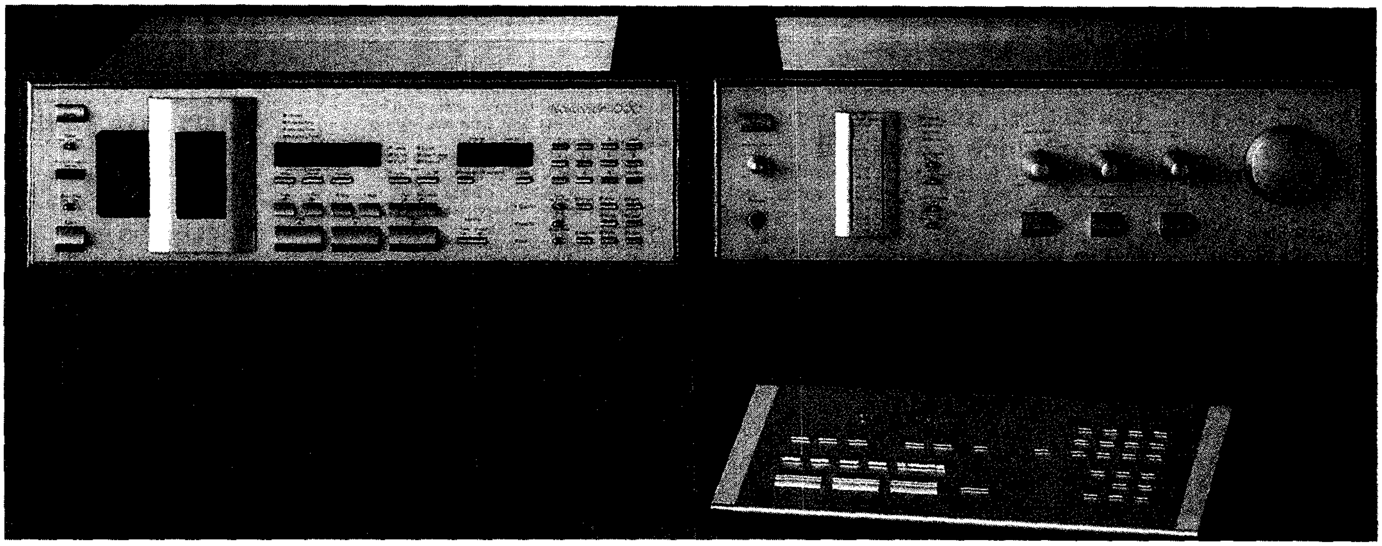
With EIS, picture jitter from one field to the next can be cancelled out — up to a degree of 15%.

The technical matter indicates that the picture is 'trimmed' to produce the stable, jitter-free picture.

As it can cope with 15% instability it's reasonable to assume the picture is







NAKAMICHI 1000 DAT RECORDER

Back in 1973, Mr Nakamichi and his team produced the first model 1000 , an outstanding machine that became the benchmark against which all other analog cassette recorders were compared. Now they've produced its successor: the new Nakamichi 1000 Digital Audio Recording System. Here is Louis Challis' report on the first sample of the new three-piece system to reach Australia.

The story behind this review really started in January 1990, when I attended last year's Consumer Electronics Show in Las Vegas.

Whilst there I saw the Nakamichi '1000', and perchance met Len Feldman at the Nakamichi display. In all seriousness, Len suggested that I didn't need to look at the equipment, "Just read my review Louis — it says it all!"

Well, I did read Len's review and although impressed, I knew that there was much more, if only more questions — and anyway, how many people would possibly want to buy a professional DAT recorder which costs US$11,000 and which is aimed primarily at well heeled consumers?

Now it's funny that you should ask that question, for over the last 35 years I have bought no less than 25 tape recorders, the most expensive of which, at the time when I purchased it, was just as expensive as the Nakamichi '1000' Digital Audio Recording System (in terms of 'then' dollars).

Now my primary requirements and selection criteria have always been "mains free flexibility', wide dynamic range, maximum possible frequency response, and of course, optimum reliability.

Not surprisingly, when the first DAT recorders came out in 1987, I managed to acquire one on a trial basis, and as I soon discovered, the DAT recorder has come closer to fulfilling some of those goals than have any previous magnetic tape recorders that I have either owned or evaluated.

Driving force

Now it's Mr Nakamichi, the president of Nakamichi Corporation, who is really the figurehead behind this review, (not Len Feldman if you had been inadvertently mislead), and who like Len Feldman is an outstanding engineer. The difference between the two men is that Mr Nakamichi has been driven by what I would best describe as a 'Magnificent Obsession'.

His original obsession was to build 'state of the art' compact cassette recorders, which would eclipse the best recorders made by any of his competitors. He and his staff would then sell those recorders to other less innovative people, whose obsession is to 'own equipment which is better than that owned by other people'.

Mr Nakamichi had already developed his reputation way back in 1972, when he developed his original Nakamichi '1000' professional cassette deck. That reputation (and the obsession) hasn't diminished in the last 18 years.

About 'fuzzy' logic...

Fuzzy logic was born in — where else? — Southern California. In Berkeley to be exact. Lotfi Zadeh, Russian-born, was a teacher at the University of California, living in a modest home on the north side. The time was the mid- 60's.

Today we'd probably call him a hacker, but in those times he was probably regarded as an eccentric. Zadeh saw most things in his life not as on-off, nor merely as black and white. To him the world was in shades of grey.

In the 1960's computers were nowhere near as ever-present as today. But Professor Zadeh still saw them as imperfect machines. The rudimentary programming of the time called for simple 'yes-no' answers, and Zadeh found this inadequate. He felt it better to program computers the same way as humans approached decision making — with continually wavering border lines.

In today's computer technology there are two approaches to computer intelligence: AI (Artificial Intelligence) and neural networks. American scientists are behind AI, which relies upon fixed rules or routines programmed into the computer, plus additional data input.

But in the 'real world' the rules keep changing, regardless of how fixed they may remain in computers.

In contrast with AI, neural network computers are able to follow the route taken by the human mind. They are able to follow the rules — even if they change — and learn from experience.

Zadeh, in his approach, combined the two schools of computer intelligence. The fuzzy computer is programmed with rules, but they are rules with a high degree of flexibility, and the capacity to adapt to changing conditions. Hence the term 'fuzzy logic'. Fuzzy computers can't re-program themselves, but they *can* adapt to changing conditions.

Sanyo quote a delightful (and possibly painful to some) parallel with the way we perceive age. Most of us would (arguably) define middle age as beginning at 35, and ending at 55. So, if the computer were so programmed, every single person in that age bracket would be labelled as being of 'middle age'. But what about the vivacious, healthy, 34-year-old secretary? Must she be judged as youthful one day and middle-aged the next — just because it happens to be her birthday? Try and ask her!

Fuzzy logic gets 'fuzzy', or imprecise over precise numerical boundaries — like 34-year-old secretaries on their birthday eve — and allows the computer to avoid strict demarcation lines, in the process helping the computer to arrive at decisions much the way humans do; to make connections and analyse situations.

In applying fuzzy logic to video camcorders, the process becomes an information processing method not limited to numerical values. The approach brings in a human subjectivity and sensibility to the computer's judgement process.

Most 1990 camcorders use microprocessors for most functions — to make decisions about focus, light, colour. In the world of the normal computer there is only black/white, on/off, or yes/no.

One example: the lens of a non-fuzzy camcorder is pointed at a snow scene. The computer says 'bright, bright', and the lens' aperture closes down so that the snow is rendered as a light surface with some detail. But unfortunately, there is also a human figure in the scene; because the aperture is now closed down so far, all detail in the figure is lost. A similar but opposite effect happens with an overly dark scene — say, a forest background.

In each case the poor rendition of the all-important figure is due to the computer delivering only one response — close the lens, or open the lens. This phenomenon is common to all automatic evaluation metering systems, in video cameras and still cameras.

Fuzzy logic takes a different route: looking at the brightness scale, it may judge where the level of illumination falls — high or low. It also may compare the light level with the reading taken on the previous scene; if the two are within a pre-set parameter the exposure won't undergo a change. Additionally, the system can be programmed to search out if there are any objects within the frame that could benefit from a change to the exposure.

When it comes to auto focus, both novices and hardened 'videoists' often find this feature of the camcorder environment the hardest to endure. Novices often suffer helplessly in blind, ill-informed fury, while the more experienced allow their itching hands to fall to the manual control, in order to maintain some sort of definition within the frame.

The problem is that most camcorders have a single zone of AF. Should the subject move out of this zone the system goes searching again, often pouncing on the most unexpected and unwanted objects in the background.

Camcorders with triple focus zones are a step ahead, but the operator must select the most appropriate zone — tight, wider, very wide — for his subject. And, should an important figure cross the frame the system will go hunting again. With a fuzzy logic system this isn't a problem.

Fuzzy logic is now a fact of life, particularly in Japan. Two companies sell washing machines that use an optical sensor which detects how dirty your clothes are, and sets up a programme to wash them efficiently and thoroughly, adjusting the intake of washing powder, water and the corresponding time cycle.

The Sendai train line employs a fuzzy logic computer to handle the scheduling, and re-scheduling, of all trains — allowing timetables and signals to be adjusted to allow for any late services. Lifts are controlled by fuzzy logic, and there is even an investment fund which uses the technique to analyse the share market. The Japanese have created a Laboratory for International Fuzzy Engineering Research, and there have been something like 2,000 fuzzy logic patents taken out in that country alone.

The US itself has embraced fuzzy logic, but slowly: the Kenmore refrigerator uses it to defrost itself; NASA's Johnson Space Centre held a conference on the concept; and one company is beginning to build chips incorporating fuzzy logic. One US analyst predicts his country's future in the concept may be in making fuzzy chips for Japanese appliances.

The name 'fuzzy logic' does seem a little inappropriate, though. Sanyo point out, 'there couldn't be a worse nomenclature' for any technology related to the business of producing precision cameras.

And what does the inventor think of the fuss?

Lotfi Zadeh is now 69, still lives in Berkeley and works at UCB. He was recently quoted in *Newsweek* as saying "In the US there is a tradition for what is precise, for Cartesian logic. In Japan there is more appreciation of the imprecise, of ambiguity." Which may be absolutely true.

But the unambiguous fact of Professor Zadeh's present existence is that he will not benefit by one solitary dollar from his rule-breaking invention.

"It didn't even occur to me to patent it."

Friendly Camcorders

cropped and the margins used as 'work space'.

The NV-S1's auto focus is 'AI AF': Artificial Intelligence Auto Focus. Using a piezo system, the incoming CCD image is scanned on an internal lens 'vibrated' to bring the subject into sharp focus.

The maximum time for focus detection and change is claimed to be only two seconds — which is quick, at least one second shorter than many other camcorders.

Now that the lens' bulky front element is not used for the focus change, the unit enjoys full-range focus — from macro, close up to the lens to infinity, without the need for a little zoom/macro stick.

Amorphous material is used in the record/replay head; this has been found to have twice the magnetic coercivity of conventional ferrite material, giving improved colour rendering — especially in the troublesome red wavelengths of the colour spectrum.

The amorphous material is also laminated, enabling video noise to be reduced — by a figure of 3dB.

Taking stills

Retailers are noticing that people tend to take a camcorder on holiday, and leave the conventional SLR or compact-format camera at home.

To aid in the displacement of conventional cameras the NV-S1 sets out to be both a recorder of the moving and still image. To activate the Still/strobe function, you push the button once, and the camcorder freezes the image; push it twice and 'strobe' comes into play and a frozen frame is captured every fifth of a second — or, to put it another way — you're shooting at five frames per second.

Which provides almost a video notebook, capturing just enough for you to replay an encapsulated version of the original action.

Snapshot mode is also installed. This records a still picture for five seconds, creating a form of electronic picture album.

Conventional 1/2" CCD/Lens System

Image size: 4.8 x 6.4mm (8mm diagonal), area 30.72mm^2.
Lens specs: F1.2, 9-54mm 6-times zoom
Number of elements in optical path: 13 spherical
Diameter of lens: 32mm
Length of optical system: 101.3mm
Weight of glass in system: 54.2 grams
Weight of lens system: 170 grams

NV-S1 1/3" CCD/Lens System

Image size: 3.6 x 4.8mm (6mm diagonal), area 17.28mm^2.
Lens specs: F1.4, 6.7-40mm 6-times zoom
Number of elements in optical path: 7 spherical, 2 aspheric
Diameter of lens: 21.5mm
Length of optical system: 60mm
Weight of glass in system: 11.6 grams
Weight of lens system: 60 grams

Reduced size

While small size does not in itself add to 'user friendliness' (unless you hold that 'small is beautiful'), the design approaches taken by Panasonic in achieving the smaller dimensions — and of course reductions in weight — are enlightening.

The drive mechanism was made about 29% lighter, and 8.6mm thinner than earlier VHS-C units, taking the weight to 275 grams.

In the process tape wear was also reduced. Drive cylinders, pinch rollers, guide posts and the capstan were all slimmed.

A new four-layer PCB was employed in both camera and record/replay sections of the camcorder. The number of surface mounted components was increased, and placed on both sides of the board — reducing the size of the board by one third, and reducing its thickness by 0.2mm. The inner two layers of the new PCB are used mainly for circuit power, earth and signal lines.

The CCD is 1/3 of an inch — contrasting with the commonly used 1/2-inch sensors in many other models, yet the company claims the pixel count is still 270,000.

The lens itself was also shrunk, by including two aspheric elements in the optical path.

Difficult to manufacture, aspherics have the benefit of reducing optical aberrations — and weight. In the NV-S1's case Panasonic saved 60 grams.

Table 1 compares the NV-S1's CCD and aspheric lens system with those of a 'conventional' camcorder CCD and zoom lens system, showing the savings in both length and weight. ■

In the early 1970's, Mr Nakamichi and his little company were just another 'small badge engineering manufacturer' offering 'budget' designs to other big name firms. He took a monumental gamble when he independently started work on what ultimately became the original 'Nakamichi 1000' cassette deck. Having developed the prototype machine, he discovered to his embarrassment, that whilst most of his clients were happy to buy his budget cassette decks (and put their names on them), virtually nobody was interested in his almost astounding new cassette deck — as it cost too much!

It was early in 1972 when Sid McLorey (of Wharfedale Australia fame), told me about his momentous meetings with Mr Nakamichi and about his "fantastic compact cassette deck, which would never be marketed because it was too good and far too expensive."

Six month later Arthur Muldoon, the Sales Representative of Magna Techtronics arrived in my office with the first 'Nakamichi 1000' in Australia, with the plea that I should review it for the magazine.

I can still clearly remember that Friday afternoon and the looks of amazement on the faces of my staff, who were unwilling to believe the claimed performance figures.

Now I can't afford a Nakamichi '1000', but I must admit that I subsequently bought a Nakamichi '700', which although more affordable, was somewhat less desirable.

When the first generation DAT recorders (as typified by the Sony DTC 1000ES), hit the Japanese market in 1987, it was obvious to Mr Nakamichi that DAT was likely to be the 'new wave' and that many of the people who had bought his Nakamichi 1000 between 1973 and 1977, would now be in the market for a new generation of premium performance Nakamichi recorders.

If the application of the 'Nakamichi touch' to achieve superior technology could enhance the compact cassette to achieve 'state of the art' performance in 1972, then it was just as obvious that superior technology (plus a little TLC from the marketing division) would achieve even more outstanding performance, and thus ensure a new market using the new DAT format for a generation of Nakamichi recorders. So started another wonderful obsession, and potentially a brand new legend to boot!

Three piece format

While almost every other manufacturer of cassette and DAT recorders has aimed for smaller and lighter configurations for their DAT recorders, the new Nakamichi '1000' goes against the trend and employs a three piece format. These three elements are the '1000 DAT' recorder, the '1000P' digital audio processor and of course, the large (which some may well describe as being unusually large) '1000R' remote control unit.

The remote control and audio processor are configured to control a second optional '1000 DAT' recorder module, to provide greater flexibility in professional or semi-professional recording situations.

The '1000P' digital processor can also be purchased separately, for use as a stand-alone converter with other DAT recorders — as well as CD players which are designed to accept either optical or coaxial digital interfaces.

Nakamichi has actually developed two different versions of the '1000 DAT' recorder. The professional version allows recording at both 44.1kHz and also 48kHz from its analog inputs, while the consumer version only provides the 48kHz capability. Two sets of analog inputs are provided on both versions, firstly as a conventional unbalanced format to suit amateur applications and secondly as a balanced configuration (with XLR socket) to suit professional requirements.

Nakamichi has adopted so many unusual features in this equipment that it's best I start with some of the more obvious ones and work my way on to the more esoteric examples..

Improved transport

The most novel feature and that which is likely to attract the greatest interest in the market place is the 'Nakamichi Fast Access Stationary Tape Guide Transport', for which Nakamichi have adopted the obvious acronym of 'FAST'. This ingenious tape transport mechanism is shown schematically in Fig.1, and offers positive and very real advantages over other more conventional tape guides — the majority of which are 'spin-offs' from video cassette recorder development.

Having examined the tape guide/loading system in my own DAT recorders, it is clear that the 'FAST' system is a radical design development, which not only offers dramatic advances in tape winding speed but more significantly, does so with reduced risks of head or guide wear, which I now realise is a cause of real concern in other (lesser) DAT recorders.

The next most important feature of the '1000' is its adoption of a four-head design, which facilitates true 'off-tape monitoring', analogous to that provided by conventional three-head reel-to-reel or cassette recorder. This feature is a bonus to the user, and as I found, a real bonus to the reviewer — especially one who wishes to undertake full objective testing.

The next most important feature is the adoption of eight times oversampling 20-bit digital to analog converters. Nakamichi has completely bypassed the more conventional 'sample and hold technology', and the design philosophy of this recorder is based on two sets of 16-bit 'glitch free' converters, supplemented by matching ROM chips on which the calibration conversion data is stored.

This particular feature appears to be unique and it facilitates the automatic correction of inaccuracies in the absolute level of individual steps in the 'A to D' converters. This in turn, is

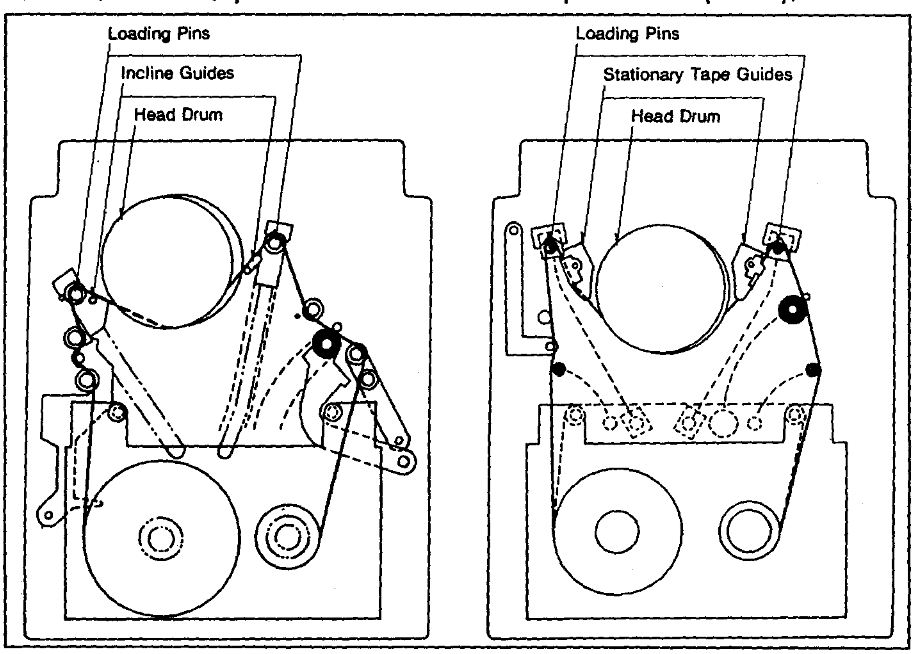


Fig:1: At left is the basic tape transport mechanism used in conventional DAT recorders. At right is Nakamichi's improved 'FAST' transport, an important advantage of which are the stationary tape guide blocks.

Nakamichi 1000

achieved through the use of a circuit which compares and then trims the values of each of the individual bits, through a novel additive process.

Although the user has a significant degree of control over some of the more important operating parameters, one of the main features of the Nakamichi 1000 is its simplicity of operation (once you get the hang of the control features).

The front panel of the 1000 recorder is laid out in four basic sections, with a power switch, separate timer switch, an Auto Play switch and an Eject button at the left hand side of the panel.

The unusual cassette well and cassette well cover are located at the left hand end of the panel, and even this goes against the trend by adopting a vertical hinged configuration in lieu of the more conventional horizontal format. This cover is easily removed to provide ready access for adjustment, tape head cleaning, and routine maintenance (by appropriately trained staff).

With the door closed, you have a better view of both the tape transport mechanism and the rotating heads (which move as a blur), than you would have on other more conventional DAT recorders — all of which provide a view of the rotating head assembly but not as well.

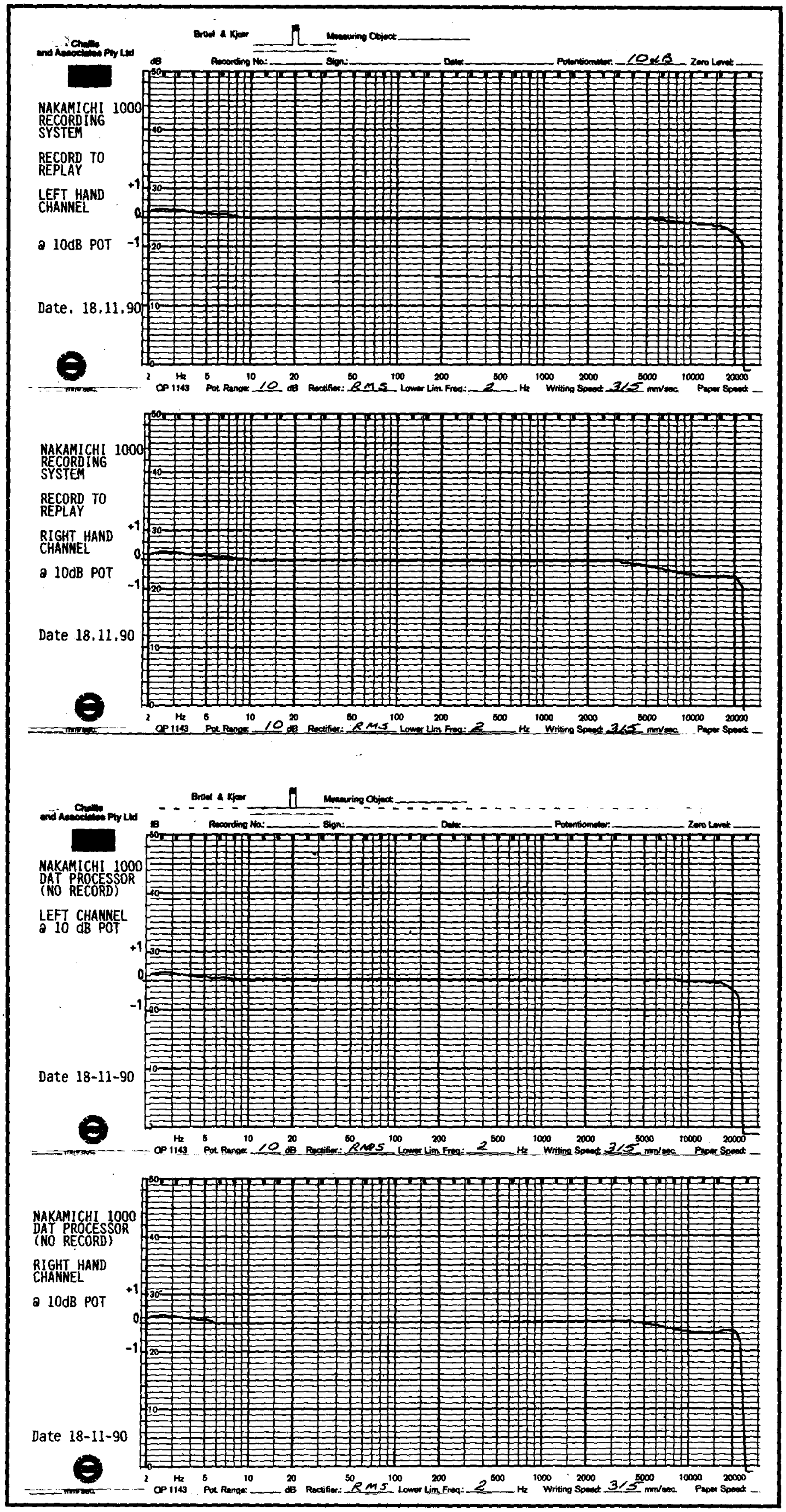
The tape transport mechanism is controlled by three large touch-buttons which actuate Stop, Play and Pause functions. Immediately above these are smaller push buttons for Rewind, Fast Forward, Reverse Skip and Forward Skip.

Above these is the digital tape counter, which operates as a conventional five digit counter, or alternatively presents data in the form of 'program time', or 'remaining time' available on the tape as well as in terms of 'absolute time' from the start of the tape.

The selected mode is indicated by lights above the display, while adjacent indicator lights show the current digital sampling rate (48, 44.1 or 32kHz) and whether the signal is recorded with or without 'pre-emphasis', whether the source data is digital (or analog) and whether the digital signal contains a 'copy inhibit sub-code'.

In this respect, Nakamichi has stuck its neck out by making it possible to record the entire signal, even if it contains the ubiquitous copy prohibit sub-code, which now inhibits other DAT recorders from recording the digital signal.

Two buttons are provided for the digital fader, which allows you to fade the digital signal 'in' and 'out'. These are of particular significance, as the analog level controls exert no influence on the digital signal path. These digital fader



Here are the frequency response plots for the new Nakamichi 1000 system. At top are the recorder-replay responses for the overall system with those for the processor unit alone shown below them.

controls once activated, cannot be deactivated in the middle of a bad sequence — which is a potential trap!

On the upper right-hand side of the deck is a supplementary display window in which the sequence number of the selection being played is shown and which is also employed in an auxiliary mode to select the number of the recorded sequence desired.

When a program is being played, this display shows how far you have progressed in the tape. Below this display are a series of buttons for Repeat, supplemented by a memory LED and a Call button which allows you to display the memorised program. To the right of these displays are a set of numeric keys to facilitate program playback as well as direct access to individually numbered tracks. In the bottom right hand corner of the panel, buttons are provided for selecting 'source' or 'monitor' together with three rows of controls and switches for setting or erasing Start ID with its own LED indication, an Auto switch for automatic program numbering, together with additional push buttons to Renumber, Write or Erase the separate ID (identification) coding.

The bottom row of switches provide 'end mark' signals at a specific point on the tape, whilst the adjacent erase button makes it possible to erase an end mark, if and when one needs to.

The back panel of the Nakamichi 1000 is rather innocuous with a coaxial digital input and in separate switched optical input, together with a separate coaxial digital output and separate unswitched optical output.

The central processor unit also has a connector for a wired remote control, with associated address selector switch so that you can use one or two decks separately or together, depending on which switch setting you have selected. There is also an additional free unused plug-in module space behind the blank top panel of the deck, so that supplementary circuitry and additional facilities may be incorporated at a later stage.

In more practical terms, it has been my observation that such supplementary capabilities are only very infrequently provided, as current Japanese marketing concepts normally aim for a planned obsolesence in one to two years.

Processor unit

The 1000P digital processor has a front fascia and construction which neatly matches that of the 1000 digital cassette recorder, but with fewer controls — compensated for by the fancy digital level display on the left hand side of the panel. The unit has its own separate mains switch at the top left hand corner, a headphone volume control and matching tip-ring and sleeve

Measured DAT System Performance of Nakamichi Model No. 1000

Serial No: 1000P Recorder A5001070
1000P Processor A50501134

1. Record to Replay Frequency Response

(Analog input to analog output) Left 2Hz to 20kHz +/-0.6dB
Right 20Hz to 20kHz +/-0.7dB

2. Linearity @ 1kHz

Nominal Level	Left Output	Right Output
0dB	0.0	0.0
-1.0	-1.0	-1.0
-3.0	-3.0	-3.0
-6.0	-6.0	-6.0
-10.0	-10.0	-10.0
-20.0	-20.0	-20.0
-30.0	-30.0	-30.0
-40.0	-40.0	-40.0
-50.0	-50.0	-50.0
-60.0	-60.0	-60.0
-70.0	-69.7	-69.7
-80.0	-79.2	-78.9
-90.0	-90.7	-87.3

3. Channel Separation

Frequency	Right into Left dB	Left into Right dB
100Hz	85.6	85.0
1kHz	85.0	85.3
10kHz	84.2	84.9
20kHz	81.2	82.1

4. Distortion

	Level	2nd	3rd	4th	5th	THD%
@ 1kHz	0	103	-	-	-	0.0021
	-1.0	101.7	-	-	-	0.0024
	-3.0	102.0	-	-	-	0.0023
	-6.0	-		100.8		0.0014
	-10	104.4	110.2	110.7	106.5	0.002
	-20	98.3	93.9	-	99.2	0.0055
	-30	-	86.9	-	79.5	0.017
	-40	83.2	77.2	-	81.5	0.035
	-50	72.2	71.6	68.0	74.7	0.11
	-60	-	57.4	57.7	56.2	0.39
	-70	33.4	36.2	41.3		2.8
	-80	26.7	27.5	29.4	30.0	7.8
	-90	26.2	23.9	-	-	8.0
@ 100Hz	0	106.2	-	-	111.7	0.0015
	-20	106.4	93.1	103.9	101.7	0.0047
	-40	91.5	76.8	-	-	0.029
	-60	71.2	58.3	61.2	55.4	0.37

5. Processor

Low Frequency Response	Left	Right
1.0Hz	-1.1dB	-1.2dB
0.6Hz	-3.1dB	-3.1dB
0.5Hz	-4.1dB	-4.1dB

6. Sensitivity

Input unbalanced for 0dB Level @ 1kHz — Left Channel 350mV, Right Channel 350mV

Signal to Noise Ratio — 2-22kHz (flat) 92dB; A-weighted into 97dB(A)

Calibration Accuracy of Digital Displays — 0-50dB Maximum Error <0.1dB; 50-60dB Maximum Error <0.2dB headphone socket immediately below. To the right of this is a large and very graphic peak level modulation display which covers the range 0 to -60dB, together with an Over-modulation display segment at the very top.

To the right of this display are four LED's indicating the selection of 48kHz, 44.1kHz or 32kHz sampling frequencies, together with an emphasis light. Below these are four switches for emphasis Off/On, meter Off/On or Peak Hold. Underneath that, a switch is provided for DAT dubbing with a selection of 1-2, Off and 2-1, whilst the last of the small switches selects either analog or digital input.

On the right hand side of the deck are three volume controls for the analog circuitry, the first being the output level control and the other two controls being provided for Left and Right channel Input circuits.

Below these are three monitor switches for selecting DAT 1, DAT 2, or the Source, while to the right of these is a large and s tylish master volume control.

The rear panel has a very busy look with the plugs and sockets provided in three distinct groups.

Uppermost are the analog source inputs with two balanced XLR female sockets and unbalanced RCA gold plated coaxial sockets, (for the analog to digital segment of the processor). In the middle are the analog line ouput sockets with balanced XLR male sockets, and two pairs of unbalanced fixed and unbalanced variable gold plated RCA sockets for the digital to analog segment of the processor.

The bottom panel contains digital coaxial and optical sockets for input and output to and from DAT 1, input as well as input and output to and from DAT 2, and also to and from a separate Digital Source.

Testing it

Some objective tests of equipment are complicated by design inhibitions which irritate and inhibit the most agreeable of engineers — but not so the 'Nakamichi 1000', which has been ergonomically designed to be used by either professionals or amateurs with equal aplomb.

The frequency response measurements were directly aided and enhanced by the adoption of the four head design and quickly proved to be both exemplary and unusually 'flat' all the way from 2Hz to 5kHz. The measured 'record-to-play' frequency response exhibited a measurable and more significantly, an observable (but inaudible) droop between 5kHz and 22kHz.

At first I thought we had done something wrong, but after checking other independent test reports, I soon realised that this was potentially a minor design anomaly. In order to confirm this and to seek more information on the subject, I spoke to Hyam Susonow at the headquarters of Nakamichi USA.

He dutifully advised me to return the 1000P processor for replacement, as it was outside the performance spec. As it would have taken a month to get the unit replaced, I decided to ignore his otherwise excellent advice and pressed on with the testing.

As I discovered, the 'Nakamichi 1000' recorder module adds virtually negligible changes to the measured frequency response and it is the characteristics of the 1000P which dominate this issue. As I soon discovered, the low frequency performance of both the processor and the recorder is exceptionally flat, being only just over 1dB down at 1Hz and just over 3dB down at 0.6Hz.

This is a real 'instrumentation recorder performance', and I can visualise large numbers of consulting engineers and other classifications of experimenters deciding that this is 'just the machine that they need for the laboratory' (and possibly appropriate to take home sometimes at the weekend).

The next thing I evaluated was the calibration accuracy of the digital display, and was hardly surprised to find how accurate it is. In fact, it's on a par with the accuracy of my laboratory reference attenuators, and certainly better than +/-0.1dB all the way down to 50dB and better than +/-0.2dB at the -60dB point.

The record to replay linearity of the recorder is of course even better than that exhibited by the display and provides an absolutely flat transfer characteristic down to -60dB. Between -60dB and -70dB, I measured the start of a gentle deviation from perfect linearity which increased between -70dB and -80dB and further increased at -90dB.

Whilst the 'automatic linearity correction circuits' certainly improve the transfer linearity of the low level signals in a positive manner, they by no means achieve the linearity figures that I would have expected on the basis of the manufacturer's pre-release publicity.

The trouble with such pre-release statements is that they seduce you into believing that a product achieves unachievable characteristics, and consequently when one detects a linearity error of 0.7dB at -90dB, (still excellent, of course), one tends to forget how many 'bits' the digital processor is left to play with.

The next parameter I evaluated was the channel separation from 'input to output' and which soon proved to be truly outstanding: better than 80dB at all frequencies. Channel separation figures of this magnitude could just not be achieved on conventional 'reel-to-reel' or compact cassette recordrs.

The measured distortion characteristics of the recorder are just what you might expect to find on a CD player — except they are slightly better. However, once your excursion takes you past the 0dB limit and the recorded signal rises to just +1dB (i.e., above the recommended limit) the total harmonic distortion figures 'take off like a rocket'. The dominant components are those at 2f, 4f, 6f, 8f and 10f harmonics, which although only 0.1% at +1dB, climb up the FFT display in a disturbing manner with a THD which reaches 8% at only +2dB.

Below the 0dB point you are talking about 0.0021% THD. At -50dB the THD is still only 0.11% while at -80dB it's up to a significant 7.8%. Surprisingly at -90dB the THD is still only 8%, so the 'automatic bit correction' circuitry really does do some useful work.

I was tempted to record some digital test data from some of my CD test discs onto the Nakamichi 1000 system, using the digital inputs, but was dissuaded by the knowledge that I had no way of checking the digital transfer characteristics of the CD player.

Notwithstanding my qualms, I decided to initiate some preparatory tests with my Sony CDP555 ESD CD player, which incorporates a digital output. I was suitably rewarded with test data which indicated low frequency distortion figures, an order of magnitude below those recorded using the 1000P's analog inputs.

The next series of tests were directed to assess the quality of sound capable of being recorded on the 'Nakamichi 1000'. I used a pair of Bruel & Kjaer type 4134 laboratory reference microphones, whose preamplifier outputs were connected directly to the unbalanced analog inputs of the 1000P processor.

The quality of sound produced was absolutely brilliant, and I was rewarded with some of the most 'true to life' sounds that I have yet experienced.

More significantly, there was no trace of hum or noise, no trace of distortion and the dynamic range was immediately confirmed to be adequate for virtually any type of acoustical measurements that I have yet undertaken — anywhere from 15dB(A) to in excess of 140dB(A) if one is prepared to appropriately set the upper or lower limits of recording as required.

I progressed past these simple tests to what some readers may regard as an equally exacting one.

This was a replay evaluation using two pre-recorded DAT tapes, regrettably the only pre-recorded commercial DAT tapes which were available to me. The first was a short Onkyo demonstration DAT tape, which I gratefully received at the Tokyo Audio Fair in 1988, and which was prepared specifically for the release of the Onkyo consumer DAT players.

The 'pop' music was recorded live in Tokyo, and is superior to virtually any pre-recorded music that I have on my shelf at home. But as I can't read Japanese, I can't recount precisely who or what was being played.

The quality of the recording was a credit to the recording engineers, and I believe superior to the best pre-recorded demonstration CD's that I have yet heard.

The second demonstration DAT tape was kindly provided by Nakamichi America, and is a German pre-recorded DAT tape entitled 'Stakkato' with 60 minutes of pre-recorded material — the majority of which is devoted to explosive examples of Tympani and percussion. The content is fine for demonstration, and some may well consider this type of material the real forte of the DAT system — although not yours truly.

Nothwithstanding my disdain for much of the material on this DAT tape, it does nonetheless provide a number of outstanding examples of the dynamic range capabilities of the DAT media, and of this particular recorder in the replay mode. The smashing of glasses may not constitute everybody's 'cup of tea', but they do provide a most complex and demanding exemplification of signals whose dynamic range exceeds 95dB and which do not need to be compressed as they would be in almost any other pre-recorded medium.

In addition, the available frequency response capabilities of this recorder mean that it is your speakers or headphones which then become the limiting factor.

Summary

The new Nakamichi 1000 DAT recorder is an outstanding piece of recording equipment, and currently typifies the highest quality in DAT recording equipment available, albeit at the highest price. In the USA, it costs a cool US$11,000.

Whilst many may aspire to own such beautiful equipment, relatively few will wish to spend that sort of money in order to satisfy the penchant to own the best.

Of course obsessions for perfection are one of the elements on which marketing hype tends to be nurtured and I have no doubt that Mr Nakamichi's magnificent obsession will provide the means of nurturing a new obsession in countless other 'would be' DAT owners.

Further information on the recorder is available from Nakamichi Australia, Level 2, 61A Dunning Avenue, Rosebery 2018; phone (02) 313 7071.■

Under the (costly) skin of a Solar Race winner

The Swiss Engineering School's solar race car *Spirit of Biel Bienne* walked away to a clear win in the 1990 World Solar Challenge. What was inside that slippery shape, to give the car its leading technology? Australian solar cells, for a start...

by BRIAN WOODWARD

The solar-powered domestic car will probably never be built. Expectations have been built up, developed and realised in the fuel burning car — expectations that simply cannot be realised from a pure solar-powered car, even when the sun shines.

The earth's star is a self-sustaining nuclear fusion reactor. Its output is 4.0×10^{26} watts. As this is dissipated in all directions, only a miniscule amount reaches this planet's surface. This tiny amount of energy is further reduced as it travels through our fragile, threatened atmosphere.

By the time this persistent stream of photons and electromagnetic energy reaches the solid part of this planet where we humans live, there is less than $1.0kW/m^2$ remaining — generally a lot less.

The average car's roof, boot and bonnet total less than seven square metres, so even using the most efficient solar cells, the amount of power which could be gathered in ideal conditions is less than 1.2kW. Compare this again with the average car, which has a fuel burning engine capable of developing 80 to 160kW, and you can see why the pure solar car is an unlikely alternative.

In Australia's outback the level of radiation is about $1.0kW/m^2$. Occasionally this level rises when low level white clouds scatter the radiation — provided the clouds do not block the direct rays of the sun, but remain 'within view' of the solar collector. The sun's energy is reflected off the earth's surface, bounces off the underside of the clouds and adds to the amount coming from the clear sky between the clouds.

Telecom engineers have measured

short bursts of $1.3kW/m^2$. The multiplication effect is capricious. If the sun's output cannot be guaranteed, then multiplying it by the natural reflection off clouds is even less predictable. During the 1990 World Solar Challenge, one massive burst of $1.8kW/m^2$ was recorded for some 10 seconds by the support vehicle following the car which won the race.

The winning car was made by the academics at the Ingeniuerschule (Engineering School) at Biel, in Switzerland — Europe's only university specialising in Automotive Engineering. When the weather was bad (as it was for much of the 1990 event — rain on many days and a persistent 15-20km/h headwind), the *Spirit of Biel Bienne* almost equalled the clear weather times set in 1987.

In fact, the *Spirit of Biel Bienne* covered the race's official 3007 kilometres in 46 hours 8 minutes, while in 1987 the *GM SunRaycer* needed 44 hours 54 minutes. So the 1990 winner took just one hour 14 minutes longer, in dreadful solar racing weather.

Obviously the Biel car must have used some exciting electronics, because the solar array on the *GM SunRaycer* was made from toxic gallium arsenide cells intended for a Hughes Aerospace satellite, while the *Spirit of Biel Bienne*'s cells were of monocrystalline silicon.

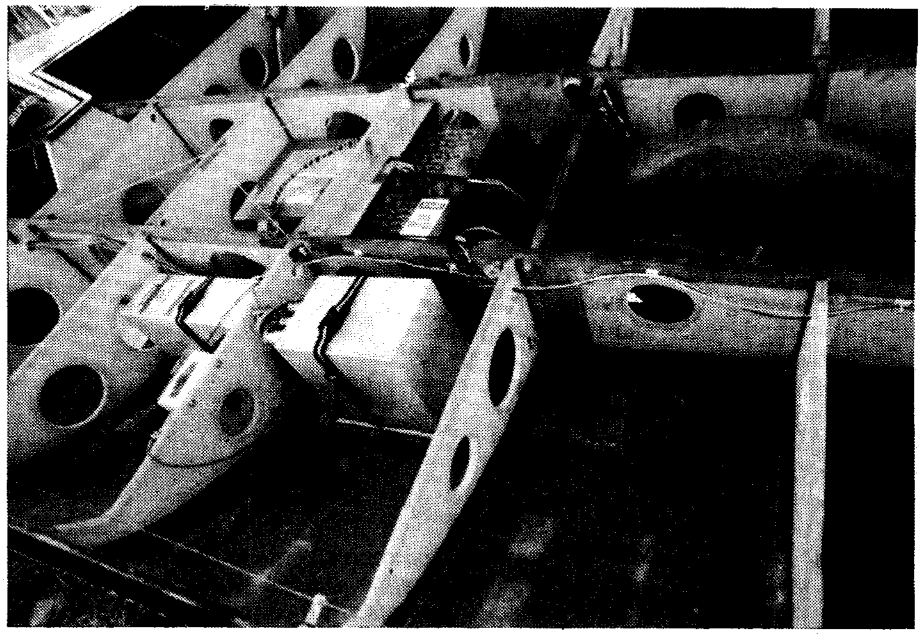
Low drag, weight

No matter how clever the electronics, a successful solar race car needs to be mechanically correct. The Biel car was developed with the aid of the industry's best. Europe's best wind tunnels were used to develop the shape.

The result was an aerodynamic drag coefficient (Cd) of 0.126, for a vehicle that is 5620mm long, 2000mm wide and 1000mm high. Much of the low Cd comes from the fact that the car's frontal area is a tiny $1.1m^2$.

The body and integral frame was made by Bucher Lightweight Constructions from epoxy resin reinforced by carbon and aramid fibres and, without electrical and mechanical components, weighs only 66 kilograms.

Mechanically the *Spirit of Biel Bienne* is a single seat three wheeler, with a double triangle transverse control linkage at the front using hydropneumatic suspension. The rear wheel is also the chain-driven wheel and hangs on a trailing arm. Front brakes are hydraulic discs, while the rear uses a handbrake and regenerative braking — where the car's motor becomes a generator and the power developed by slowing the car is returned to the car's batteries.



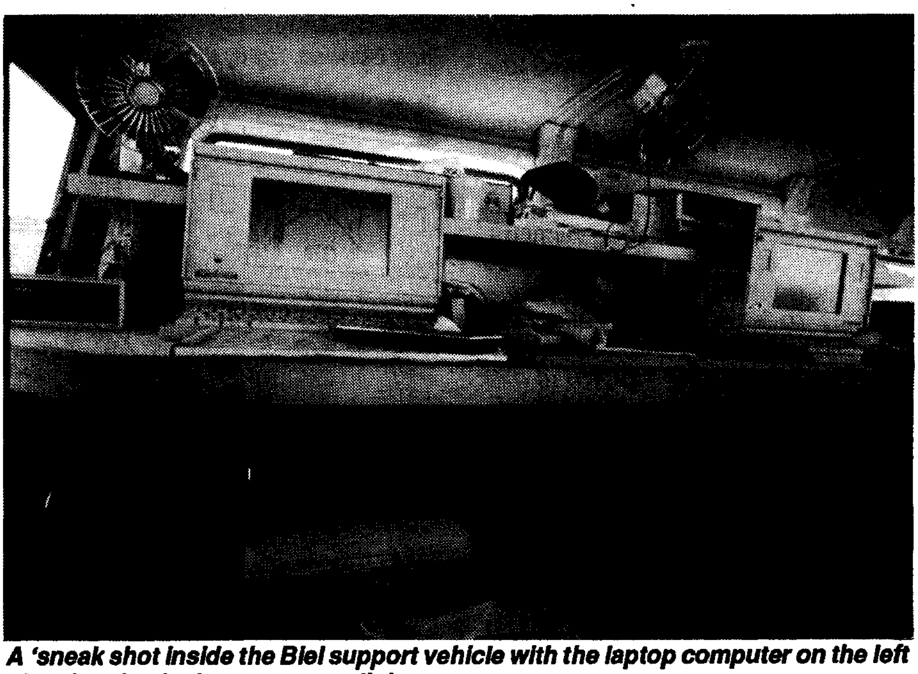
Inside the Spirit of Biel. The tiny motor is immediately in front of the shrouded rear wheel. In front of it are the silver zinc batteries and nearest the camera, the power tracking and management circuitry

Solar array

The basic electrical structure of the car starts with the solar array. This uses laser-grooved cells, developed by Professor Martin Green and his team at the University of NSW in Sydney. For the *Spirit*, the cells were made by a Green licensee, Telefunken Systemtechnics (a division of German Aerospace).

In laboratory tests 'Green' cells have recorded electrical efficiency in excess of 24%. In practical use, the cells recorded a maximum of 17% during the 1990 WSC.

Green cells use laser-cut micro grooves to bury the electrical contacts beneath the cell's surface, plus a laser-cut surface texture to capture more photons and minimise light reflection from the cell's surface. A further development was to overlap or 'shingle' the cells, so that the waste



A 'sneak shot inside the Biel support vehicle with the laptop computer on the left showing the day's average sunlight energy.

area at the edge of each cell was overlapped by the next cell.

The result of overlapping meant that the *Spirit of Biel Bienne* carried a greater active surface area than any other car (the overall size of the solar array is fixed by the race's regulations), measuring 7.67m^2 and 1.3mm thick. It is sandwiched and reinforced with fibreglass.

At the standard 25°C/1.0kW/m^2 rate, the array developed 1.3kW of power. Allowing for daily average and weather-induced variations and losses, the Spirit of Biel Bienne's 17-kilogram array had an output of 980 watts, compared with the much-favoured Honda car's 800 watts.

The *Spirit* was one of the few cars in the 1990 WSC which was *not* using a power tracker and management system developed by Australian Stuart Watkinson. Watkinson's 'Power Maximizer' was used by about 80% of the 36 cars entered. Biel's engineering school developed its own 400-gram weight power tracking system, which gave 98.6% efficiency under nominal power at 30°C.

Management system

The power tracking and engine management system is controlled as part of the car's race strategy. It balances the often conflicting elements of solar array output, storage battery level and the motor's demands. The management system is supplemented by a sophisticated light, wind and weather monitoring system aboard the support vehicle which followed the race car.

In 1987 the *GM SunRaycer* team used 100-channel telemetry between the race car and the support vehicle, to monitor all aspects of the race car. The Biel team was reticent about telemetry, but had sufficient computing power on board the support vehicle for running changes to be made to the power management system using telemetry.

Storage batteries in the *Spirit of Biel Bienne* consist of 86 1.5-volt silver zinc batteries in series, for a nominal 129 volts. Weighing just 38 kilograms, the US-manufactured Eagle Picher batteries' capacity is 25 amp-hours.

The drive motor was designed and made in-house by the academics of Biel's Ingenieurschule. It is a permanent magnet synchronous motor with a nominal power of 1100 watts and a peak power of 5.0kW at around

Communications to the rest of the world were maintained by two Telecom Iterra satellite phones which were set up along the route. They may not be solar powered, but communicate with a phone system that is largely solar powered in the outback.

Dick Duncan, right, discusses the weather with a WSC official.

Dick Duncan's mobile weather monitoring station set up at the side of the road near Darwin.

65 volts. This very clever motor weighs only 4.2kg and has 94.5% efficiency at its rated load of 1.1kW.

Each car in the 1990 WSC had to have brake lights, turning indicators and a hazard warning system. This is powered by a separate silver-zinc battery in the *Spirit*.

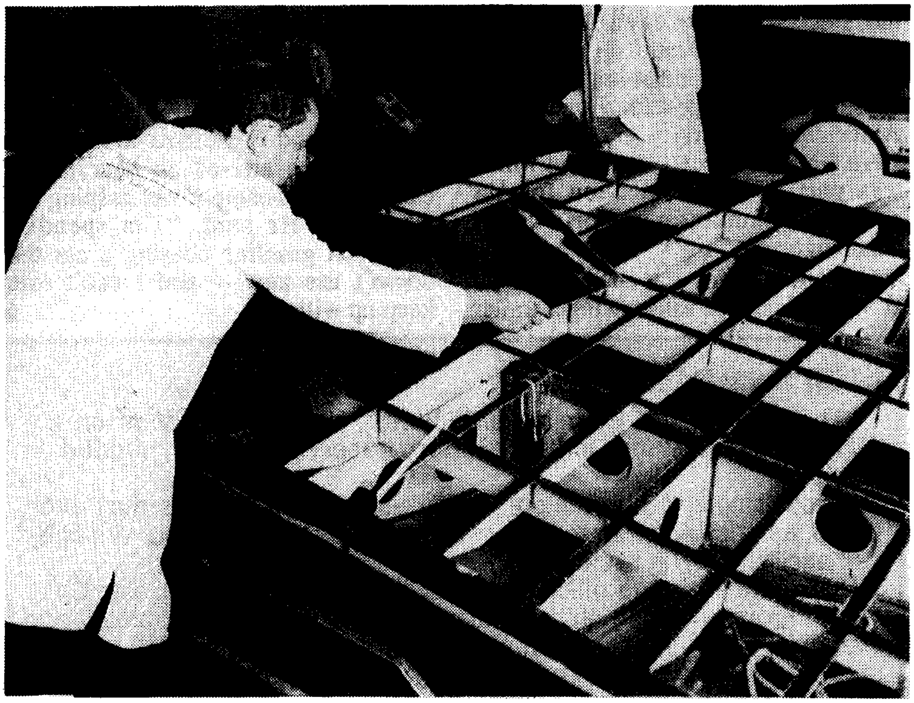
Inside, the car has an instrument panel showing remaining battery voltage, Amp-hour counter, current in each of the seven power trackers, motor tachometer, power from the solar array, power taken by the car's electronics and a powermat. This last unit provides constant electrical power while driving (meaning that the car slows down on hills — not that there are too many hills between Darwin and Adelaide).

Each car in the 1990 WSC had an 80-kilogram driver. If the driver was less than 80kg, the car was ballasted with lead shot. Drivers over 80kg were told to diet. With the *Spirit* in race trim, ready to roll and with driver aboard, its weight was only 255kg.

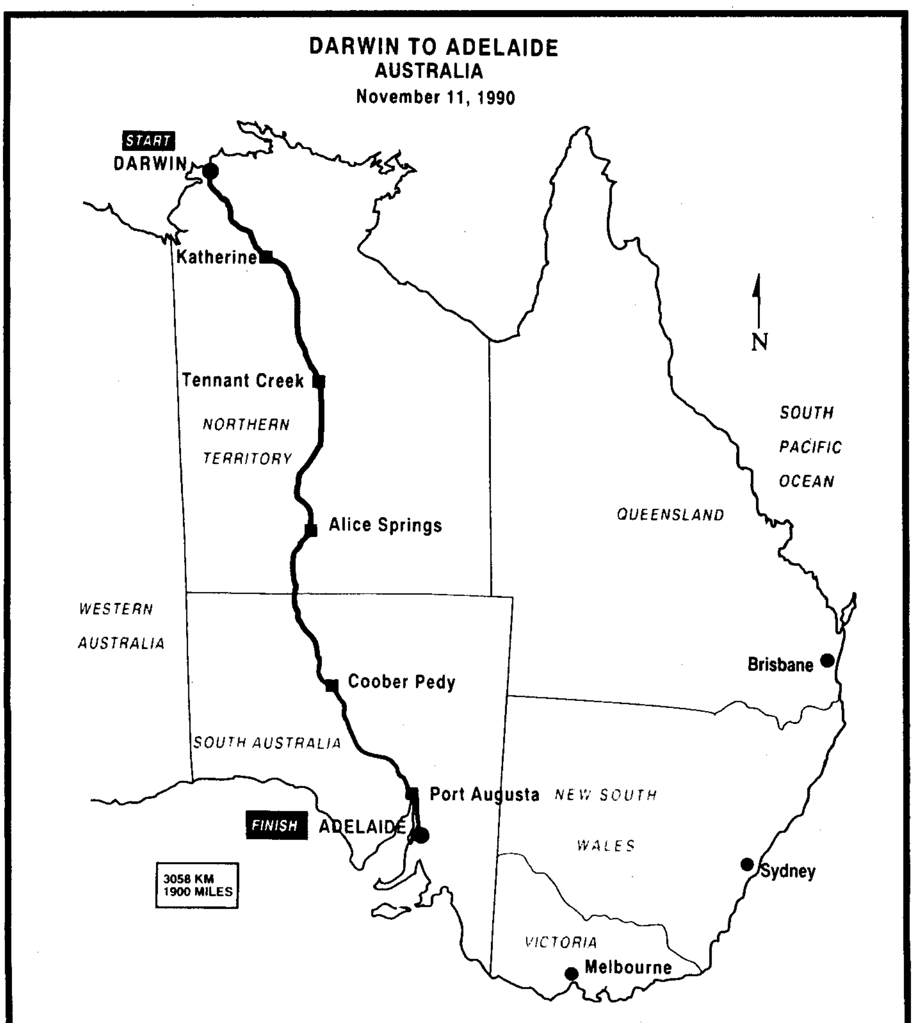
Over the 3007-kilometre official race distance, the *Spirit of Biel Bienne* averaged 65.184km/h. In clear, ideal racing weather when the batteries were fully charged and it was able to run on the full output of the solar array, it was clocked at slightly more than 100km/h (south of Woomera — I was following it, and using a corrected speedometer). Under slightly overcast conditions, or when it was necessary to bring batteries up to full charge for poor weather further ahead, it was able to maintain 80km/h. In light rain and full, but thin cloud cover, it was able to maintain 50-60km/h at the expense of some battery reserve.

The race started in poor weather in Darwin, with heavy overcast clouds and occasional rain. The word went around that the weather was clear and fine to the south. Cars streaked away from the start using precious amp-hours of battery reserve, in the hope of reaching the replenishing sun down south. It was soon discovered by about half of the contestants and the *Spirit* managed to beat the *GM SunRaycer*'s first day distance by a few kilometres. The other half of the contestants were caught in cyclonic weather, which ended the race for a few and put the rest of the field so far behind that they never caught up.

By the end of the first day the *Spirit* was in the lead, and that lead was not challenged for the remainder of the race. The first day's tactics paid off.



Cells in their fibreglass supports being attached to the Spirit of Biel in Germany.



This map shows the route that was travelled by entries in the World Solar Challenge, starting in Darwin and finishing in Adelaide.

Solar Race

Conclusions

Developments in solar cells will continue as the reality of electric cars emerges. Solar cells will not power the car in the same manner as they did the 36 cars which left Darwin in November 1990.

But solar cells will certainly be used to recharge the batteries of electric cars parked in the sun. Solar cells will also be used for 'luxury' ancillary systems such as car sound and air conditioning.

Australia leads the world with the cell technology developed by Professor Martin Green and his team.

Both Telefunken and BP Solar are licensees for the new cells, and production lines are being established in Germany and Spain. When BP Solar's production facility in Spain is fully operational (and the bugs ironed out) it will be duplicated in Australia for local cell manufacture.

Why? Because Australia is already the world's largest consumer of solar generated electricity. Telecom alone uses 2.0 megawatts of solar cells for phone and microwave communication power in remote Australia.

Mass production of the 'Green' cells will greatly reduce their cost. The dollar cost per watt has been falling dramatically and is now as low as $9.00/watt.

Cost per watt has been the greatest advance since the first Solar Challenge in 1987. The *GM SunRaycer*'s gallium arsenide cells were reported to have cost $1.5 million. The hand-built prototypes on the *Spirit of Biel Bienne* cost around $400,000 — less than one third as much, for the same output.

This dramatic cost reduction, plus the improved management of solar arrays (as confirmed by Stuart Watkinson's Australian Energy Research Laboratory entry in the race — it was the first Australian car home) is the future of solar-assist.

Except for communications and low-level domestic power requirements in remote places, solar cells have little future except as an aid to other forms of electrical generation.

But this assistance provided by solar cells is dramatic and worthwhile and, environmentally, offers benefits this beleaguered planet cannot ignore.

The sponsor of the 1990 World Solar Challenge was the American J. Ward Phillips. Mr Phillips made a fortune in the California real estate boom, and has since retired to a small island in America's north west. The island has no power, so he is no stranger to solar energy. He also sponsored one of the American University entries in the 1990 GM SunRayce — an event which was part of a pre-selection for US entries in Australia's World Solar Challenge.

J. Ward Phillips travelled the 1990 WSC in a camper van, towing a trailer with a 240 volt generator (to power the van's air conditioning during the hot evenings of the race). To him goes the last word.

The last day before arriving in Adelaide, he arrived an hour late in camp with his camper van gasping and wheezing. He said, "I'm spending $1500 on gasoline chasing a car that doesn't use any — and I can't even keep up with it!" ■

Solar monitoring

"The weather this morning is 650W/m^2, rising to 980W/m^2 on the coast and 1.1kW/m^2 inland. Battery reserves will be needed in Hobart..."

As solar cells become more widely used, radio stations may even broadcast their weather reports in a manner useful to people with solar cell ancillary power systems.

Dick Duncan is the official weather man for the World Solar Challenge. From a Holden station wagon, Dick monitors solar radiation in watts/m^2, wind speed in km/h, temperature in EC and humidity. He's a laconic man, whose experience with scientific instruments, the weather and the Australian bush made him one of the best prepared for the roadside camping which predominated the 1990 WSC.

He doesn't predict, but he's been asked so often that his answer comes quickly and precisely when asked what tomorrow's weather will be. "I record what happens, when it happens", he replies. "The information is for the record, when somebody sits down years from now and asks 'Which car was best?' — they'll be able to look at the parameters it ran under."

Dick's car carries two anemometers to measure wind speed. One is for instant readings and the other for an hourly update on the car's laptop computer. The pile of 'upturned pie dishes' contains the sensors for measuring temperature and humidity. Behind this is an instant temperature sensor.

Naturally, Dick's equipment is solar powered. The small panel of cells recharges the batteries used for the sensors, processor and computer.

The instruments on the Commodore's roof also contains three pyranometers which measure the heat of the sun. One is for instant readings, the others for the daily average and hourly readings.

Information is stored on chip — he uses only 36 kilobytes of RAM and compresses the information for storage. In fact, five weeks of hourly updates can be stored on just 36KB.

The equipment is made by Monitor Sensors of Caboolture in Queensland. Mindata of Seaford in Victoria is Dick's local agent, and his participation in the WSC wouldn't have been possible without their sponsorship.

Dick's experience with solar racing is as long as any person's in the world. In 1982 Hans Tholstrup approached Dick to make some means of measuring solar energy and recording it, so that the flow and ebb of power could be checked later. This was for Hans' epic journey across Australia in the BP Solar car — the world's first trans-continental trip in a solar powered car.

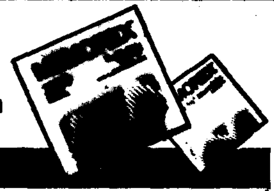
By the time the World Solar Challenge of 1987 became a reality, the lessons learned from the world's first solar car trip enabled him to expand the system to the degree of sophistication it has reached. The weather information is available for teams to make a close assessment of their vehicle's performance under differing conditions.

After many years in the scientific instrument industry, Dick's experience and Monitor's equipment means that the Australian WSC has an unbeatable degree of competence in recording this vital aspect of the race.

FREE 148 PAGE ELECTRONICS CATALOGUE WITH 32 PAGES OF DATA FREE WITH EVERY ORDER OVER $100

AUSTRALIA'S CHEAPEST DISK PRICES

ALL PRICES PER PKT/BOX OF TEN



MEMOREX DISKS

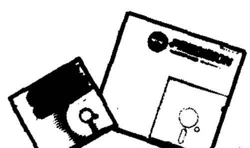
	1-9 Boxes	10+		1-9 Boxes	10+
3 1/2"DD	$19.95	$18.95	5 1/4"DD	$14.95	$12.95
3 1/2"HD	$45.95	$42.95	5 1/4"HD	$23.95	$22.95

VERBATIM DATALIFE

	1-9 Boxes	10+
3 1/2"DD	$28.50	$27.95
3 1/2"HD	$53.50	$52.50
5 1/4"DD	$22.95	$21.95
5 1/4"HD	$24.95	$23.95

VERBATIM VALUELIFE

	1-9 Boxes	10+
3 1/2" DD	$23.95	$22.95
3 1/2" HD	$39.95	$37.95
5 1/4" DD	$12.95	$11.95
5 1/4" HD	$19.95	$18.95



PRECISION

	1-9 Boxes	10+
3 1/2"DD	$19.95	$18.95
3 1/2"HD	$39.95	$37.95
5 1/4"DD	$9.95	$8.95
5 1/4"HD	$19.95	$17.95

TDK

	1-9 Boxes	10+
3 1/2"DD	$39.95	$37.95
3 1/2"HD	$69.95	$67.95
5 1/4"DD	$19.95	$18.95
5 1/4"HD	$39.95	$37.95

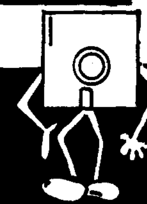
DYSAN

	1-9 Boxes	10+
3 1/2"DD	$22.95	$21.95
3 1/2"HD	$39.95	$37.95
5 1/4"DD	$19.95	$18.95
5 1/4"HD	$31.95	$29.95

XIDEX

	1-9 Boxes	10+
3 1/2"DD	$29.95	$27.95
3 1/2"HD	$49.95	$47.95
5 1/4"DD	$19.95	$17.95
5 1/4"HD	$29.95	$27.95

SAVE ON "NO BRAND"

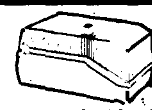


FREE DELIVERY OVER $100

BOXES OF 10 DISKS
LIFETIME WARRANTY

	1-9	10+	50+	100+	500+
5 1/4"DS/DD	$4.95	$4.80	$4.70	$4.60	$4.40
5 1/4"DS/HD	$10.50	$10.25	$10.00	$9.50	$8.90
3 1/2"DS/DD	$9.75	$9.50	$9.25	$9.00	$8.50
3 1/2"DS/HD	$19.50	$18.95	$18.50	$18.00	$17.50

DISK STORAGE BOXES



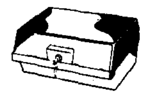
100 x 5 1/4" ECLIPSE
C16042....................$11.95

40 x 3 1/2" ECLIPSE
C16040....................$8.99

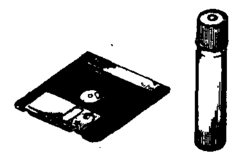
120 x 3 1/2" LOCKABLE
C16039....................$21.95

100 x 5 1/4" LOCKABLE
C16020....................$13.95

50 x 5 1/4" LOCKABLE
C16025....................$11.95



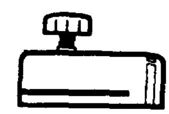
120 x 5 1/4" LOCKABLE
C16028....................$19.95



HEAD CLEANER DISKS

It only takes a minute amount of dust, dirt or magnetic oxide particles on your drive heads to cause problems: errors, downtime or an expensive service call. Regular use of a head cleaner will keep your drive free of trouble causing dirt and help keep your system up and running. These disk cleaners are simple to use, and include cleaning solution and instructions.

- 3 1/2"
  C12560.................$6.95
- 5 1/4"
  C12555.................$6.95



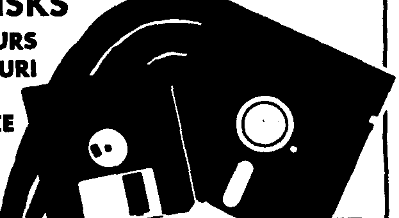
DISK NOTCHER

Converts 5 1/4" single sided floppy disks to double sided, by placing an appropriate notch in the floppy disk jacket.
C21070.................$5.00

MAIL ORDER HOTLINE 008 33 5757

RAINBOW DISKS

5 DIFFERENT COLOURS
OR 1 SINGLE COLOUR!
10 DS/DD
COMES WITH A FREE PLASTIC DISK BOX!
ONLY $9.99



RODIRVING ELECTRONICS

ROD IRVING ELECTRONICS

CITY: 48 A'BECKETT ST, MELBOURNE	PH: (03) 663 6151	FAX: (03) 639 1641
NORTHCOTE: 425 HIGH ST, NORTHCOTE	PH: (03) 489 8866	FAX: AS PHONE.
SYDNEY: 74 PARRAMATTA RD, STANMORE	PH: (02) 519 3134	FAX: (02) 519 3868
MAIL ORDER: 56 RENVER RD, CLAYTON	PH: (03) 543 7877	FAX: (03) 543 2648

POSTAGE RATES

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

008 335757 TOLL FREE MAIL ORDER HOTLINE FOR CREDIT CARD ORDERS!

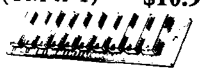
FREE 148 PAGE ELECTRONICS CATALOGUE WITH 32 PAGES OF DATA FREE WITH EVERY ORDER OVER $100

ROD'S BARGAIN BUYS!

RODIRVING ELECTRONICS

EXPANDED DYNAMIC RAM RANGE

	Speed (ns)		1-9	10+	100+
4164-10	100	(64K x 1)	$3.95	$3.50	$2.90
4464-10	100	(4 x 64K)	$4.50	$3.90	$2.95
4464-08	80	(4 x 64K)	$4.90	$4.50	$3.50
41256-10	100	(256K x 1)	$3.95	$3.50	$2.95
41256-08	80	(256K x 1)	$4.50	$3.95	$3.50
44256-10	100	(256K x 4)	$9.95	$9.50	$8.50
44256-08	80	(256K x 4)	$10.95	$9.95	$8.95
1M-10	100	(1M x 1)	$9.95	$9.50	$8.50
1M-08	80	(1M x 1)	$10.95	$9.95	$8.95



SIMMS

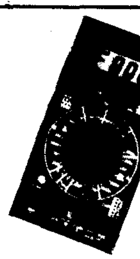
	Speed (ns)	1-9	10+
256K x 9	80	$35.00	$29.50
1M x 9	80	$99.00	$95.00
1M x 9	70	$109.00	$99.00
1M x 8	70	$105.00	$95.00

SIPPS

	Speed (ns)	1-9	10+
256 x 9	80	$35. 00	$29.50
1M x 9	80	$99.00	$95.00
1M x 9	70	$109.00	$99.00
1M x 8	70	$105.00	$95.00

MASSIVE TEST EQUIPMENT SALE!

FOR SPECS ON TEST EQUIPMENT SEE OUR NEW 148 PAGE ELECTRONICS CATALOGE. FREE WITH ORDERS OVER $100.

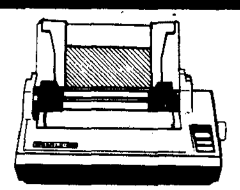


- LOGIC PROBE (LP-2800)
  Q11272 ....WAS $29.95 NOW $19.95
- DIGITAL MULTIMETER HC-4510
  Q13030 ....WAS $149.95 NOW $119.95
- DIGITAL MULTIMETER HC-5010EC
  Q13010 ....WAS $119.95 NOW $99.95
- DIGITAL MULTIMETER HC-889
  Q13040 ....WAS $99.95 NOW $89.95
- DIGITAL MULTIMETER HC-3500T
  Q13000 ....WAS $149 NOW $119
- ANALOGUE / DIGITAL MULTIMETER HC-5050DB
  Q13020 ....WAS $169.95 NOW $129.95

OSCILLOSCOPES

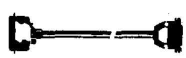
- 100 MHz 3 CHANNEL 8 TRACE MODEL 5510
  Q12109 ....$2995.00
- 20 MHz DUAL TRACE MODEL OS -620
  Q12105 ....WAS $750 NOW $715

QUALITY EPSON PRINTERS AT THIER LOWEST PRICES YET!

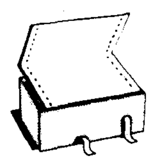


LX -400........... $275
LQ-400............ $475
LX-850............ $395
LQ-850............ $995
LQ-1050.........$1195
LQ-550............ $625
LQ-1010.......... $795

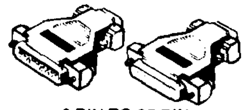
COMPONENTS BARGAIN BOX



PRINTER LEAD
- Suits IBM* PC/XT, compatibles
- 25 pin "D" plug (computer end) to Centronics 36 pin plug
- 1.8 metres
  P19029.................$14.95
- 3 metres
  P19030.................$19.95
- 10 metres
  P19034.................$39.95

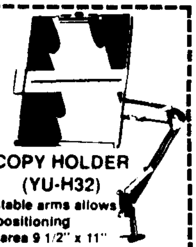


COMPUTER PAPER
Quality paper at a low price! 2,000 sheets of 70 gsm bond paper
Cat C21003 11 x 9 1/2" $41.00
Cat. C21005 15 x 11" $67.95



9 PIN TO 25 PIN CONNECTOR ADAPTORS
NEW! The ideal solution! Features gold plated pins
X15668 DB9 Plug to DB25 Socket
X15669 DB9 Socket to DB25 Plug
each $8.95

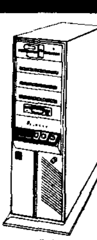
KEYBOARD EXTENSION LEAD
5 Pin Din plug and socket
P19038.................. $9.95



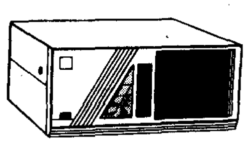
COPY HOLDER (YU-H32)
- Adjustable arms allows easy positioning
- Copy area 9 1/2" x 11"
- Sliding line guide
- Clamp mounting

C21062...........$39.95

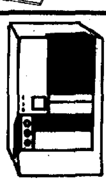
NEW COMPUTER CASES
STYLE FOR THE 90'S



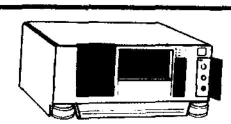
NEW TOWER CASE
Give your computer that professional look.
X11105
$250



RITRON EXECUTIVE CASE
X11089.................................$119



MINI TOWER CASE
200 X 415 X 330mm INCLUDING 200W POWER SUPPLY
X11100..........................$325



TOP OF THE RANGE AT EXECUTIVE CASE
FOR 386 & 486 SYSTEMS INC. 200W P.S
X11101...............................$320

QUALITY JAPANESE DRIVES!!

5 1/4" 360K DRIVE
- 500K unformatted
- IBM* XT* compatible

Cat.C11901 .... $175

5 1/4' 1.2 M/BYTE COPAL DRIVE
- 1.6 M/Byte unformatted
- IBM* AT* compatible

C11906................$195

3 1/2" 1.44 M/BYTE DRIVE
- Switchable 1.44 M/Byte formatted or 720K formatted
- Double sided double density
- Power supply adaptor provided
- 5 1/4" mounted

Cat. C11911 .... $195

CONTROLLER CARD TO SUIT
X18009 $139

$ SAVE SAVE SAVE $
HARD DISK SCOOP PURCHASE

20 MEG HARD DISK WITHOUT CONTROLLER.............. $399
20 MEG HARD DISK WITH CONTROLLER $499

40 MEG HARD DISK
28ms ACCESS WITH IDE/FDD CONTROLLER............ $495

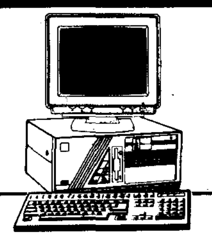
80 MEG HARD DISK
28 ms ACCESS WITH IDE/FDD CONTROLLER.......... $895

008 335757 TOLL FREE MAIL ORDER HOTLINE FOR CREDIT CARD ORDERS!

RITRON EXECUTIVE COMPUTER SYSTEMS

ROD IRVING ELECTRONICS

FOR TOP QUALITY AND GREAT VALUE YOU CAN'T GO PAST RITRON EXECUTIVE.



RITRON 386SX-16

- 80386SX-16
- 42 MEG 28ms HD
- 1.2 MEG 5 1/4" DRIVE
- 16 BIT 512K VGA CARD
- VGA COLOUR MONITOR (1024 x 768)
- SERIAL, PARALLEL JOYSTICK PORTS
- 101 KEYBOARD
- 12 MONTHS WARRANY

$2395

RITRON EXECUTIVE 386-33.56 MHz LANDMARK

- IDEAL CAD MACHINE, 33M WITH CACHE
- 1.2M FDD
- 1MB RAM & EXPANDABLE
- MASSIVE 42M BYTE HDD. 18ms
- SUPER VGA .28 DOT PITCH (1024 x 768) COLOUR MONITOR.
- 512K VGA CARD, (256 COLOUR)
- 101 EXTENDED KEYBOARD
- 2 x SERIAL PARALLEL, GAMES & PRINTER PORTS

$3495

VGA 40 MEG AT with SUPER VGA Colour monitor (1024x768)

- MINI CASE & P S
- 101 KEYBOARD
- IDE/FDC CARD
- VGA 256K CARD 12M MB
- 42 MEG HD 28ms
- 1.2 MFDD
- 1M RAM
- (16 MHz LANDMARK)
- 12 MONTHS WARRANTY

FREE SPREADSHEET WORDPROCESSOR SOFTWARE

DON'T PAY $1990! **$1699**

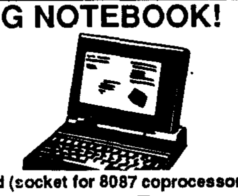
RITRON EXECUTIVE 386 SX-16 WITH 85M HDD

- SUPER FAST 21M LANDMARK
- 512K VGA CARD
- 2MB RAM
- MASSIVE 85 MEG HD 18ms
- 1.2 M FLOPPY
- MINI CASE & 200W PS
- 2 YEAR WARRANTY
- SUPER VGA (1024 x 768) COLOUR MONITOR
- SERIAL, PARALLEL & GAMES PORTS
- 101 EXTENDED KEYBOARD

$2795

AUSTRALIA'S TOP SELLING NOTEBOOK!

PC-4741 COMPACT NOTEBOOK.

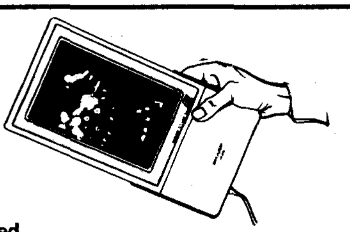


- Triple super twist LCD (640 x 400) with 4 shades of grey
- 8088 compatible processor with 10MHz clock speed (socket for 8087 coprocessor)
- 40 MB hard disk drive with 29ms access time
- 3.5" 1.44MB high density floppy disk drive
- 640 Kb internal RAM expandable to 1.6 MB
- Weighs only 3.8 Kg
- Battery or mains operated

X20004..$3499

(Available to order)

SHARP JX-100 Colour Scanner



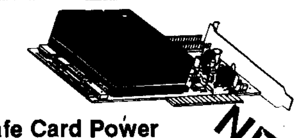
Sharp invented the colour scanner and we have scooped a batch of their A6 size units for you. Compatible with the Apple Mac II and with IBM or equivalents this impeccable unit brings quality scanning within easy operational and financial reach. For IBM the RPP (including MS Windows and Mouse) is $1499, and for the Mac $1299.

SPECIFICATIONS:
Type: Flat Bed
Resolution: 200 dpi
Image Size: 100mm x 160mm
Colours: 262, 144
Grey Levels: 64
Colour range: 6 bit
Colour Accuracy: 6 bit
Interface: RS232C
Supplied Software:
Mac II: Chromascan 100
IBM: Microsoft windows with mouse, Colour Lab 100

IBM X19905..$1499

MAC X19907..$1299

SAFE CARD POWER FAIL PROTECTOR



NEW

The revolutionary Safe Card Power Fail Protector. This little gem takes away all the risk of losing hours of important work when the power dips or fails. Ideal for areas where power is a problem or data integrity is vital. The need for a huge bulky in-line back-up system is now eliminated by the single slot 1/2 Card. Introductory offer for this Australian promoted product is $595 and only available from us.

X11118..$595

SCAN YOUR EYES OVER THESE GREAT COMPUTER IDEAS!

COLOUR YOUR WORLD WITH THE GeniScan

SAVE $100

COLOUR SCANNER

The GS-C105 Colour scanner scans any colour or Black & White image into your IBM PC AT, PS-2 or compatible system without loss of hue.

FREE SOFTWARE!

The powerful Colour Maestro allows you to scan an image and then do colour editing in colours you can create yourself! You can draw different shapes, modify objects, alter colours and edit a palette of 256 colours by using the commands on your pop-up menus. You can even design your own font type size.

SPECIFICATIONS:
- 105mm scan width, multi-scan up to 300mm
- 100-400 DPI selecable in steps of 10 DPI for 2,8, & 16 colours
- 64 shade levels
- Scanning speed: 3.5 ms/line

....$895

HS - 3000 HANDY SCANNER

$299

INCLUDES *FREE SOFTWARE!* PC PAINTBRUSH & IMAGE TOOL

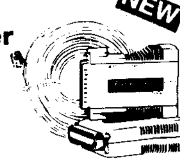
- WIDE 4.13" (105mm) scan width
- 100/200/300/400 switchable DPI resolution.
- Four encoded modes: B/W and three half tone patterns.
- Thrity-two shades of grey.
- Built-in scanner view window for accurate scanner placement.

X19945.............................$299

PARALINK II

Parallel Interface Extender

NEW



RANGE UP TO 400 METRES!

In the real world of interfacing computers to parallel printers, it is often very usful to extend the distance over the normal 10 foot limitation. Paralink II is the inexpensive and effective way to do this. It's ultra high speed transmission rate produces parallel-like speed. It is compatible with all software & hardware & installs in seconds because there is no need for an external power source. Comes complete with a transmitter, receiver & 50 feet of straight through RJ-11 modular cable.

C22162.............................$395

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 shie... computer interfac...
- m = metre

W12670 • CI...
1-9 m ... $1.30m ... 100+ m $1.00m

W12672
1-9 m ... $1.60m ... 100+ m $1.20m

W126.. ...12
1-9 m ... 100+ m $2... 2.20m $1.90m

• CIC16
10+ m 100+ m $3.20m $2.50m

...8 • CIC25
10+ m 100+ m ...0m $3.40m $3.00m

TAKE 25% OFF THESE PRICES

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

		10+
• 150 x 90 x 50mm H10111	$4.95	$4.75
• 195 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	1.65	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

MAMMOTH PRICE REDUCTIONS!!!

ECONOMY TRANSFORMERS

	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 CatM12851	$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 5/8" T12461...$12.95
115V 4 5/8" T12463...$12.95
240V 3 1/2" T12465...$12.95
115V 3 1/2" 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

red 5mm	1-9	10+
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

HAVE YOU RECEIVED YOUR NEW 148 PAGE ROD IRVING ELECTRONIC CATALOGUE WITH 32 PAGES OF DATA. FREE WITH ORDERS OVER $100

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

SAVE $2

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

MAIL ORDER & CORRESPONDENCE

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

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

The above postage rates are for basic postage only. Road freight, bulky and fragile items will be charged at different rates.

NEW 52 PAGE CATALOGUE WITH 13 PAGES OF DATA SENT FREE WITH EVERY MAIL ORDER OR BRING THIS AD INTO OUR STORES AND PICK ONE UP

ROD IRVING ELECTRONICS

ROD IRVING ELECTRONICS

CITY: 48 A'BECKETT ST, MELBOURNE PH: (03) 663 6151 FAX: (03) 639 1641
NORTHCOTE: 425 HIGH ST, NORTHCOTE PH: (03) 489 8866 FAX: AS PHONE.
SYDNEY: 74 PARRAMATTA RD, STANMORE PH: (02) 519 3134 FAX: (02) 519 3868
MAIL ORDER: 56 RENVER RD, CLAYTON PH: (03) 543 7877 FAX: (03) 543 2648

All sales tax exempt orders and wholesale inquiries to:
RITRONICS WHOLESALE.
56 Renver Road, Clayton.
Phone: (03) 543 2166 (3 lines)
Fax: (03) 543 2648

FREE 148 PAGE ELECTRONICS CATALOGUE WITH 32 PAGES OF DATA FREE WITH EVERY ORDER OVER $100

ROD IRVING ELECTRONICS

NetComm FAX CARD

Turn your computer into a Fax Machine. with the NetComm PC Fax Card! Send and receive facimile documents over the phone.

- Multi speed, multi standard.
- PSTN Dial up
- 12 months warranty
- Australian design & manufactured
- Telecom approved

INCLUDED WTIH FAX CARD:

- Users manual
- Telephone cord
- Three 5 1/4 floppy disks containing " PC fax card " software.

X19091 .... $595

AUTOMATIC TELEPHONE ANSWER/ CALL CARD

TURN YOUR IBM* PC, XT, AT INTO A FULLY FUNCTIONAL ANSWERING MACHINE!!!

- A Sophisticated Voice coil mail system
- Auto answering Dialing
- 100 voice mail boxes
- Password protection
- Message mailing
- Auto redialing
- Beeperless remote control
- Toll saver
- Call screening
- Electronic phone book
- Works in background
- Menu driven software
- Simple and concise operation

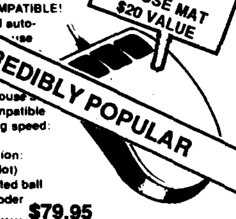
Not only can this card turn your computer into a 24 hour personal receptionist , but can answer with different phone messages for particular callers.

X19084............ONLY $199

MICE

FREE MOUSE HOUSE & MOUSE MAT $20 VALUE

INCREDIBLY POPULAR



QUICK MOUSE

...OFT* COMPATIBLE! ...and auto- tr... ...use system ... mode and Mic... mouse mode

- Microsoft Serial Mouse ... Mouse System compatible
- Super high tracking speed: 600mm/sec
- Super high resolution: 200 D.P.I. (0.12mm/dot)
- Silicon rubber coated ball
- Optical rotary encoder

X19952.................. $79.95

EVER POPULAR LOW BUDGET

WITTY MOUSE

NOW $39.95

- Three buttons, user definable
- Silicone coated steel ball
- High resolution movement of 195 dots/inch. Smaller table space and less hand movement required
- Optical rotary encoder
- Max. tracking speed: 200m/sec
- Mouse resident firmware
- Size: 116 x 66 x 34mm
- Mouse Driver Software included, allowing you to install with all popular software packages. Also included is the handy Pop-up menu software that allows the user to integrate the mouse with the keyboard, DOS, and other popular software packages

X19950......... $39.95

MOTHERBOARDS

21 MHz ALL IN ONE AT MOTHERBOARD WITH THE LOT!

All you have to do is add a Graphics card. This ultra high performance PC/AT motherboard has everything! This top quality motherboard uses state of the art ACER technology & surface mount design for the best performance & reliability.

- 16 MHz o wait state CPU (21 MHz landmark speed rating)
- Up to 4MB of RAM on the Motherboard 0 Ram fitted ons or 100ns RAM can be fitted.
- 3 x 16 bit & 3 x 8 bit expansion slots
- 2 Serial & 1 Parrallel Port
- Dallas real time clock fitted life expectancy 10 years
- IDE 40 pin connector for hard disk interface (You just need to add an imbedded hard disk drive)
- Floppy disk controller on board
- You only have to add a Graphics card.

X18198.. $595

CHECK OUT OUR HUGE RANGE OF IBM CARDS AVAILABLE.

XT HD CONTROLLER.......	$129
AT HD CONTROLLER........	$199
RS 232 SERIAL CARD......	$49
RS232 / SERIAL / CLOCK..	$59
MONO / COLOUR CARD....	$96
MULTI I/O..........................	$99
512K RAM..........................	$59
DIAGNOSTIC......................	$849
TTL / PRINTER....................	$89
RAM 2M AT EXT/EXP........	$225
8M AT EXT / EXP...............	$325
4 PORT SERIAL..................	$89
VGA 256K..........................	$199
VGA 512K..........................	$299
VGA 1 MEG.........................	$495
VOICE MAIL CARD.............	$199
PRINTER CARD...................	$35
EGA CARD..........................	$139
2 WAY FDD CONT. (360K).	$49
GAMES CARD.....................	$29
AT S/P GAMES CARD.......	$35
4 WAY FDD CONT. (360-1.44M)........................	$129
CLOCK CARD......................	$49
SMART DRIVE ADAPTER IDE / FDC..............................	$89
SMART DRIVE ADAPTER IDE I/O FDC	$119

TOUCH MOUSE

A STATIONARY BREAK THROUGH

SAVE $40

Now you can use your fingers instead of your mouse.

MODELS: ATM- 110 Touch Mouse for IBM PC/ XT/ AT and compatible's, Operates under Microsoft / mouse system mode.

FEATURES:

- User's finger movements on the 58 X 48mm front panel of the touch mouse control the on- screen cursor movement.
- With no ball, the touch mouse requires no desk space for movement.
- No pad to get dirty and take up desk space.
- One finger can do all the users drawing.
- Compatible with all existing mouse software.
- RS- 232 serial port
- Especially suitable for laptops, the touch mouse saves on desk space.

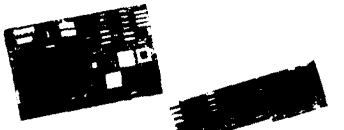
FREE SOTWARE INCLUDED!

- MOUSE DRIVER
- TEST PROGRAM
- DEMO PROGRAM
- HIGH LEVEL LANGUAGE INTERFACE ROUTINE: Microsoft C, Microsoft Fortran, Quick Basic, Turbo C Pascal ...etc.
- POP-UP MENU

DR. HALO III GRAPHICS SOFTWARE

X19960.. $109

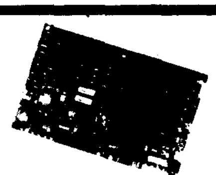
386-33 CACHE MOTHERBOARD



- Processor 80386-33
- Cache Controller 882385, 32 Bit Peripheral
- Memory 32KB Cache memory (35 ns)
- Expansion slots: 1 x 32 bit, 3 x 8 bit, 4 x 16 bit
- Intel* Combo Chip set: 82230, 82231
- Shadow RAM
- C&T 82C206 Intergrated peripherals Controller
- LED display for speed indication
- Ability to run OS/2, MS/DOS, XENIX
- Real time clock/calender with battrey back up
- Baby AT* size board
- Reset button Connector
- Keylock button connector
- Speaker connector

X18112.. $2495

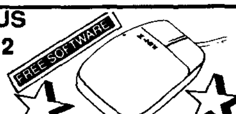
386SX 16MHz MOTHERBOARD



- Processor: 80386SX-16MHz (0/1 wait state)
- Co-processor: 80387SX-16 (optional)
- CHIPS & TECH NEAT chipsets
- (SMT) Surface Mount Technology for chipsets & CPU
- Supports up to 2MB on board, (Sixteen 44256 and Eight 41256 sockets)
- Three 8 BIT slots • Five 16 BIT slots
- Memory Expansion Slot
- Optional 2-8MB memory card
- Supports LOTUS-INTEL-MICROSOFT (LIM) Expanded Memory Spec. (EMS) version 4.0
- Supports Page Interleave Mode using 100NS DRAM
- BIOS: AMI or PHOENIX
- Turbo Light and Hardware Reset connector
- Keyboard or Hardware Reset connector
- Power Good Signal on board • Baby size main board

X18094. OK RAM........................ $695

SUPER BUS MOUSE 2



The new Z-NIX Super mouse 2 allows you to get the most out of your computer and enhance your productivity. It gives you the ability to expand the versitility of your computer through the use of graghic software such as paint, draw and CAD programs. The super mouse 2 allows you to run programs like GEM and Windows which makes al operations of the computer easier and faster. Many popularSpreadsheets, databases, word processors and other programs can also be worked with the Super Mouse 2.

- 100% Microsoft Compatible
- IBM or APPLE Family Computer Compatible.
- Free Software with Pop-up Menus
- Life time Warranty
- Also supplied with the Super Bus Mouse 2 are 2 FREE Telepaint disks which allows the user to perform high resolution graphics with the mouse.

X19951.. $119

008 335757 TOLL FREE MAIL ORDER HOTLINE FOR CREDIT CARD ORDERS!

The lucky winner of our Icom IC-R100 Competition

Judging by the large number of entries we received, the prospect of winning one of Icom's new 'mighty midget' IC-R100 wideband communications receivers motivated a lot of readers to send in their 'funny antenna story'. Unfortunately there was only one IC-R100 to be won, and therefore we could only have one winner. It was a hard decision...

The lucky winner turned out to be Mr Maurice Freeman, of Doncaster East in Melbourne. We were able to advise Mr Freeman of his win in mid-December as promised, and he was presented with his IC-R100 by Icom Australia — in good time for Christmas. Mr Freeman was delighted with his win, and looking forward to using his new receiver to explore the spectrum.

Just to remind you, the IC-R100 offers continuous digital synthesiser tuning from 100kHz in the LF band, right up to 1856MHz in the UHF band. Other features include AM/FM/WFM reception, 100 memory channels, multimode scanning and lots more — all packed into a tiny case which measures only 150 x 181 x 50mm. *EA*'s editor Jim Rowe reviewed in the October 1990 issue, along with its even smaller brother, the handheld IC-R1 receiver.

Mr Freeman's winning entry is published below. It's a true story from his youth, which he has apparently kept secret until now — for reasons which will be clear when you read it. With the thought that it might just win him the IC-R100, he decided it was time to 'clean the slate' and confess. In this case confession was not only good for the soul, but bore fruit as well! We trust you'll enjoy Mr Freeman's entry, which the judges found most amusing of all the entries we received.

Winner Mr Maurice Freeman being presented with his IC-R100 wideband receiver by Icom Australia's National Marketing Manager Mr Bob Wiley.

But there were so many other entries that were almost as good, that we've decided to publish a selection of the best runners-up, next month.

Needless to say, all of the entries that we publish will bring their authors a small publication fee, by way of a 'consolation prize'.

So watch out for a collection of further 'funny antenna stories' in next month's issue.

Icom Australia and *EA* both extend our grateful thanks to everyone who sent in an entry, and helped make the competition such a resounding success. ■

The lightning strike that wasn't...

I was 13, and had been given my first receiver. It was my prized possession. Of course I knew that a radio needed an aerial to work, but I didn't have a clue as to the design required to get the best reception. An idea came to mind that 'bigger is better' — maybe I should have been born in the USA.

Anyhow, I proceeded on this course and strung out a reel of wire that stretched from the chimney of my house across the road, and nearly 300 metres through the reserve, to the lone gum tree down next to the creek. I climbed the tree and fixed the wire as high as I could, then tested the reception.

Not surprisingly it wasn't too good. This was probably due to the fact that I had my aerial wire hanging only inches from the power lines running down the street.

That night during supper, a bit of a storm blew up. The gum tree swayed, and my antenna wire pulled up tight against the power lines. There was an almighty bang, together with a 40,000- volt flash that extended from my bedroom, up the chimney and all the way across to the tree. Then silence engulfed the neighbourhood, as everyone's power went off for blocks around.

The aerial wire and half the components in my receiver had vapourised. It took the authorities several hours to restore power, and they assumed that the cause of the blackout had been a lightning strike. By the way, I was never able to repair my receiver!

No prizes. No free gifts. Just Australia's best selling electronics magazine, at the best possible price.

If you're a regular reader of Australia's largest-selling electronics magazine, taking out a subscription is always a good idea. It gives you the convenience of home delivery every month, plus a very healthy saving on the regular cover price. Most of the time the saving for subscribers is around 17%, with the added bonus of a small gift and the opportunity to win a valuable prize.

However we know that many of our committed readers are really only interested in getting the magazine itself — at the best possible price. So from time to time, especially for these people, we make a special offer: no prizes, no gifts, just *Electronics Australia with ETI* at the lowest possible price.

This is one of those times. From now until the end of March 1991, we're making this offer: a full 12-month subscription for only $38.50, or a 24-month subscription for only $77.00. These figures are for subscriptions within Australia, and *include* postage.

These prices represent a saving of over 35% compared with our current cover price. In other words, by accepting this offer you'll save over $20 for a 12-month sub, and over $40 for a 24- month sub. Or if you like, you'll be effectively paying for only eight issues in each 12, and getting the other four free!

Subscribing also buys you protection against the inevitable rises in cover price that occur from time to time, with all goods. By subscribing now, you ensure that your next 12 or 24 issues will cost you **only $3.20 each,** regardless of what may happen to the cover price during the period concerned.

Now is the time you've been waiting for, then, if you're one of our readers who prefers our 'no frills' discount subs offers. But don't forget — this offer ends on March 29, 1991. Why not fill out the coupon and post it with your cheque, NOW!

Incidentally, this discount offer also applies to renewals and extensions, as well as new subs. Here's your chance to renew or extend that *existing* sub, at the lowest possible price...

Electronics Australia *with* eti

Australia's biggest, brightest and most informative electronics magazine - have it home delivered each month.

BUT HURRY — THIS OFFER ENDS March 29, 1991!

Been waiting for our next discount offer on EA subs? Your time has come again.

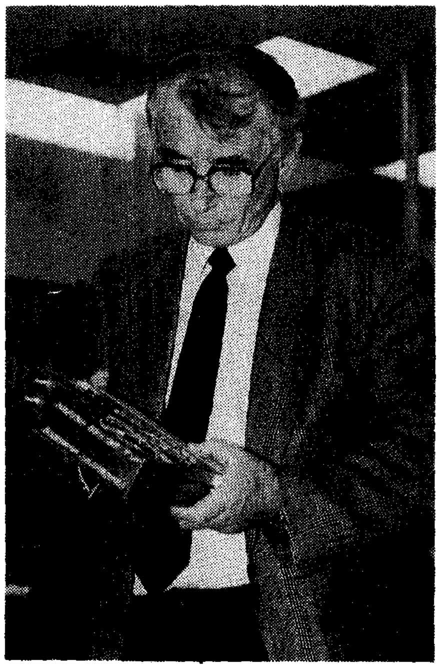
NEWS HIGHLIGHTS

SIEMENS EXPERT PREDICTS BOOM IN PHOTONICS

Massive new business opportunities in the mid 1990's are forcing the pace of the current race in research laboratories around the world to develop totally new electronic components. This was among the revelations made in Melbourne recently at the Australian Electronics Outlook Conference by Dr Herbert Stegmeier, Executive Director at Siemens Munich based central laboratories for public communications network.

In his invited keynote address, 'Photonic Visions for Communications in the Future', Dr Stegmeier surveyed the technical possibilities for the next five years and even into the second half of the 1990's.

More than a mere research curiosity, the world spotlight is now on photonics — the combination of optics and microelectronics. Dr Stegmeier predicted, "Within five years, photonics will impact dramatically the way you do business in offices and also your lifestyles at home. Huge new business opportunities will result for quick thinking companies. Among the first fields to be revolutionised will be the colour printing industry, from the initial artistic layouts through to the finished four-colour printing process, medical diagnosis procedures for road accident victims, the transport requirements of legions of office workers, who may find it more convenient to work from home; and even the present system of TV broadcasting, which will face new competitors delivering up to 48 channels to the home, together with full ISDN telecommunications services." "All of these new opportunities and many more, will emerge when there is an optical fibre connected to your home or office. Although the fibre technology already exists, and is reasonably economical, we are blocked because the new optoelectronic microcircuits are not yet ready. For economic mass production, the light signals which carry the information must not be converted too often back into electronics for logical processing.



At Siemens, we aim to switch and control the light signals using photonics, which will make the new opportunities economically feasible," continued Dr Stegmeier.

"One of the most difficult fields to master is how to switch these light signals between various subscribers. At the moment, our EWSD digital switch is among the world's most advanced, but all the switching is still done by conventional electronic microchips. My research teams are flat out finding ways to process as much as possible in optics, but in a way which remains compatible with the present EWSD electronic systems. Then we can satisfy the market demand to gradually phase in photonic systems rather than having to scrap existing networks and begin from scratch."

"One thing is certain. The microelectronics revolution which has hugely altered our work places and lifestyles since the 1947 birth of the transistor, will continue at least through the 1990's. Now this recent marriage of optics and microelectronics will produce many fascinating new children. At Siemens, we believe consumers of information will be delighted with the new arrivals", added Dr Stegmeier.

ELENEX AUTOMATE SHOW IN SYDNEY IN 1991

Elenex Australia, the 3rd Australian International Electrical and Electronic Industries Exhibition will be held in conjunction with Automate Australia, the 2nd International Robotics and Industrial Automation Exhibition, from June 30 to July 3 1991, at Darling Harbour, Sydney.

The two popular high technology exhibitions were held concurrently in Melbourne last year. That event comprised 193 exhibitors from seven countries and attracted more than 8000 industry buyers over the four days.

This year, Elenex Australia will feature all aspects of the electrical and electronic industries, from industrial applications through to the most sophisticated electronic assembly equipment and componentry.

Automate Australia will include the major industry suppliers displaying the latest in automation equipment, robotics, computers, CAD/CAM and process control equipment from around the world.

The conference running in conjunction with Elenex is entitled Elecon 91 — Electronics, the Next Decade and it will be held from Monday to Wednesday, 1-3 July. Elecon 91 is being organised by CIMA Electronics, a Victorian-based company which specialises in design and development in electronics (particularly microelectronics) and technology transfer.

Elecon 91 will cover many topics relevant to the Australian electronics industry including design for manufacturability, surface mount technology, semiconductor technology, quality assurance, achieving standards, optoelectronic devices, voice and data systems, sensor technology, project, system and logistics management and marketing issues.

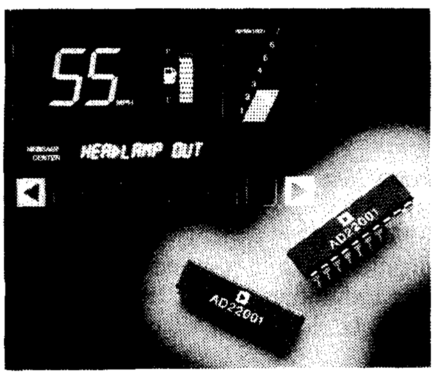
BMW, ANALOG DEVICES DEVELOP AUTOMOTIVE 'SMART SENSOR'

BMW of Munich, Germany and Analog Devices Inc of Norwood, Massachusetts have jointly developed a smart sensing integrated circuit (IC) that automatically detects the failure of headlamps, indicators and other lights. The device improves safety by continuously monitoring the condition of up to five lamp filaments in either the 'on' or 'off' state, and also by testing the in-line fuse in two series circuits. Packaged in a 20-pin DIP and consuming only 300mW of power, the monolithic circuit replaces a complex, board-level design in 1991 BMW cars, reducing cost and improving reliability. A device based on this circuit, the AD22001, is available now on the open market.

The AD22001's five comparators operate by detecting a very small threshold voltage, nominally 1.75mV across a small shunt resistor in series with the lamp being monitored.

A length of standard copper track on the circuit board can serve as the shunt resistor, minimising IR dissipation and component count.

Each comparator automatically compensates for variations in both the



power supply or the shunt resistance value. No external circuitry is required for operation.

AWA WINS PHILIPPINES ROAD TRAFFIC PROJECT

AWA has been awarded a $5.9 million contract to supply, install and maintain a road system for Cebu City on the Philippines island of Cebu.

The contract win, achieved in the face of strong competition from highly regarded Japanese and American suppliers, demonstrates the quality of the Australian traffic control product and its competitiveness in world markets.

The AWA solution is based on the SCATS Area Traffic Control System which was developed by the NSW Roads and Traffic Authority and which is used in most Australian and New Zealand cities as well as key international centres including Shanghai, Singapore and Dublin.

Under the contract which has a lifespan of 18 months, AWA will supply all equipment including its Delta traffic controllers, traffic lights, computer software, computers and design services for an initial 68 intersections. The equipment will be manufactured at AWA Traffic and Information Systems in the Sydney suburb of Homebush. Besides building the system, AWA will also install and commission it and provide project management services.

COMPONENT DATABASE ON CD-ROM

Details of over half a million integrated circuits, discrete semiconductors and optoelectronic components from around the world are contained on a new Australian compact disc CD-ROM, recently announced by Melbourne firm, ACEL Information.

Called ACEL Electronic Device Finder, the Australian-designed information system will save hours of frustrating search time for people who source electronic components in Australia.

All you do is key in a device number. Within seconds, the system tells you what the device is, who makes it, its Australian distributors (including phone and fax numbers), a list of equivalent or alternative circuits, and which of the manufacturers' databooks it appears in.

The CD-ROM includes thousands of discontinued devices (going back to the 60's), as well as devices not normally available in Australia.

ACEL Electronic Device Finder is updated four times a year with a replacement CD-ROM.

The CD-ROM uses audio compact disc technology to store 580 megabytes of data. To access it you need a CD-ROM drive and any AT or XT compatible computer.

For more information, please ring ACEL Information in Sydney on (02) 929 6088 or in Melbourne on (03) 826 6099.

BUSINESS AWARD FOR TECHNICAL WRITING FIRM

Hard Copy, a Sydney technical writing company, was presented with a 'highly commended' award by NSW Premier Nick Greiner at the 1990 NSW Australian Small Business Awards.

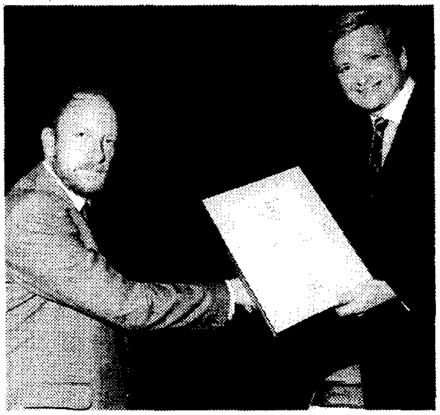
The awards are given on the basis of excellence in innovation, marketing, product development, training, export, and the ability to respond to business challenges.

Hard Copy specialises in the writing and production of software manuals. It has been in business since 1981 and its clients include DEC, Fujitsu, Honeywell, Software Developments, Computations, AUSSAT and Telecom.

Phil Cohen, a director of Hard Copy, said that he believed the reason for the award and the company's strong growth over the past few years lay in an increasing sophistication amongst local software companies in their attitude to documentation.

"At long last there's starting to be an understanding in Australia that if you're going to sell software, you have to be able to get the manuals right," Mr Cohen said.

"And it's absolutely essential to get documentation to a high standard if you intend to export your product."



OTARI MIXING CONSOLE

The Australian broadcasting Corporation has installed an Otari/Sound Workshop Series 34C Console as part of the major rebuild of Sydney's 'OB-1' outside broadcast van.

One of five vans operated in Sydney, OB-1 has been in service since the mid 1970's. Refurbishment began in January last year under the supervision of Bob Shirley, Project Planning Officer. The only original components remaining are literally the wheels and body work.

The audio control section is based largely on the ABC's Melbourne OB van, which also features a Sound Workshop Series 34 console. Commenting on the installation Michael Roberts, Senior Sound Operator OB-NSW said: "We chose the Series 34C for its compact design and reliability, as proven in five years of constant use

NEWS BRIEFS

- CBS Records Australia has changed its name to **Sony Music Australia.** Also CBS Productions has changed to Sony Music Productions. Company addresses and phone numbers are unchanged.
- John Wilbrow has been appointed to the new position of Business Development Manager for **Defence Science & Technology Organisation's Electronics Research Laboratory (DSTO ERL).** Mr Wilbrow has 18 years experience in establishing new industrial capabilities based on defence-related science and technology.
- Melbourne-based **Talia Sound and Vision** has moved to new and larger facilities in Bayswater. The new address is Unit 3, 49 London Drive, Bayswater 3153; phone (03) 720 7700, fax (03) 720 7662.
- **ATUG '91**, the Australian Telecommunications Exhibition and Conference, will be held at Sydney's Darling Harbour Exhibition Centre from Tuesday April 30 to Thursday May 2. It is expected to be the largest telecomms forum ever held in Australia.
- Robert Hayes has been appointed Marketing Services and Advertising Manager for the Consumer Products Group of **Sony Australia.** Robert has 15 years experience in agencies and print media, and has been outside consultant for Sony for the last six years.
- **Crusader Electronic Components** has been appointed Australian agent for German measuring and control equipment maker Joens Mess and Regeltechnik GMBH. The Joens product range includes transmitters for temperature, humidity, pressure, flow rate and displacement, as well as measuring amplifiers and indicators.
- China's largest exposition of advanced radio and TV broadcasting equipment and technology **BIRTV '91**, will be held at the newly reconstructed China World Trade Centre in Beijing, from September 6 to 10. Further details are available from Business & Industrial Trade Fairs Ltd, 28/F Harbour Road, Wanchai, Hong Kong — fax 834 1171/834 5373.
- PC enhancement board maker **Hypertec** has revealed that chairman Geoff O'Reilly is now the majority shareholder, with 58.4% of the shares. Another 20% is held by licensed MIC BT Innovation, while a further 21.6% is held by senior management.
- **Nilsen Instruments** has been appointed sole Australian distributor for Keithley Metrabyte and DAC products. Among Keithley's products are data acquisition I/O and comms boards for PC compatibles and Apple MacIntosh computers, DAC systems and field data loggers.

in our Melbourne van. The console features comprehensive equalisation and provides a high degree of flexibility, required for location work. Equally important, the price met our budget requirements."

The ABC chose a 32-input mainframe, fully loaded and fitted with ARMS II console automation.

Six stereo input modules were also supplied, which are easily installed in place of the standard mike/line modules when required.

STANILITE TO SUPPLY ANZAC SHIP COMMS

Australian electronics firm Stanilite Pacific has received a major subcontract to supply equipment for the ANZAC ship project.

Prime contractor AMECON has issued Stanilite Pacific's wholly owned subsidary, Stanilite Electronics with the subcontract for the supply of internal and external communications equipment for the 10 new frigates being built for the Royal Australian and Royal New Zealand Navies.

The subcontract value exceed $130 million, and is the largest subcontract to be awarded to a wholly Australian-owned technology group.

The work involves the design, manufacture and fit out of both external and internal communications equipment for each of the 10 Meko design frigates being built by Amecon at its Williamstown, Victoria, dockyard.

Stanilite will provide systems designs and integration together with the design and manufacture of key equipments.

Altogether there are 14 sub-systems, comprising a complex integrated system allowing voice and data communications to other ships, aircraft and shorefacilities.

KENWOOD OPENS NEW HEADQUARTERS IN SYDNEY

Kenwood Corporation in Japan has highlighted its long term commitment to Australian consumer and industrial markets with the official opening of its new $8 million Australian headquarters in Homebush, near Sydney.

The two-level 3900 sq.metre building, sited at the highly successful Australian Centre Business Park, was formally opened by senior executives from Kenwood's head office in Japan.

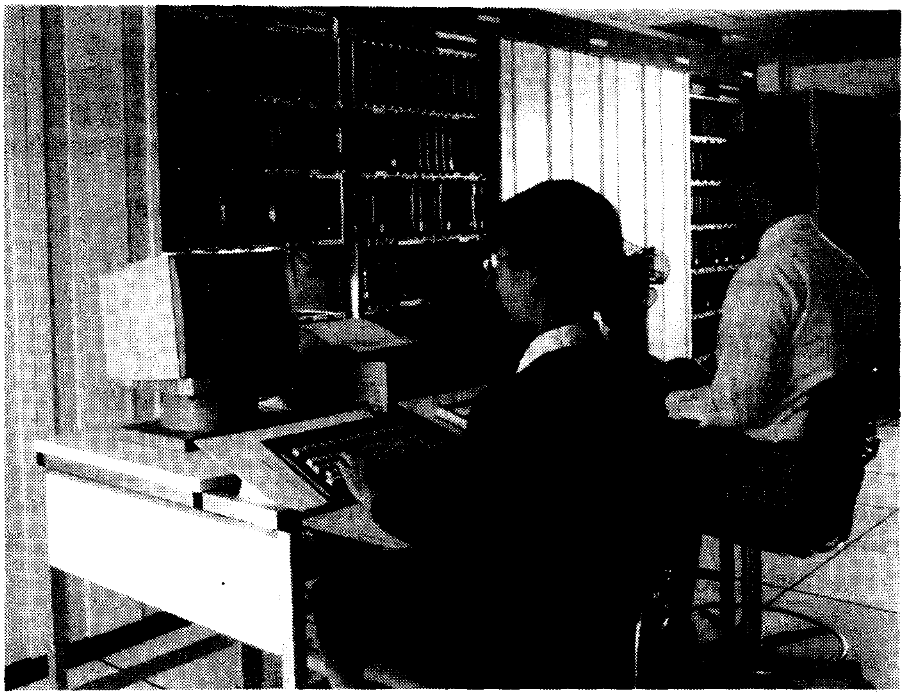
More than 100 guests attended the grand opening ceremony, which featured traditional Japanese cherry tree planting and ribbon cutting ceremonies.

Indicative of the importance of the Australian ceremony was the attendance of Kenwood's President, Mr Makoto Oka, along with Mr Keisuke Musumi (Managing Director and International Marketing Division General Manager), Mr Motoaki Hirabayashi (Managing Director and Administrative General Manager), and Mr Kazuo Suzuki (General Manager of International Marketing Division).

In his speech, Mr Oka highlighted Kenwood Japan's support for its Australian operation, saying that the company firmly believed in the Australian market and its ability to sustain growth, specificially for audio and communications equipment.

Mr Oka used the opportunity to announce the appointment of Mr Ted Ito to the position of Managing Director of Kenwood Australia, effective December 1st. Mr. Ito replaces Mr Jun Karasawa, who, after four years in Australia, will be returning to Kenwood's Japanese headquarters to take up a new assignment.

According to the Managing Director of Kenwood Electronics Australia, Mr Jan Karasawa, the new headquarters will provide the company's 40 employees with spacious international standard working conditions. ■



ALCATEL EXCHANGE WINS TELECOM CONTRACT

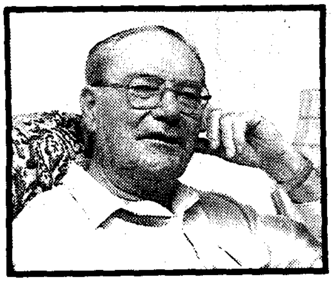
Alcatel STC Australia has succeeded against worldwide competition in being selected to supply digital telephone exchanges to Telecom Australia.

The system selected is Alcatel's System 12, which is now in service in 23 countries and has been described as one of the most successful switching systems of modern times. The award covers both Rural and Urban digital exchanges and new Operator Assisted Services.

"We are very pleased to have been selected by Telecom Australia, as this continues our unbroken role as a supplier of telephone exchanges in Australia, which dates back to the company's inception in 1895," said Alcatel STC chairman and managing director Mr Bill Page-Hanify.

The reference list for System 12 includes Germany, Switzerland, Italy, Holland, Norway, Belgium, Spain, Portugal, Turkey, Mexico, Taiwan and China which is a coverage of countries that has not been matched for a single system for over 50 years. An additional 10 countries have placed orders for System 12.

With an impressive investment program of A$45 million, Alcatel STC will be moving immediately to establish new manufacturing facilities for the production of System 12 in Australia. Equally important will be the expansion of the software and system support group which Alcatel STC has in place for the recently announced System 12 contracts for Papua-New Guinea.



When I Think Back...

by Neville Williams

'Shadders on the wall' — the story of an old-time country picture show

There's another side to the slickly presented moving pictures which appear on cue between the velvet curtains of a modern urban cinema, with full colour, wide format and stereo sound. I have in mind the primitive, often makeshift conditions under which the weekly 'flicks' once used to be screened in country community halls.

Before taking up the above theme, I should perhaps offer a word of explanation about the title of this article:

Thirty or more years ago, while I was still occupying the editorial chair of this magazine, a youth from the country joined our laboratory staff — a pleasant, technically promising young man with the typically unhurried speech and dry humour of a 'bloke' from the bush.

One day, over morning tea, other men in the workshop were involved in a protracted argument about the merits or otherwise of some new movie technique. For our young recruit, concentrating on a problem with a project, it proved too much of a distraction and, in measured tones, he remarked:

"It beats me how youse blokes can get so worked up about shadders on the wall!"

It served as a timely reminder that they, too, had a job to do. But the phrase also lodged firmly in the vocabulary of those of us who heard it.

'Shadders on the wall' — projected images, moving and still — antedated the writer by quite a few decades but they were foreign to me as a child, mainly because I spent my early years at Bargo on the NSW southern highlands. Too small a village to attract even an itinerant 'picture show man', it was also too far from a town to encourage sorties to the 'flicks' along the pot- holed blue-metal track that passed, in the early 1920s, for the main Sydney-Melbourne road.

Community hall

The first step towards a local picture show was taken about 1922, when my maternal grandfather, the late Alma Pyne ('Alf') Hicks, decided that the small but growing community needed a motor garage and a general purpose assembly hall — equivalent to the time-worn 'Mechanics Institute' or 'School of Arts' that can still be found in some Australian country towns.

Alf Hicks, plumber, gasfitter, motor mechanic, electrician and picture show man. His wife Emily's main technical contribution was to put out crockery dishes and collect 'dill' (distilled water) for the battery bank when it rained.

An unpretentious fibro and galvanised iron building, with a sturdy old Beale piano and a stack of 4-chair folding plywood seats, Hick's Hall (pronounced with or without the aspirants) soon became the automatic venue for church services, dances, lodge meetings, village concerts and even Saturday 'arvo roller skating.

Rather than rely on kerosene wick, or petrol pressure lamps for the complex, the innovative/hobbyist side of Alf Hicks' make- up opted for electric lighting — which had to be locally sourced because the nearest power mains were miles away.

As an interim measure, he installed a commercial 32V system, popular on rural properties, but he clearly had more ambitious ideas in mind — like a picture show.

So, down behind the hall he built a galvanised iron shed with a solid concrete floor and hardwood shelves sturdy enough to support an assortment of automotive accumulators, linked in series to produce an appropriately higher voltage. I gather that he was aiming at 110V, but finally settled for 80V as a more manageable figure, for which standard light globes were available.

To charge the battery bank he installed a horizontal single- cylinder petrol engine with twin flywheels, as commonly used on farms to pump water and/or drive a sawbench for cutting firewood.

A flat pulley and leather belt drove a chunky DC generator delivering 100 or so volts DC, sufficient to charge the battery bank.

On the wall, he mounted a stout bakelite panel carrying a couple of meters, knife switches and a fuse box, the exact function of which I can now only guess at.

As a bonus, the system offered a way of charging 'wireless' A-batteries (4V or 6V lead-acid acummulators). This was a service that local wireless fans could scarely have done without, when public broadcasting began in 1923/4.

Scarcely a day would pass without Alf Hicks spending an hour or more in the engine shed checking through the batteries with his faithful old hydrometer, to see whether they needed an extra boost from the generator.

The system expands

In due course, the DC supply was extended to other nearby shops and dwellings, the owners of which were only too happy to pay for the convenience of electric light. By present-day standards, the 80V globes were of modest wattage, but to people accustomed to the pale glow of candles and wick-type kerosene lamps, they were brilliant!

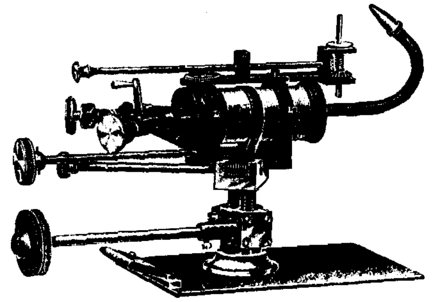
Expansion of the system carried with it a responsibility to the customers, leading to the installation of a second — and larger — generator and a much more powerful single-cylinder engine designed to start on petrol, warm up on kerosene and run on diesel fuel. Just starting it, with a crank handle on the flywheel spindle was a job-and-a-half in itself.

His crowning achievement was the ultimate provision of night lighting for a nearby tennis club — I gather by running 110V lamps direct from the larger generator, independently of the battery bank. Installed on high poles around the court in large down-reflectors, they provided ample light for social tennis. With lighting representing the main load on the system, the battery bank could cope with daytime needs but, as darkness fell, someone always had to be on hand to start up one or other of the engines, depending on the anticipated load.

And, come hail, rain or crackling frost, someone had to wait up until everyone else had gone to bed before turning the engine off again!

To a mechanically minded grandson, this was fascinating stuff. And, for me, 'Pa' Hicks became a role model of a man who did things because he saw them as a challenge — with the happy knack of making them pay well enough to support his next venture, whatever it might be.

Only recently, long after his death, did I learn from my mother that, as a licensed plumber and gasfitter, her father Alf Hicks had been closely involved in gas street lighting in what is now the city of Orange in the central west of NSW. This was around the turn of the century.



A limelight burner, as used in very early slide and movie projectors.

When the local council subsequently decided to update to electricity, Alf Hicks read up on the technology and got involved in this as well. As a much older man, his installation at Bargo was, in a sense, an exercise in turning back the clock. But I must get back to the original theme.

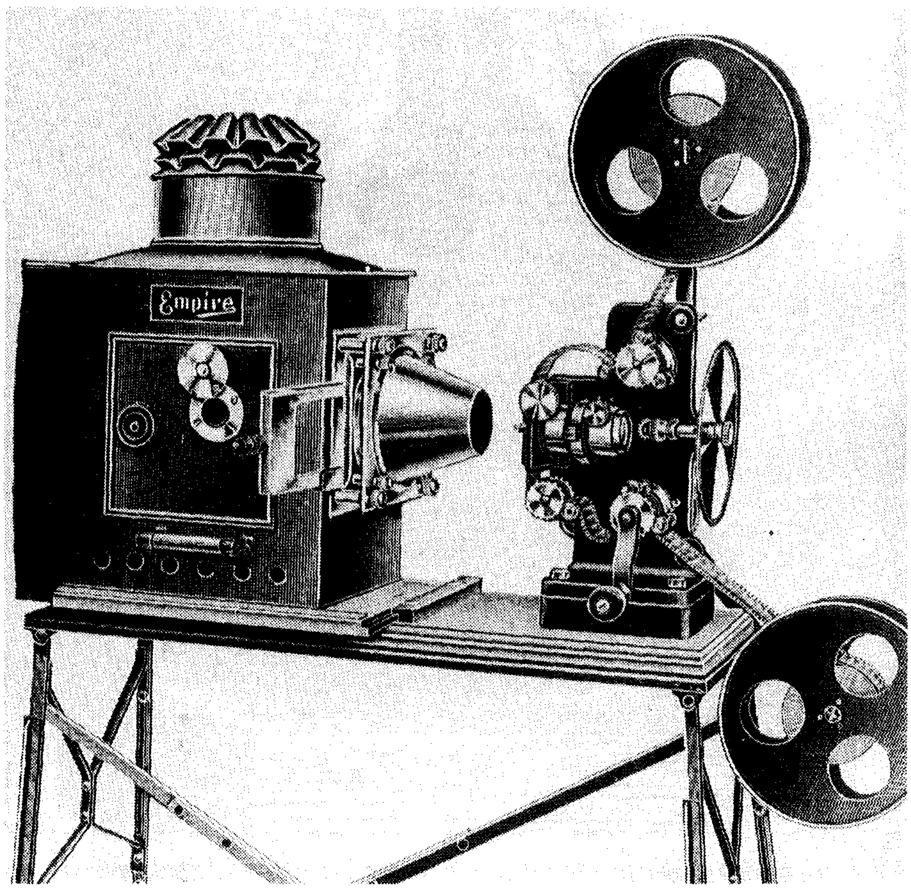
First 'shadders'

As far as I can recall, it was in Hicks' Hall that, as a lad, I saw my first-ever projected pictures — not of the moving kind, but as still pictures from hand-tinted glass slides and a still projector (a 'magic lantern') brought along by a visiting Christian missionary. Even now, still projectors offer a tempting subject in themselves, ranging from those distant days to the electronically automated Paximat that I currently own.

A British encyclopaedia, published around 1850 described a magic lantern as: *An optical instrument by means of which small figures painted with transparent varnish on slides of glass are represented on a wall or screen considerably magnified. It is generally used as a toy and affords amusement from the grotesque character of the figures.*

The dictionary went on to explain that the magic lantern had also found a serious application for educational purposes, as for illustrating astronomy lectures. Moreover, with improvments in the art of photography by Daguerre and Talbot, large-scale enlargement and presentation made possible by the magic lantern brought an awareness of form and beauty in items as small as a few grains of desert sand.

My recollections of this first encounter with a magic lantern are vague but I do remember a large lamphouse surmounted by a curved metal chimney, obviously intended to let heat out but keep stray light in. On the front was a brass



An 'Empire' silent projector of 1914, probably rather similar in construction to the machine that Alf Hicks used when he set up his first picture show in Bargo.

rack to accommodate the slides, each about 90mm square, plus a lens in an adjustable sliding tube.

In the absence of normal mains power, I can only assume that the projector used limelight — explained in my century-old *Science for All* as a Bunsen-type burner from which the flame played on a piece of lime to produce a brilliant white light. The burner was fed from a mixture of oxygen and hydrogen (or coal gas, or acetylene), either from separate pressure cylinders or pressure bags shaped rather like old-fashioned bellows and loaded by weights to expel the gas under pressure.

Looking back, I can recall being vastly intrigued by the idea of projecting images on the wall, and even more so by the notion of moving pictures. Indeed some of my limited pocket money was diverted to the purchase of toy projectors of one kind and another — all of them a complete let-down.

I also became an exponent of the art of drawing stick figures on the edge of consecutive pages of exercise books. When flipped through, they would perform a variety of gymnastic tricks — a more graphic explanation of moving pictures to my schoolboy peers than any number or words.

Movies at last

Local interest in the lantern lecture, plus a couple of belated visits from an itinerant picture show man must have spurred on my grandfather, because it was about that time that he began seriously to explore the possibility of running his own picture show. This, of course, was well back in the silent era.

Initially, he could have got away with using the hall back-to- front, as was often done by itinerant picture show men. The seating would be set up with the audience facing a screen erected near the front entrance, with the projector shooting over their heads from the elevated stage.

Rather than do things by halves, Alf Hicks fitted out a projection room above the entrance, lined with fibro-asbestos and galvanised flat-iron as a precaution against any accident with the highly flammable nitrate film. It proved to be a timely provision, with fire safety regulations being progressively tightened over the years that followed. He also confirmed that a carbon arc system could be operated directly from his 80V DC supply, and determined specifications for the lenses necessary to project an adequate image on to a permanent screen above the stage at the far end of the hall.

On the strength of this, he bought a second-hand Powers projector and lamphouse — a typical early model with an exposed (and noisy) gear train that posed an ever-present threat to straying fingers or loose clothing. It was duly set up to one side of the new projection room, leaving space for a second projector, if and when he could afford one.

Film distribution

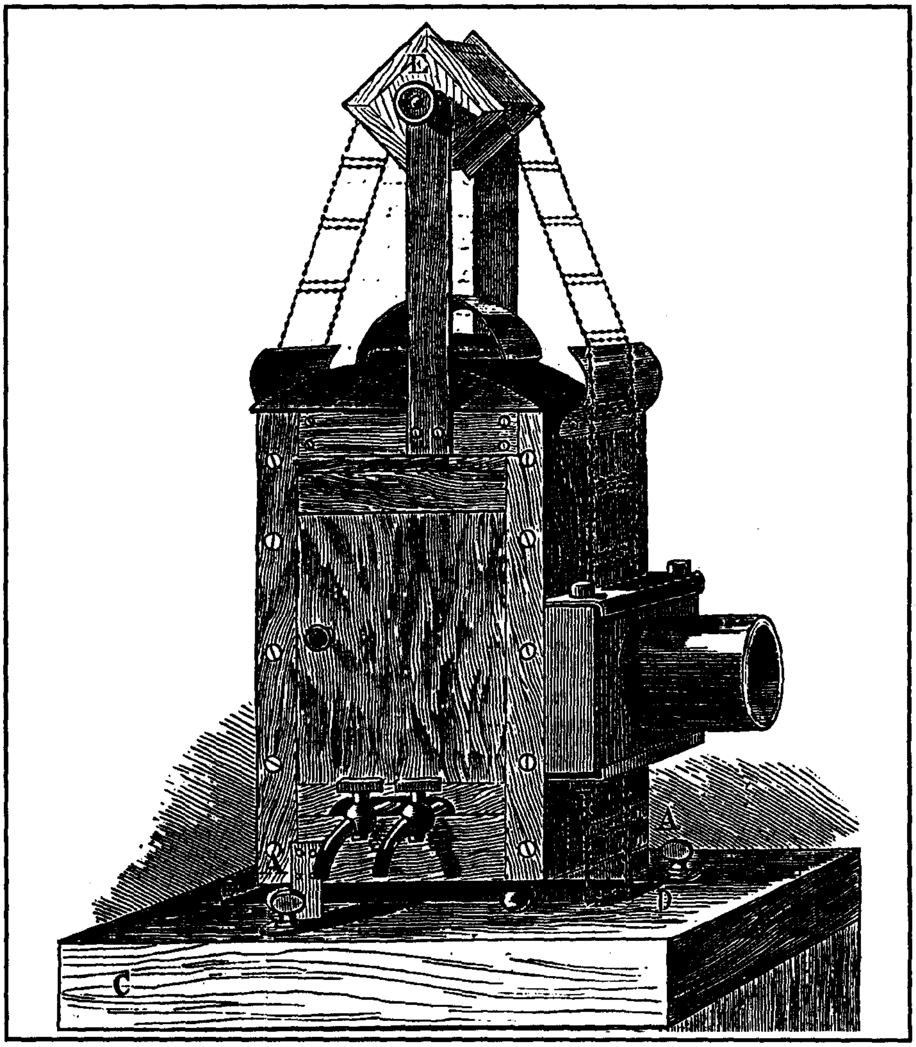
To receive regular programs in those days, an obvious course for an isolated country exhibitor was to arrange with a major film library for inclusion in a distribution circuit. Despatched in cans in a stout steel box, a complete program (two full length features plus supporting shorts) would be sent by train to town A.

Having been shown on the appropriate night, the exhibitor would be required to repack and forward the films to town B on a nominated passenger or goods train. The films would continue thus to towns C, D, and so on, until the last exhibitor on the list returned them to the distributor.

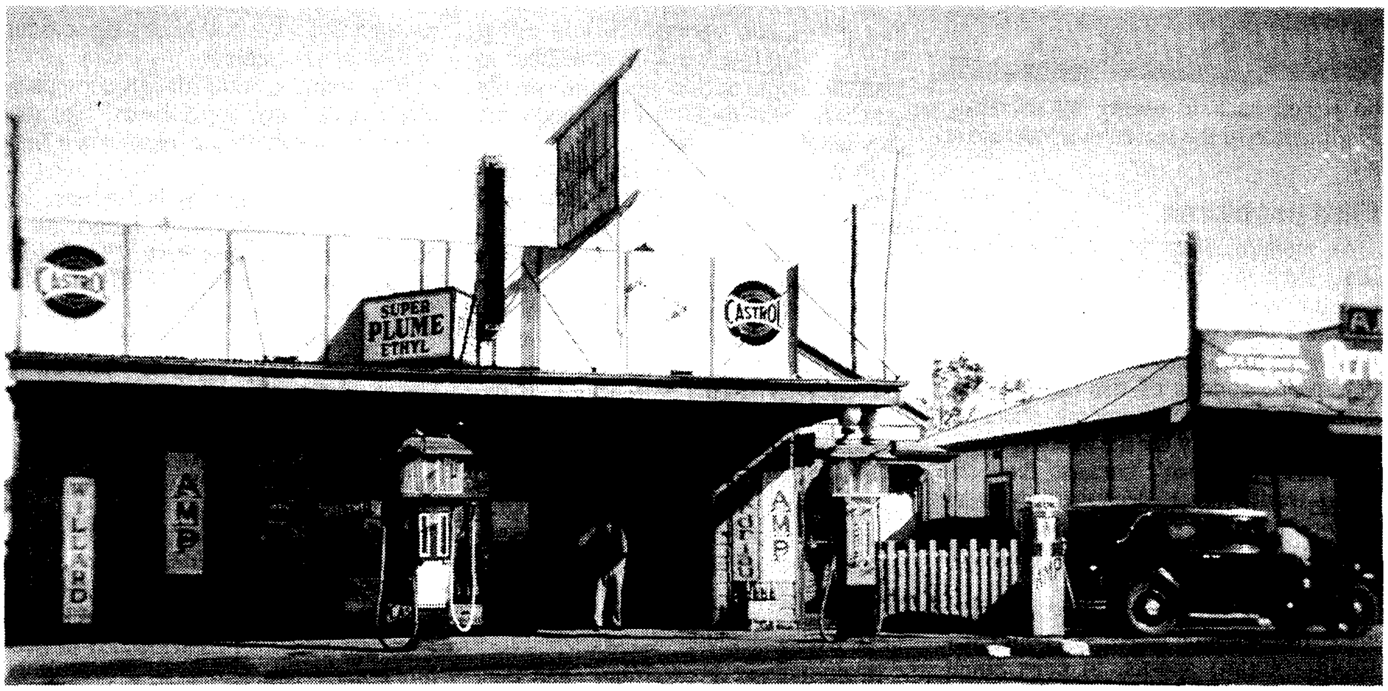
According to a friend who was himself involved with a country show in the early days, the circuit idea had been adapted from the USA and UK.

The classic example, he said, was in North America where the films in one circuit ultimately ended up in Alaska, by then so far away (and so worn?) that they were scarcely worth the cost of recovery. Accordingly, the distributor arranged for the programs to be written off and literally buried in Alaska — box, cans, spools, films and all.

According to a more recent report, someone had dug up some of the boxes, to find that the Alaskan permafrost had preserved the contents more effectively than if they had been returned and stored in the normal way. A virtual treasure



A high tech slide projector 100 years ago. Slides clipped into a chain leading out of — and back into — the storage box. The lid could be tilted to elevate the image. Note the gas tubes feeding the limelight burner.



Hicks' garage at Bargo, operated by Alf Hicks (pictured) and his son Reg, a formally trained fitter/machinist. It provided a ready technical back-up for the picture show and the associated electricity supply system.

trove of historic prints stood to be recovered.

There was no such romance about our local distribution circuits, which were viewed rather as a 'white knuckle' arrangement, with each and every show heavily dependent on the previous exhibitor and the ever-present vagaries of the transport system.

Film check

As a lad, I can recall being despatched to the station on my bike to check when a certain train was due and to inquire whether anyone could confirm that a box of film had indeed been loaded into the guards van. When the box did finally arrive, someone had to manhandle it on to a station porter's trolley and trundle it down the road to the community hall.

When he finally got his show under way, my grandfather soon discovered that getting hold of the films on time was only half the story — but more about that later.

As originally set up, the Bargo picture show was about as basic as it could be and thereby typical of many other village picture shows around the country.

From about 7.45pm onwards, the more conservative patrons would take their (plywood) seats in an orderly fashion. But the 'mob' would congregate outside, enjoying a mag and a fag before they went in. Just before 8.00, the operator would flick the outside lights on and off, as a sign that the show was about to start. The mob would then surge inside, to be greeted by a local family musician, settling down for a long session at the piano.

One soon got to know the style and repertoire of individual players. One had contrived endless variations of 'Bye, Bye Blackbird': pensive, romantic, dramatic and so on. Another would trail off into near silence when he, along with the audience, became engrossed in the action on the screen.

On special nights, when the distributors came up with a big-name feature, the audience might be treated as well to a local violinist — likewise rewarded by a 'few bob' and the chance to see the film for 'nix'!

Would you believe that the writer even made his debut, in those days, as a picture show lolly boy with a box-tray slung from his shoulders and expectantly intoning: "Peanuts, lollies and chocolates!"

The technical side

Up in the operating booth, the sole silent projector was hand- cranked, requiring the operator and/or his assistant (official or otherwise) to turn the handle for the three-odd hours of each show. To be allowed to 'operate' the projector was a rare treat, but one from which the novelty soon evaporated as one alternated from right hand to left hand and then both hands together.

Silent films were meant to be projected at a rate of 16 frames per second, but the speed was not critical. Operators tended to keep the speed down to the nominated figure if the program was short, but to speed things up a bit if they wanted to avoid too late a night.

Every 11 or maybe 22 minutes, the show would come to an abrupt stop while the operator loaded the next spool — a situation that was the signal for loud boo-ing and whistling from the kids occupying the 'sixpenny backless' wooden stools up front.

Years later, I attended a film show in a similar community hall on Norfolk Island. If it hadn't been for the difference in time and place, I could have sworn that the kids down the front were the same ones that used to patronise the show at Bargo!

As well as loading and cranking the projector, the operator had to keep an eye on the arc, visible through small ruby glass windows in each side of the lamphouse and controlled by knurled fibre knobs on shafts protruding from the rear. It was strictly a manually operated device, uncomplicated by any 'new-fangled' automatic feed.

To strike the arc, the carbons were touched together and then immediately separated until the arc looked about right. Evidence that it was so was a brilliant, steady pool of light neatly encompassing the film gate on the projector.

To keep it that way, the projectionist frequently had to nudge one or other of the controls to compensate for gradual erosion of the carbon rods. If, for any reason, he overlooked to do so, he would be jerked back to reality by wavering illumination of the screen or no picture at all!

Film problems

As mentioned earlier, picking up the films from the railway station was only half the story. Ideally, they would have arrived ready for screening; but as an interested kid, I can recall the long hours that projectionists of the day used to spend on Saturday afternoons checking out the films ready for the evening.

It certainly wasn't because they enjoyed work; rather, because they were anxious to avoid the embarrassment of things going wrong before an audience known to them personally.

Depending on the title and the supplier, films might arrive on nominally 1000ft (300m) spools, in cans about 25cm (10") in diameter.

They would often be labelled and/or carry a 'leader' and 'trailer' identifying the film's title and 'Part 1', 'Part 2' etc., and would run for around 10 minutes. Some films, alternatively, would arrive on larger spools carrying a nominal 2000ft and running for 20-odd minutes.

Operators in country circuits soon learned, however, not to take the films for granted.

Films from the last showing could even be taken straight off the projector and despatched 'end out' — in the wrong can.

Even if rewound — presumably by a junior — they might arrive 'start out' but with the emulsion on the wrong side. In that event, the operator would either have to double rewind or remember to load them on to the projector supply sprocket back- to-front, in the hope that they would feed correctly.

To minimise the number of change-overs in a show, particularly with only one projector, the projectionist had the option of splicing together 1000ft reels and winding them on to larger spools. In so doing, they could either leave the intervening leaders and trailers in situ or temporarily remove them — with the risk of re-attaching them later to the wrong reels!

There were stories of films being dumped off split reels straight back into the can, with no spool; of metre-lengths of film being snipped out, to disguise the fact that someone had damaged them by mis-loading; and so on.

Working ahead

In the course of rewinding, and time permitting, a fussy operator might well run an entire suspect film through his fingers, sensitive to anything that could suggest a faulty splice or a torn sprocket hole. Better to re-splice then, or snip around the torn hole than risk a break in mid-show.

From conversations overheard at the time, the condition of films doing the rounds of country shows in the early '20s was the subject of on-going complaint. The distributors blamed exhibitors for mistreating them, and inspectors did the rounds looking for handling abuse or projectors with worn sprockets, jammed guide rollers or fouled gates.

Exhibitors, on the other hand, would complain that the prints were already patched and scratched after long seasons in the city and suburbs.

Film traumas were always somebody else's fault. They were either 'like that when we got them' or 'okay when they left here'!

What was not hearsay is the fact that, in the operating booth at Bargo, as in other country picture halls, there were always enough scraps of nitrate film lying around to make 'stink bombs'. Rolled tightly with a strip of paper and lit, the film would smoulder rather than burn and emit the most pungent odour imaginable. Set off in the leading carriage of a country train, it could penetrate a whole string of corridor cars. But I digress...

When a break did occur during actual projection, skilled operators were amazingly adept at minimising the interruption, particularly in the early days before feed and take-up magazines on projectors became mandatory.

In less time than it takes to tell, the operator would snap shut the light shutter between the lamphouse and gate, flip open the guide rollers and sprockets and yank a couple of metres of film from the top spool down the side of the projector. This would then be slipped back into guides and sprockets so that the projector could be re-started.

The operator (or his assistant) would meanwhile pick up the end feeding on to the floor and tuck it under the loose end on the take-up spool. It would be held in place for a couple of turns until it grabbed and the show would proceed, leaving the break to be spliced later.

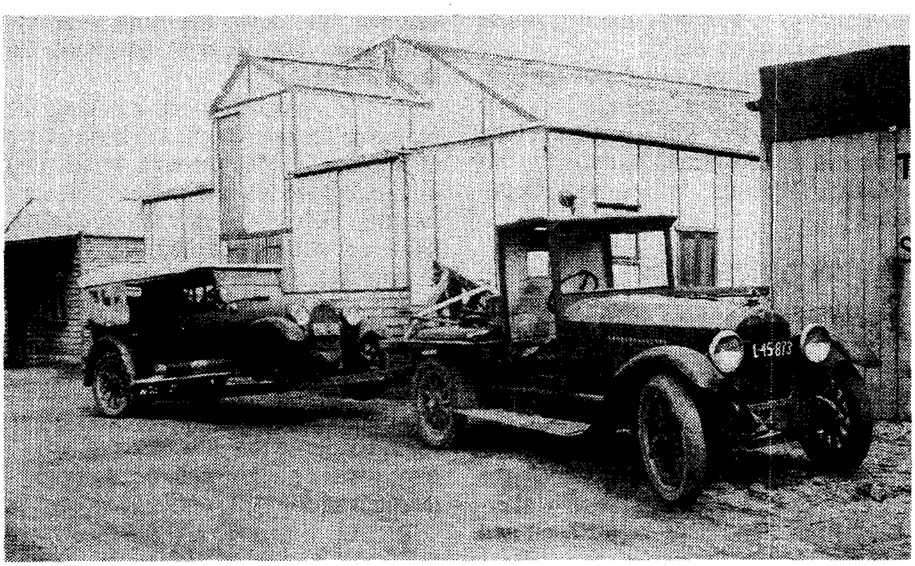
Electric drive

To a practical man like Alf Hicks, the need to hand crank the projector posed an obvious challenge. It wasn't long before he dug up an 80V DC motor from somewhere and worked out a way to drive the projector with a V-belt and a couple of pulleys.

The drive motor and an extension shaft were mounted on a board, supported at each end by angle brackets anchored to the front wall of the projection booth. The board was held by a bolt at one end and a bolt and wing-nut at the other.

The operator soon realised that by good luck or good management the tension on the belt could be varied enough by simply nudging the board to serve as a speed control — by belt slip — or as a clutch, if he pushed/pulled hard enough.

With the original projector motor driven, the obvious next challenge was to instal a second projector, hopefully without costing the proverbial arm and a leg. From somewhere (presumably



This picture is the only one available of Hicks' hall in the days when it doubled as a cinema. Note the projection room over the front entrance, the unforeseen rendez-vous for a million airborne insects on hot summer evenings!

You've gotta' laugh — or maybe cry!

During the preparation of this article, a friend volunteered the following sorry tale of what befell his father, as operator of a picture show in a small town in the NSW west.

It happened, he said, in the early silent days, before film magazines became mandatory. Operators with only a single projector available would often splice three 1000ft reels on to 2000ft spools to minimise the number of breaks — a 'dicey' procedure which was frowned on by the film companies.

On this particular day, some of the films, on arrival, seemed to be in the wrong cans. But after carefully sorting through them, only two reels remained in doubt, one of which had to be 'THE END' of the first feature.

The preceding reel ended in a snow scene and since one of the two doubtful reels started with a similar snow scene, they reckoned that it was a fairly safe bet to splice them together.

The remaining reel was accordingly spliced between the opening reel of the short feature destined to follow interval and the start of the main feature — all three being wound on to a single spool.

The support feature turned out to be a real 'tear jerker', and handkerchiefs were out all over the hall as the stern father prepared (literally) to fling his fallen daughter out into the cold, cold snow.

At that point, the final reel came up. But instead of the forlorn figure, bespectacled comedian Harold Lloyd suddenly appeared doing his own ludicrous thing — in the snow!

The operators had no choice but to let the film run, in the full knowledge that Pansy's fate was firmly spliced half-way through the next overfull reel — between the first half of a Harold Lloyd comedy and the start of the main feature.

through the exhibitors' 'grapevine') he located a second Powers, similar to the one already installed. It had no lamphouse but it was a start.

It was duly set up in the projection booth, complete and working except for a light source. The answer to that small problem, dreamed up by my grandfather and a fitter/machinist uncle — Reg Hicks — was both novel and successful.

A suitable platform was contrived for the non-existent lamphouse, and two boards bolted in place to form a bridge between it and the original lamphouse stand. A half-inch (13mm) diameter steel rod was then pinned to each board, to form two slightly curved parallel steel tracks. Saddles were then added to the underside of the lamphouse, loose enough and with a smear of grease, to ensure a smooth ride from one projector to the other. The rest was easy:

The operator would start up on projector 1, then duck around under the 'bridge' and load up projector 2. As the reel film came to its end, he would start up projector 2; his assistant would then close the shutter on projector 1 and give the lamphouse a quick shove along the tracks. Next moment, the new image would be in place. If he forgot to close the shutter, ghostly patterns would traverse the hall as light spilling from the lamphouse shone through the various ports.

Fortunately, the lamphouse didn't seem to mind the treatment and the routine was vastly preferable to the earlier pandemonium between reels, particularly when the changeover coincided with a tense moment in the action.

Actors, good & 'bad'

Speaking of on-screen action, having a picture show in the family rapidly transformed my complete ignorance of the 'flicks' to a relatively high degree of familiarity. Along with other kids in the district, I soon developed strong likes and dislikes for particular actors.

Tom Mix was a rare treat and Richard Dix could usually be relied on for a bit of action. Charlie Chaplin, Harry Langdon and other comedians were measured, not by their artistry but by how much they made us laugh. At the very bottom of the list was Adolph Menjou, a ladies' man who, we all agreed, 'wouldn't have been able to fight his way out of a paper bag!' As for the 'sorts', in my book Bebe Daniels left the rest for dead.

(I still remember my dismay when, reviewing a 'memories' record album, decades later, I came across a song by my one-time idol. Let's just say she would never have been a candidate for *The Sound of Music*).

As an exhibitor, my grandfather was on the mailing list for lavish film catalogs produced by the various film companies. I liked to browse through them, proud of the number of films I had seen. These days, those same catalogs would be treasured by historically minded film buffs but I guess that, like so many other publications, they were simply 'shot out' when they appeared to have served their immediate purpose.

Back in the projection booth, the two Powers machines did a good job for quite a while, thanks to mandatory maintenance and up- dating — such as, for example, the addition of fireproof magazines for the feed and take-up spools. Itinerant inspectors were not exactly the most welcome people around the film circuit.

As it happens, however, Alf Hicks was offered a Kalee projector, of much more modern design than the other projectors, with an enclosed drive train and much quieter in operation. It was duly given pride of place in the booth, and the Powers it replaced put to one side as a possible source of spare parts.

There was just one problem, in that the lamphouse had to be re- positioned. So instead of the rails being curved in a simple arc, they had to be kinked. The system still worked, but the erratic movement of the lamphouse from one projector to the other became little short of spectacular!

Down in the audience, one didn't need to be told which projector was in use. The projection booth may have been reasonably fireproof, but it certainly wasn't soundproof.

Nor was it insect proof. With no street lights, the one outdoor bulb high up on the front of the building attracted insects from miles around. When they arrived, they would discover an even brighter light just inside the door: a carbon arc. On warm summer evenings, occupants of the projection booth had two choices: close the outside door and suffocate, or open it and be targeted by a host of airborne creepy-crawlies!

But the days of the show in this form proved to be strictly numbered, due largely to the emergence of the 'talkies' around 1930.

With the supply and the appeal of silent films drying up, village picture shows faced a crisis. If they were to continue in operation, they would have to be re-equipped for sound, requiring new film gates and lenses, sound heads and an amplifier system, and projector drive systems that would be both accurate and wow- free. There was much talk also about more stringent maintenance procedures and increased film hiring charges.

What with that and an availability problem with operators, Alf Hicks decided to give the game away — for the time being, at least. The projection booth was locked and the projectors were left to languish under oilstained dust covers, awaiting a new burst of enthusiasm. But that is another story.

(To be continued) ■

SPECTRUM

Communications News & Comment

AUSSAT CONTRACT TO US FIRM

A $630,000 contract has been awarded to Scientific-Atlanta Inc of the United States, for equipment to provide television uplinks for expansion of Aussat's major city earth station network.

Aussat has contracted with Scientific-Atlanta to supply 15 model 7555B Ku band satellite TV exciters and ancillary equipment.

The exciters condition the raw video and audio signals and use them to modulate carriers at the microwave frequencies used by satellites.

Aussat's Frank Mullins said there were several significant reasons for Aussat's selection of the new model. "These included the excellent performance of the exciters and the added advantage that Scientific-Atlanta offers full local repair and servicing facilities from its Sydney headquarters," he said.

"The new model's flexibility, especially the multiple video formats, was also an important factor. They can be used for PAL, SECAM, NTSC or B-MAC formats, including other non-standard satellite video formats as well as those used by commercial TV networks for programme interchange," Mr Mullins said.

Premier Batteries have just released a range of rechargeable Cellular Mobile Phone Batteries to suit most popular types of cellular phones, including Panasonic, Uniden, OKI, NEC, Mobiletronics and Novatel. Being direct replacements for the original manufacturers' product these batteries can be readily charged on existing equipment.

AUST CT3 DEMONSTRATIONS

Australian businesses have been given their first opportunity to experience the benefits of the highly acclaimed CT3 cordless telephone technology (third generation).

Ericsson Australia, NIRA Australia and Novatel conducted demonstrations of CT3 recently, in both Sydney and Melbourne.

The CT3 technology is in line with the European standard (DECT) to be introduced in 1992 which defines all application areas of cordless telephony, in particular in the business environment, but also for Telepoint applications in the street and the home.

The current business application of the technology allows for a fully cordless PABX system to be realised immediately. However, in the near future cordless FAX, Local Area Networking (LANs) and computer links will be achieved with the system.

The only drawback to the current benefits becoming available to Australian business is if commercial operating frequencies are denied by the Australian authorities.

The Government is currently looking at frequency ranges for which cordless telephony standards will be defined.

The flexibility of CT3 is such that no longer will business people be required to be at a desk to answer business calls. The portable handsets, along with their light weight and breast pocket size — 190 grams and measuring only 155 x 45 x 21mm — allow people to take the handsets with them and still receive calls whenever they move around an office building or factory.

CT3 uses Time Division Multiple Access (TDMA). It operates within any band between 800 and 1000HHz and has a maximum band range of 8MHz. It can cater for systems between 500 to 10,000 subscribers, or smaller systems of 10 to 500 extensions.

BBC TV EUROPE OPTS FOR D2MAC

BBC TV Europe, the satellite replay of the best of BBC television to viewers in Europe, is to be relaunched from September 1991.

Among the new features to be introduced from that date is a change of the encryption system to D2MAC/Eurocrypt.

Introducing the plans for the relaunch, Peter Ballard, Deputy Director of Broadcasting Services at BBC Enterprises, said: "The new BBC TV Europe will offer a number of new features not at present provided. There will be stereo sound for many programmes for subscribers with stereo TV receivers or stereo hi-fi equipment. We intend to provide high quality feeds of BBC Radio 4 for Direct-to-Home subscribers, as customers have indicated a strong interest in this BBC radio network. BBC World Service will continue to be available for everybody (subject to cable carriage) to complete a package we believe customers will find extremely valuable.

The present teletext service will be expanded, and we want to include more programming which addresses the needs of European viewers, and by the same token, take out some which is of strictly local interest only within the UK."

"We have chosen D2MAC/Eurocrypt because we believe it offers the technical facilities we require whilst being an 'open' system that will be widely adopted throughout Europe, especially in Scandinavia, which is a prime market for BBC TV Europe. Reception equipment is being made and marketed by all the major consumer electronics manufacturers, and should be readily available to subscribers across the continent."

INMARSAT APPROVES AIRCRAFT SATPHONE

The world's first commercial satellite telephone installation aboard an aircraft has been approved by Inmarsat.

The aircraft is a Gulfstream IV business jet, operated by Gulfstream, whose plant is in Savannah, Georgia.

Other Gulfstream IVs, operated by a number of international companies, are expected to be commissioned with satellite communications equipment within days of the approval.

Until now, aircraft communications have been limited in range, quality and reliability. Using high frequency radio, communications have been mainly limited to aircraft operation and Air Traffic Services communications.

The Inmarsat satellite system provides virtual global coverage for high quality, reliable communications links to support all aircraft communication requirements, including public telephony.

As well as corporate aircraft, a number of airlines, including British Airways and Japan Air Lines, have already flown Inmarsat satellite communications equipment for evaluation purposes and several are expected to begin using the service commercially within the next few months.

This will mean that airline passengers will be able to make direct-dial credit-card telephone calls wherever the aircraft is flying.

Facsimile and data communications will also be possible for passengers and aircrew.

Initially, telephone calls will be via Inmarsat's Atlantic Ocean East satellite through British Telecom's newly authorised Skyphone aeronautical ground earth station (GES) at Goonhilly. However, as additional GESs become operational in other countries over the next few months the service will become available worldwide.

AUST 10TH IN NUMBER OF PHONES

Australia is the 10th ranking country in the world for the number of its telephone lines, which total 7.2 million.

The country with the most telephone lines is the USA, with 121.5 million. In second place is Japan with 52.0 million, followed by West Germany with 28.4 million.

These figures are reported in the latest edition of 'The World's Telephones', a 160 page reference book just released by AT&T, the world's largest telephone company.

Published annually since 1912, the book also gives figures for teledensity — the number of telephone lines per 100 population. Australia rates 6th in the world for teledensity, with a figure of 46.6.

The most lines per 100 population can be found in Sweden, with 66.7, followed by Switzerland, Canada, the USA and Norway.

The AT&T book contains information on the number of telephones, the type of telephone equipment, the calling patterns of countries around the world, the number of public telephones and the amount of local, long distance and international calls.

Copies of 'The World's Telephones' may be purchased for US$49.95, plus US$20 for shipping and handling, from AT&T 'The World's Telephones', 26 Parsippany Road, Whippany, NJ, 07981-9990, USA. Orders may also be placed by calling 1-201-386-0349 from Australia.

ORBITEL/MATRA TO SUPPLY FRANCE'S CT2

Orbitel Mobile Communications will supply digital cordless (CT2) telephones to France Telecom, following an order won by its French partner Matra Communications SA.

Under the terms of the contract placed with Matra, the CT2 handsets and base stations will be used by France Telecom in a trial it is undertaking in Strasbourg this year. This equipment will be based on designs developed by Orbitel. Matra and Orbitel have agreed to collaborate on the supply of CT2 products in France.

Orbitel views France as a key market for digital cordless telephones, as marketing director Richard Mendelsohn explains: "We anticipate that by 1995 France will have a subscriber base of over one million, with annual equipment sales in the region of 40 million pounds at end-user prices."

Orbitel, a member of the Racal group of companies, is marketing internationally, a complete range of digital cordless products.

These comprise a choice of handset models and both single and multi-line base units, aimed at the business, telepoint and residential markets.

Orbitel is also developing telepoint base stations and an integrated network management capability.

FIRST INMARSAT 2 SATELLITE IN ORBIT

The first Inmarsat-2 commercial global mobile communications satellite, launched from Cape Canaveral, Florida, on October 30, is now in geostationary orbit with all systems operating normally.

Early operations on the satellite went so well that command of the spacecraft was handed over from the Centre National d'Etudes Spatiales (CNES) in Toulouse, France to Inmarsat's satellite controllers ahead of schedule.

CNES performed the initial maneuvers and checks on the satellite using a chain of telemetry, tracking and command stations around the world.

The satellite, the first designed and built specifically to provide commercial mobile communications services for ships at sea, aircraft in flight and land mobile users, was built by an international consortium headed by British Aerospace and launched aboard a Delta II rocket.

On Tuesday, November 13, the satellite's communications payload was turned on, and the first signals sent and received via the satellite's two transponders.

"After a perfect launch, the satellite and Inmarsat's ground systems have been performing flawlessly," said Ahmad Ghais, director of Engineering and Operations for Inmarsat. ■

SHORTWAVE LISTENING

by Arthur Cushen, MBE

Radio listening — a popular retirement pastime

Judging from the growing numbers of over-50s among the members of radio listening clubs, many people who had a keen interest in the hobby when they were young, back in the 1940's, are returning to it as a pastime for their retirement. They're finding it much more satisfying than before, due to today's vastly improved receiver technology.

There was a boom in shortwave and mediumwave listening back in the 1940s and 1950s. Large numbers of people took up the hobby, despite the poor frequency calibration of that era's receivers, and the general lack of information available on the world radio scene. However pressures of employment and family life tended to cause a gradual drift away from radio listening, in the following decades.

Now, however, there is evidence that many of the former enthusiasts are returning to the hobby, in their retirement. And of course the situation today is entirely different from that back in the 1940s. With a modern 'keypad' receiver, an outside aerial and a couple of reliable reference books, the world is literally at your fingertips.

A recent survey by the Southern Cross DX Club in Adelaide and the NZ Radio DX League of Invercargill, indicates that more than 50% of club membership is over the age of 50. Today a tremendous number of people are finding radio listening an inexpensive, fascinating and educational retirement hobby.

Listeners do not need to write for station verifications if they are not inclined. Of course, station schedules are available on request from many radio stations, if it is the programme side of listening they are interested in. There are also many publications that give monthly summaries of what is heard on the medium and shortwave bands.

Armed with the latest *World Radio TV Handbook,* the most comprehensive directory of radio, television and satellite broadcasting, the new listener has a most comprehensive publication on which to base his listening. Now in its 45th year of publication, the *Handbook* lists every station in the world by geographical areas, and for cross reference all the stations are listed in the back of the book in frequency order. The *Handbook* runs to 576 pages and not only covers radio listening, but also provides background material on portable and communications receivers, and features on radio listening as a pastime. Another publication which is written for listeners in the South Pacific is my own *Radio Listeners Guide,* which covers over 60 articles on radio listening subjects — illustrated by more than 100 photographs and based on 55 years of listening experience. It is not written in competition with the *Handbook,* as it does not have extensive coverage of station information, but features articles on the various aspects of medium and shortwave listening.

With your keypad radio, which gives you instant access to any frequency you wish to tune, an outside aerial which will give you stronger incoming signals and with some books on radio listening, there is a fascinating future awaiting your enjoyment.

AROUND THE WORLD

CANADA: Radio Canada International has an excellent news programme Monday-Friday 0615-0700UTC. Frequencies of 6050, 6150, 7155, 9740, 9760 and 11840kHz are used. The broadcasts of RCI Montreal to Europe and Africa are also received in this area with English 2130-2200 on 11880, 13670, 15150 and 17820kHz and 2200-2300 on 9760 and 11945, with 'Shortwave Listeners Digest' broadcast on Sunday 2235UTC. There is a relay through the Austrian Radio Vienna to the Middle East, and English is broadcast 0400-0500UTC on 11925kHz.

DENMARK: Radio Denmark uses the transmitters of Radio Norway, and is well received 0830-0900 and 0930-1000 on 21735 and 25730kHz. Two other transmissions are 1930-2000 on 15220kHz and 2130-2200 on 15165kHz. All broadcasts are in Danish, but there is a short English announcement at the opening of the transmission.

GUAM: KTWR Agana Guam has a service to Africa at 1615-1658 in English, on the new frequency of 17775kHz. The transmission to Australia remains on 11805kHz 0827-0957UTC.

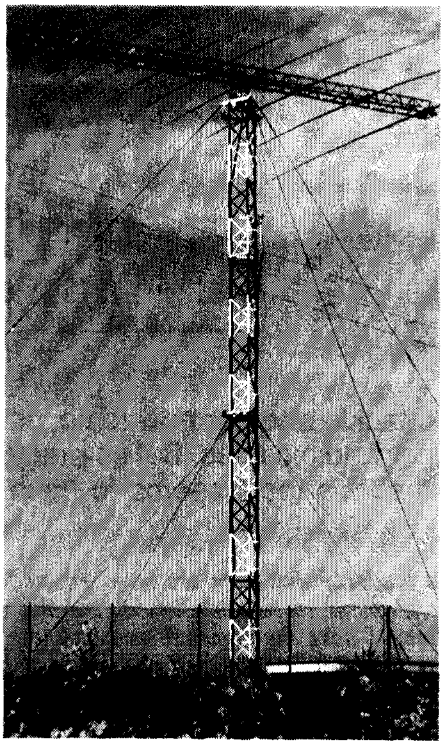
HOLLAND: Radio Nederland is using the new frequency of 11720kHz at 0330-0425UTC to North America, with the broadcast continuing on 9590kHz. Both transmissions originate from the relay base on Bonaire.

NORWAY: Radio Norway, Oslo now has English on Saturdays and Sundays to this area 1900-1930 on 15220 and 21705kHz. There is a daily service in Norwegian 0800-0830 on 17740 and 25730kHz; 1900-1930 on 15220 and 21705kHz; and 2000-2030 on 9610 and 15220kHz.

SAIPAN: KHBI, operated by the Christian Science Monitor, now has a daily programme for listeners in Europe 1800-2000 on 11650kHz. The other English broadcasts are 000-0200 and 0600-0800 on 17555kHz.

USA: WHRI with its gospel programming from South Bend Indiana is using 7315kHz at 0800 with a service to Europe. The same programme is carried on 7355kHz, which provides better reception.

The Voice of America has altered its frequencies for service to this area and is heard during our mornings 1900-2000 on 9525, 11870 and 15180kHz; 2100-2200 on 11870, 15185 and 17735kHz; and 2200-2400 on 11760, 15185, 15305 and 17735kHz. On Monday at 2105 'Communication World' is broadcast which is a magazine feature covering radio and allied subjects.



AWR transmitting site at Forli in Italy which is to be expanded to include transmitters of 250kW, beaming programmes to Eastern Europe and the Middle East.

In today's changing world news and information is a very satisfying area. A keen listener can be right at the source of a major event, if they know when and where to listen. The romance of mediumwave listening may have disappeared: to talk to one's friends of listening stations in New York and Boston on mediumwave, lacks the impact that it did years ago.

Even to tell visiting Americans that you have tuned to their hometown station brings the reply that 'you must have heard it on shortwave.' Nevertheless mediumwave is unpredictable, while shortwave is the reliable field of overseas listening.

AWR — Forli, Italy

Adventist World Radio in Forli, Italy has been broadcasting on low power since 1985. The fact is that Italian radio law has been indecisive, meaning that only now have stations been granted recognition as shortwave broadcasters.

The first transmitter of AWR was 2.5kW, using a log periodic aerial. Adventist World Radio has for some years leased a transmitter in Portugal from Trans Europe. It now plans to expand this operation but the site in Forli is too small for expansion.

Plans are underway for a larger shortwave facility for a new site to serve Europe, North Africa and the Middle East, and which will eventually have four 250kW transmitters.

The new site will not be far from Forli with an area enabling the erection fo several transmitting towers.

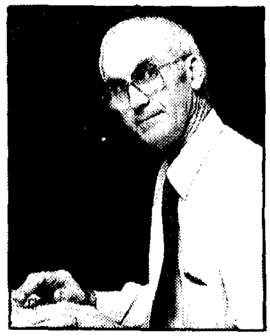
It was earlier reported that AWR would go to San Marino, but the site offered was too hilly. Earlier on the organisation had broadcast from Andorra, but problems were experienced in trying to modify the service in response to concern expressed by France and Spain.

Since authorisation from the Italian Government, the new high powered station will be built immediately and in two stages; the station should be operating by 1992. At present Adventist World Radio Forli has a 10kW transmitter and is heard in English at 0830-0900 and 1130-1200 on 2730kHz. The rest of the schedule is in various European languages. ■

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



The great debate about ELCBs, and whether or not to earth your bath-plug — 4

At the end of last month's column, I volunteered that this month we'd tackle another new topic, as well as simply 'tying up the loose ends' regarding both ELCBs and fancy audio cables. But so many more letters have turned up with further comments about ELCBs that this topic seems to have demanded a further column of its own. Who am I to argue?

It's reassuring, I guess, that so many people have written in to offer their 'two cents' worth' on this subject. Obviously many people are reading Forum, and have found the subject matter interesting enough and/or important enough to motivate them into joining the fray. This certainly seems to vindicate our original correspondent Jeff Thomas, who believed it was a subject that we all needed to think much more about. Hopefully it also vindicates my choice of Jeff's letter and its topic, for discussion in Forum.

Mind you, one of Jeff Thomas's own colleagues has written in to take me to task about this — more about this shortly.

Jeff Thomas himself has also written in, with comments in reply to those made by others in the November issue. And as many of those comments were fairly critical of points he raised in his first letter, I think it's only fair to let Jeff have the right of reply. In fact we'll start this fourth round of the great ELCB bout by letting him throw the first few punches:

WOW! I have just opened the November issue at 'Forum', and I'm flabbergasted.

It is obvious that some people see and read, but do not comprehend. I had thought that I had presented my topic in a reasoned and reasonable fashion, and I thought that I had made it fairly clear that the subject was based on FACT, not conjecture.

- *Fact One: People are killed in baths by appliances falling into them. Generally the reports in newspapers talk about 'hairdryers', not 'bar radiators', and generally the victims seem to be children, and invariably the result is tragic. The reasons for, and the method of death may be complex and may require some delving into textbooks on field theory to explain it, but the fact remains: live appliance plus wet skin plus unprotected bathwater equals lethal situation. We can expound on and on about the why's and the wherefore's, however people DO DIE in these situations.*
- *Fact Two: It was proved that 'protected', exposed, live electrical contacts falling into a non-grounded bath did not trip a properly installed ELCB. The correspondents who did not pick up on this missed the point, that an experiment was carried out in a typical 'protected' modern bathroom situation — and the ELCB did not trip.*
- *Fact Three: If the bathwater is not earthed, either in the way I suggested or in some other way, if a non-earthed appliance falls into that bathwater while connected to ELCB 'protected' mains, as already proven, the ELCB may not trip, and anybody in the bath stands a very good chance of being electrocuted even though they were considered 'safe'. If the chain is present (tied securely to ground), or a ground reference is established in some other way, the ELCB WILL trip and the person in the bath will stand a very much better chance of coming through the experience alive!*

As Alan Fowler pointed out, maybe if the installation is NOT protected by an ELCB, then we have a 'more lethal' situation (if we can discuss degrees of death) by earthing the water. However I am considering ONLY the situation where ELCB protection is present.

Surely these are not matters of conjecture. Surely they are matters of fact.

My original purpose was only to bring your attention to this anomalous situation, and suggest a practical method of overcoming the problem. In no way was I denigrating any maker, nor damning the use of ELCB's. They are lifesavers, and it is laudable that they are now required equipment in new electrical installations. I have my domestic and business situations fully protected with such devices.

I don't think that discussion of people 'relying' on ELCB's is appropriate here, and it wasn't my intention to advocate this approach. ELCB's are there as a safety backup system only, to protect against faults (and, I guess, stupidity). I DO agree that the use of any electrical appliance in a bathroom is foolhardy, however people do insist on doing this. Since we have the technology available to save lives in these situations, it is incumbent upon us to use this technology as effectively as possible.

One last point. I think we are all indebted to Graeme Daw for his treatment of the 'mechanics' of the field theory and the process of electrocution. However I think that if I was in a bath keeping company with a live double-insulated hair dryer, I would much prefer to have the ELCB go off in 40 milliseconds with even a 6-amp belt, than to sit there paralysed with 100 microamps flowing into eternity!

It is not only the effect of the current through the heart we have to worry about — there are also the effects of stray currents flowing through the other muscles in the body to consider.

Here we go again!

Thanks for those further comments, Jeff. By the way, this letter was written before the December issue was published, so Jeff Thomas wasn't aware at the time of the later material we were publishing from Peter Foley, Professor Biegelmeier or Drew Winning.

It's good that Jeff reminded us of his enthusiasm for ELCBs, and that he was merely pointing to a problem where a ELCB may 'need help' in providing ade-

quate protection. I think some of the later correspondents somehow tended to read into his letter some sort of criticism of ELCBs, or a suggestion that they're either unnecessary or shouldn't be used. Obviously that wasn't the case.

Jeff's also right, I believe, to point out again that the combination of 'live' hair dryers and naked humans in baths is in fact a very dangerous one, and does cause a high incidence of fatality. His reminder that this is a fact, and the subject is not merely one of idle conjecture, is very pertinent.

His 'fact two' is also fairly undisputable. I think everyone will agree now — even the most ardent advocate of ELCB/RCDs — that these devices cannot trip unless a fault situation results in a significant 'unbalancing' of the active and neutral currents, which can only be produced by a separate path to earth. In other words, without an earth path, the ELCB/RCD cannot provide protection.

However it seems to me that Jeff's multi-barrelled 'fact three' is the one with which most of our correspondents have disagreed, and the one that is most open to question. Essentially what most of the other people seem to have said (boiling the arguments down) can be summarised as follows:

1. That even though an ELCB cannot trip if a non-earthed appliance like a hair dryer is dropped into a non-earthed bathtub of water, neither is the risk of electrocution in such a situation as high as Jeff has suggested. In other words, that the very situation where the ELCB/RCD cannot trip, though very disturbing and possibly quite spectacular, is also one of relatively low risk. This is assuming, of course, that the bath's occupant doesn't grab an earthed tap or pipe, in their understandable panic. Then the risk of electrocution will rise dramatically — but so too will the potential for the ELCB/RCD to trip and protect them.

2. That the degree of protection offered by Jeff's suggested earthed bathplug chain is open to debate. True, it will convert the situation into one where the ELCB/RCD should be able to trip, by ensuring that current flows to earth immediately in the event of the appliance falling into the water. But it may also result in a much larger current flowing through the bathwater and its unfortunate occupant, for the 15-40ms or so before the ELCB/RCD trips. Assuming it *does* trip, of course — and quite a few people still seem to have some reservations about the long-term reliability of these devices.

Incidentally Jeff Thomas may not have *intended* to advocate that people 'rely' upon ELCB's, but wasn't this really implied in his suggestion of an earthed bathplug chain?

Surely the only reason for fitting such a chain is that it ensures that a relatively heavy current *will* flow to earth in the event of an unearthed appliance falling into the water. If an ELCB/RCD *isn't* fitted, this would be disastrous — so surely the only justification for doing it is because we're relying on the ELCB/RCD to break the circuit...

Jeff Thomas is of course quite entitled to his view, that an earthed bathplug chain and its risk of producing a 'short sharp shock' scenario with the ELCB/RCD is preferable to relying upon wastepipe water leakage and a possible 'weak but indefinite' shock scenario. Just as Graeme Daw and others are entitled to hold the contrary view. Both approaches seem to have their advantages and shortcomings.

Me, I think I'd still prefer not to have *any* unearthed electrical appliances anywhere near the bath!

By the way, Jeff Thomas does point out that many of the recorded fatalities from bathtub shocks are of children. That's something many of the other correspondents seem to have overlooked. And much of the technical data on electrical behaviour of, and the effects of current flow on, the human body seems to talk only of adults. A child's body may well have lower skin and bulk resistance, and hence be at much greater risk.

It's also easy to overlook the tendency for children in particular to panic in a dramatic situation, or one where they may be experiencing a shock that while not in itself necessarily serious, is nevertheless very upsetting. Whereas an adult may just possibly have the presence of mind to stand up — without reaching for an earthed tap or pipe — and haul the hairdryer out by the cord (or yell out for someone else to do so), it's probably very unlikely that a child would be able to do so.

All the more reason for ensuring that ALL bathrooms are fitted with the protection of an ELCB/RCD, of course — whether or not you're prepared to follow Jeff Thomas and fit an earthed chain.

Colleague's letter

And with that comment I think we'll leave Jeff Thomas's own letter. But as I mentioned earlier, another letter came in from one of his colleagues, taking me to task for the way I handled both Jeff's original letter and the comments from later correspondents.

The letter concerned came from Anthony May, of Caringbah in Sydney, and it too arrived before the December issue was published — so it again doesn't reflect anything that was said in December's column. Mr May was obviously also quite upset with some of the rather critical comments made by correspondent Chris Hackett, and in his haste to defend his colleague makes some comments of his own that could possibly produce legal action if I were to reproduce them here.

As his letter is a little too long in any case to reprint in its entirety, I'm proposing to reprint only the salient and safe sections:

Having just read November's Forum, I was left very concerned about a number of issues raised in that column, of both technical and 'professional' nature. I shall start with the technical issues regarding the electric fields present in a bath of water when say, a hair dryer is immersed.

This is not a simple situation, electrically speaking. To say that "Because the conductors are so close together, a strong electric field (strong enough to kill) is unlikely, away from the appliance" is grossly incorrect. Countless people have died from just this very situation...

Quite apart from the theory of electric field strengths, the proof is in the statistics. People die from electrocution in baths. Obviously there is a strong enough field produced to kill someone. This is the painfully obvious fact in this matter which some people, in their eagerness to have another 'Forum slanging match', have ignored...

My other concern is about people of the likes of Mr Chris Hackett, whose opinion of 'professional' people in Australia seems to be less than desirable, if Australia is to become the 'Clever Country' as our PM would express it. He obviously has a 'chip on his shoulder' regarding formally (tertiary or otherwise) educated people...

I am also quite disappointed in you, Jim Rowe, as your comments like "If nothing else, I think this information from Graeme Daw tends to put the final 'nail in the coffin" of Jeff Thomas' proposal to use an earthed bath chain' do nothing for a person's professional reputation. After all, one does not know if one's clients read EA. Whether a contributor is right or wrong, these kinds of comments so early in this new topic of ELCB's are quite unwarranted — as I hope my, and I believe Jeff Thomas' subsequent letter to you will have shown.

Without wanting to boast, I researched the topic, theory and maths involved, at least at a basic level, and 'picked the brains' of those more experienced and qualified than I, before I wrote this letter. Unfortunately, some of the above mentioned people appear to have written off the top of their head. In doing so, and in you publishing them, you have 'buried' an otherwise sound solution to a very serious problem.

This saddens me, as I will now be very reluctant to contribute to 'Forum' in future, for fear of appearing foolish due to the thoughtlessness of other contributors 'swamping' my ideas etc... Contributors who are eager to quash someone else's ideas, yet provide no alternatives of their own.

Well, there you are. Much of the rest of Mr May's letter either expresses many of the points raised in Jeff Thomas's own second letter, in his own way, or deals again with an analysis of the electrical situation in a bathtub, as discussed in December's column.

My main impression with the technical side of Anthony May's letter is that in his desire to support his colleague, he seems to have made a number of assumptions that are not easily justified.

Granted that far too many people have died from electrocution, following an appliance such as a hair dryer falling into their bathtub, what can we deduce from this? Mr May seems to assume that it proves that a lethal electric field extends well beyond the immersed appliance, even if the bath and water are not earthed, and that hence an ELCB/RCD would not have saved the people concerned even if one had been fitted. And he also seems to assume that anyone who doesn't agree with this can't have considered the matter carefully enough.

Differing opinions

Well, people like Graeme Daw and Professor Biegelmeier have studied this kind of situation at great length, as have other people like Brian Byrne — whose letter is quoted later — and these people don't seem to agree. It also seems to me that about the only thing one *can* validly deduce from those cases of bathtub fatality is that in each case, for one reason or another, the current that flowed through the body of the unfortunate person concerned was sufficient to kill them. And since the current was inevitably flowing in response to a field, then there must have been a field extending sufficiently from the appliance to achieve this.

But whether or not the bath and water and/or occupant were earthed, is an entirely different matter. As is the question of whether or not an ELCB/RCD would have been able to save them, with or without an earthed bathplug chain. My understanding is that we simply don't have the hard, factual evidence to support any deductions along these lines.

Peter Foley was quoted in the December column as writing that 89% of people electrocuted in domestic situations between 1983 and 1987 would not have been killed if an ELCB/RCD had been fitted. This suggests that in roughly 9 cases out of 10, the fatal current flowed via an earth path — the very kind of situation which an ELCB/RCD is designed to detect.

Following the evidence provided by Professor Biegelmeier, my own guess is that in most cases of bathtub fatality, the person concerned was either sitting in an earthed tub, or grabbed an earthed tap or pipe in their panic and distress when the appliance fell into the water. And since at this stage the vast majority of homes are still not fitted with an ELCB/RCD, this would have resulted in almost certain death.

I'm sorry, Anthony, but I don't think you can deduce from the mere fact that many people have been electrocuted by an appliance falling into their tub, that this shows a fatal electric field extends through the water, even in an unearthed tub. Some of the people who wrote in following my publication of Jeff Thomas's first letter may have expressed this rather intolerantly, but I suspect that's the point they were trying to make.

Which brings me to the other points raised in Anthony May's letter, about whether or not I should have published letters that were critical of Jeff Thomas's letter, and suggested as I did that Graeme Daw's information had 'put the last nail in the coffin' of Jeff's proposal to use an earthed bathplug chain.

I can see what Anthony is driving at, and I confess I've felt a little the same way at times when people have heaped scorn over things I've written myself. All the same I think he's wrong, as generally I have been in such situations.

The whole idea of Forum is to help us all clarify interesting and/or important technical problems, and hopefully arrive at a more accurate, objective and factual understanding. It's almost inevitable that many of us (me included) will find that our first conceptions of these matters were either wrong or incomplete, and that we'll end up being 'put straight' by others.

The idea, not the person

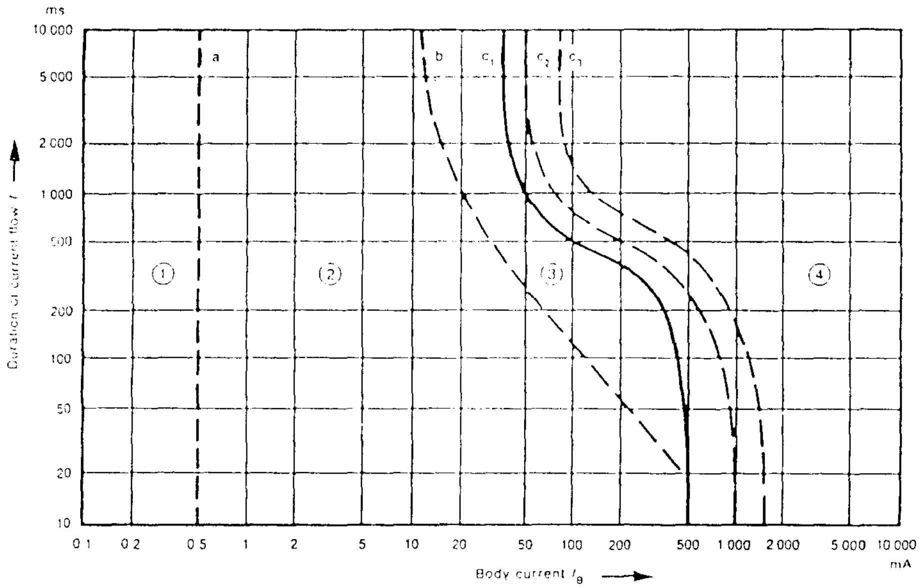
In this kind of a situation, I believe it's very important to distinguish between the *person*, and the concept or idea they're putting forward. A concept may be wrong, but that doesn't make the person who puts it forward a fool, or incompetent. If that were so, the whole of humanity would be both, because we ALL make mistakes — to err is human, etc. Anyone who expects an engineer, a doctor, a magazine editor or anyone else to never be mistaken is therefore themselves being quite unrealistic — and in a way, foolish.

Of course it's all too easy to take umbrage when someone shows us that one of our pet ideas or beliefs is wrong, because we all tend to feel that this is a criticism of *ourselves*, not just our idea. Presumably we get upset because we all like to think of ourselves as infallible and omniscient, and it isn't nice when someone proves our fantasy wrong. But in reality we should be grateful when someone *does* show us where we're wrong, because they then present us with the opportunity to correct a little more of our inevitably imperfect belief system, and approach ever-so-slightly closer to our fantasy goal.

I think it was Socrates, about 2000-odd years ago, who wrote something like 'He who shows me where I am wrong does me the greatest possible favour'. I mightn't be quoting him exactly, but certainly that was the gist of it. And to my mind, it's just as true now as it was then.

While trying not to get too lofty or pretentious, it's with this principle in mind that I try to run Forum. The idea is that we all should concentrate as much as possible on the concepts, looking at these as critically and objectively as possible — whether they come from you, me or other correspondents. Only in this way are we likely to arrive at the truth.

Of course if we believe we've found a flaw in someone's ideas, the ideal approach is to point this out calmly and objectively — taking care not to confuse



Notes: 1. *As regards ventricular fibrillation, this figure relates to the effects of current which flows in the path 'left hand to feet'. Other current paths are discussed later.*

2. *The point 500 mA/100 mS corresponds to a fibrillation probability in the order of 1 in 700.*

Zones	Physiological effects
Zone 1	Usually no reaction effects.
Zone 2	Usually no harmful physiological effects.
Zone 3	Usually no organic damage to be expected. Likelihood of muscular contractions and difficulty in breathing, reversible disturbances of formation and conduction of impulses in the heart, including atrial fibrillation and transient cardiac arrest without ventricular fibrillation increasing with current magnitude and time.
Zone 4	In addition to the effects of Zone 3, probability of ventricular fibrillation increasing up to about 5% [curve c_2], up to about 50% [curve c_3] and above 50% beyond curve c_3. Increasing with magnitude and time, pathophysiological effects such as cardiac arrest, breathing arrest and heavy burns may occur.

A graph showing the effects of alternating currents (15-100Hz) on the human body, together with an explanatory table. This is taken from Brian Byrne's paper, but Professor Biegelmeier also gives essentially the same graph and table.

the idea with its proposer. I certainly try to do this myself, and it's gratifying to note that most of our correspondents do too. It's only the occasional one that gets a bit abusive...

I certainly tried to do this in the November column, in the section to which Anthony May refers. It seemed to me that Graeme Daw had thrown considerable doubt on the advisability of following Jeff Thomas's idea of using an earthed bathplug chain; hence my comment that it had 'put the final nail' in the idea's 'coffin'. Perhaps this was a little colourful, and possibly even a little premature; but all the same, I was certainly only referring to the idea/proposal — certainly not to Jeff Thomas himself.

Judging from his letter, Mr Thomas appears to be a highly professional and public-spirited person. He also seems a very reasonable person, and I suspect he'll agree that he's no more infallible than the rest of us. This being the case, hopefully he'll also be aware that his professional reputation will in no way be effected, should one particular proposal he has made turn out to be of debateable merit. All it will show is that he's human, too.

As a final comment about Anthony May's letter, I note that he too seems to have fallen into the same trap, of confusing the person with the idea. In seeking to reply to the ideas expressed by those correspondents who criticised Jeff Thomas's proposal, he has accused them of 'writing off the top of their heads' (i.e., without adequate study or knowledge), of being 'thoughtless', 'eager to quash someone else's ideas', and unable to provide any alternative ideas of their own. All of which sounds to me rather similar to the comments from a certain Mr Hackett, that he found rather upsetting...

Anyway, let's all just concentrate on the facts and ideas, folks, and try to forget the insults!

Incidentally, it was interesting to note the number of people who somehow inferred from either Jeff Thomas's letter or my own comments, in either the August or November columns, that we were criticising ELCBs and/or their use. As a result they apparently felt obliged to spring to the 'defence' of these devices — treating them a little like a sacred cow, which cannot be be seen to be even vaguely associated with any kind of taint or criticism.

We technical types do seem to have a curious tendency to elevate concepts or devices to 'sacred cow' status, despite our protestations of objectivity and hard-nosed professionalism. And ELCB/RCDs seem to be one of the devices that have achieved this status, with any suggestion that they are anything short of 'perfect' tending to bring forth the wrath of the righteous.

I can only assume that this effect has something to do with them being associated with electrical safety. But no-one seems to get upset at suggestions that ordinary fuses or circuit breakers have their limitations, do they?

Back to the topic...

And after that short sermon, I really *must* return to the actual topic, and the remaining letters.

Mr Jim MacDonald of Vermont in Victoria wrote in just after the November issue had been published, enclosing a copy of Professor Biegelmeier's papers. Thanks for your courtesy, Jim — but as you no doubt saw from the December column, I had become aware of the Professor's work by then. I hope everyone else found it as interesting as I did.

Mr Raoul Pelham of Queanbeyan in NSW wrote to say how much he appreciated the Forum columns on ELCBs, which had caused considerable reassessment in his household of the risks involved in using 240V electrical appliances in a bathroom/laundry. His response to Mr Hackett's suggestion that we were being irresponsible in publishing Jeff Thomas's letter was brief but concise:

"Forum irresponsible in publishing — BAH, HUMBUG!"

Mr Michael Hayes of Ingleburn in NSW, like Jeff Thomas a professional electrical engineer and licensed electrical contractor, wrote with a copy of a letter he had written to the SAA, complaining about advertisements which he believed made unwarranted claims about ELCB/RCDs. In the letter he had also suggested the use of an internal earthed 'guard ring' for double- insulated appliances, along the lines suggested by Jeff Thomas, to ensure ELCB/RCD tripping if the appliance is immersed in water. (An idea I was happy to endorse, by the way.)

Mr Hayes also enclosed a copy of the reply from the SAA, which essentially said that (a) the wording in advertising for ELCB/RCDs was outside the charter of SAA, and (b) the SAA did *not* like the idea of the internal earthed electrode or 'guard ring'. Ah well — we tried, didn't we, Jeff and Michael?

Finally, I must acknowledge a letter from Brian Byrne, who has written to Forum on previous occasions. Mr Byrne is again a professional electrical engineer of long experience, and has in fact made a particular study of electrical safety. He has also been a member of many SAA committees and working parties on safety, electrical wiring practices, RCD applications and associated topics, and is accordingly very well qualified on this topic.

With his letter, Mr Byrne sent in a copy of a paper he had presented at an SAA seminar on RCDs, in September last. This is titled 'The Effect of Current Passing Through the Human Body', and seems to convey much the same basic information as found in Professor Biegelmeier's papers — although expressed in terminology that I found rather easier to follow, I must confess. Thanks, Brian!

Body resistance

One point Brian Byrne makes is that Graeme Daw's statement that 'up to about 4000 amps is available to flow to earth', before the circuit is interrupted by the ELCB/RCD, could be construed as misleading. This is because the resistance of a human body is around 1000 ohms, when skin breakdown occurs. This suggests that the maximum current likely to flow through a human body to earth, before the ELCB/RCD trips, is likely to be no more than 240mA or so. As Brian Byrne adds:

As it happens, the conditions leading to fibrillation include both the current level and the time for which the current is applied. As a yardstick, a maximum 'safe' figure is 100mA for 500 milliseconds (or 50mA for 1 second, and so on). If an RCD interrupts the actual body current (perhaps 240mA) in 200ms or less, survival is virtually certain.

Fair enough, I guess. Incidentally I note from a graph given in Brian Byrne's paper that currents of below 30mA through the body seem to be regarded as 'unlikly to produce fibrillation' — even if they continue almost indefinitely. This suggests that a properly functional ELCB/RCD may well provide sufficient protection, even in a bathtub that is relatively insulated with respect to earth.

And with that I think we'll finally give the subject a rest, at least for a while. Thanks to everyone who took part in a very informative discussion, even if a few feathers became ruffled in the process.

I hope you'll join me next month, for an attempt to round off the thorny subject of fancy audio cables. Hopefully we might even get a chance to start another new topic, as well! ■

Silicon Valley NEWSLETTER

AMD can use '386' — for now

In its second major legal victory in less than a month, Advanced Micro Devices has won a key scrimmage in the intense on-going legal battle with Intel. San Jose-based Federal District Court Judge William Ingram denied Intel's motion for an injunction that would have prevented AMD from using the '386' numbers in the cloned version of the popular Intel 80386 microprocessor. The decision clears the way for AMD to launch the chip, called the 'Longhorn'.

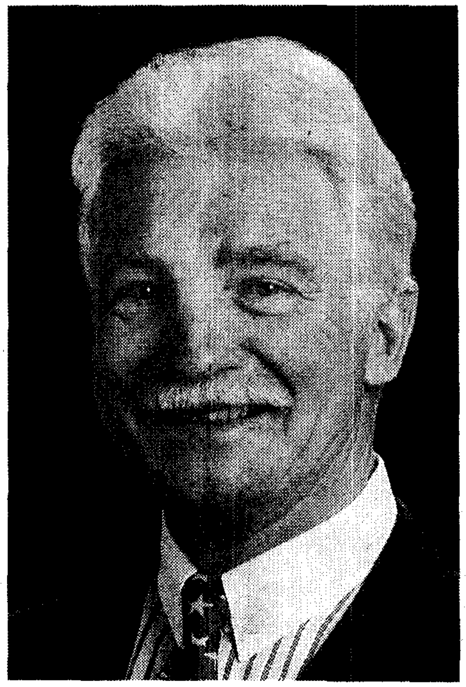
The injunction motion was part of a lawsuit Intel filed against AMD on October 3, last year, shortly after Intel obtained AMD documents describing a chip called the 'AM-386DX. As part of his ruling, Ingram removed the temporary injunction he imposed on AMD's use of the '386' designation, at the time Intel filed the case.

AMD wasted little time, hailing the decision as a major victory. "Basically, we can call our chip what we want to call it. We believe that we can use the number 386 pending a trial," said AMD spokesman John Greenagel.

Intel legal counsel Thomas Dunlap conceded defeat. "We lost this scrimmage, but we haven't lost the war," Dunlap said, adding that Intel will take its legitimate trademark even though the company did not register it as such when it introduced the chip.

Industry analysts said the Ingram decision will make an Intel victory at trial all the more difficult. Since it could well be another year or more before the case can go to trial, there will literally be hundreds of thousands of AM386DX processors out in the marketplace. It will be a lot harder to identify the 386 name just with Intel.

Industry analysts Michael Slater and Michael Murphy said they believe the AMD chip will be a tremendous success for the company, as many computer manufacturers resent being dependent on Intel for critical microprocessors. Intel's monopoly has kept prices artificially high and has hurt their sales during extended periods of shortages.



AMD's colourful chairman Jerry Sanders has particular reason to smile, after his company won two successive court battles with rival Intel Corporation.

Winning this case, together with the finding that Intel had breached its technology exchange agreement with AMD, could boost AMD's annual sales by as much as US$500 million.

Bell develops holographic memory

Researchers at Bellcore laboratories in Livingston, New Jersey, the joint research arm of the regional Bell telephone companies, announced the development of a holographic-based computer system memory technology they believe could store 2000 times more data than any silicon chip-based technology and store and retrieve data 1000 times faster as well.

The development, researchers at the lab said, could lead to advanced-media computers capable of performing many demanding tasks simultaneously.

The technology is based on the use of a split laser beam. Data is carried in the form of an optical image along one of the two beams, while the second, parallel beam stores reference information to later retrieve the data.

Next, the two beams are recombined in a sugar cube-size crystal to create a three-dimensional holographic image. A single such crystal would be capable of storing up to one gigabyte of data, or 2000 times more information than a state-of-the-art four megabit DRAM.

$6 billion bid for AT&T/NCR merger

AT&T is reportedly negotiating a US$6 billion acquisition of NCR, including the merging of their respective computer operations, according to unnamed executives involved in the talks.

However, the same sources, said to be in the AT&T camp, cautioned that AT&T may be reluctant to part with so much money in view of the general slow-down in worldwide computer sales. One industry analyst said that while it is a fact that the two companies are discussing an acquisition or merger, the chances of an agreement may only be about 40% at this point.

Rumours about an AT&T/NCR merger have been floating around Wall Street for more than a year. Other rumours have mentioned a merger of AT&T and Digital Equipment.

Analysts point out that one of the strongest arguments in favour of a merger with NCR is the fact that the company's computers are built in large part around the same Unix operating system being pushed by AT&T as an industry standard. That would make the integration of both company's product lines relatively easy.

Intel unveils new supercomputer

Intel has unveiled what is claimed as the world's most powerful computer, at a New York press conference. The so-called 'Delta System' runs on 528 Intel i860 RISC processors and has a top processing speed of 32 gigaflops (32 billion floating point instructions per second). The machine was custom-built by Intel for the Concurrent Supercomputing Consortium, a group of major US research institutions led by the California Institute of Technology (CalTech).

The first of the machines will be installed at the CalTech campus in Pasadena and will begin to tackle the first of a number of 'Grand Challenges.' These are as many as 20 massive research projects that are too demanding for even the most advanced conventional vector-processing-based supercomputers from Cray.

Some of these tasks include mapping the entire human gene system, modelling global climate changes and complex chemical reactions.

The development of the Delta Systems also signifies a key moral victory for DARPA, the Defense Advanced Research Projects Agency, which has been an early supporter of the development of massively parallel computer architectures. The Delta system is a spin-off of several DARPA-led massively parallel processing research projects In recent years, DARPA has been criticised by the Bush Administration for its backing of specific technologies, as opposed to conducting mainly basic research in advanced new technologies.

Intel and CalTech officials would not disclose the price of the Delta System, although Intel speculated that a commercial version of the machine would probably cost between US$15-20 million

Moore, Kilby receive top US award

Intel co-founder Gordon Moore has received the United States' highest technology honour at a special ceremony where President Bush presented Moore and nine other scientists with the National Medal of Technology.

Moore received the award in recognition of his 'leadership in microelectronics innovations of large-scale integrated memories and microprocessors.'

He joins a distinct group of 50 winners of the award, including the late Robert Noyce, HP founders Bill Hewlett and David Packard, and Apple Computer founders Steve Jobs and Steve Wozniak.

This year's recipients, besides Moore, included Texas Instruments engineer Jack Kilby for the integrated circuit which he and Noyce invented independently of each other. "The award has been limited to a relatively small group of people so far, and I think it is nice they recognised that our industry has produced some significant technology," Moore said.

The award was established in 1980 by the Stevenson-Wydler Technology Innovation Act, and was first awarded in 1985.

HDTV groups go 'digital'

The US Federal Communications Commission expects to start testing as many as six proposed HDTV broadcast technologies in the coming quarter. But in a surprise development, sponsors of four of the six proposals are scrambling to replace their current analog-based HDTV system with an all-digital system. The sudden change in strategy was brought on by a surprise last-minute proposal submitted last June by General Signal, proposing an all digital broadcasting system that would offer features far ahead of anything analog-based HDTV signals can accomplish.

General Instrument's main business has been in communications systems for the military, including advanced digital signal scrambling. The company's HDTV proposal is a direct spin-off of its advanced military communications technology. Using an all-digital signal, televisions would in effect gain the same data and image manipulation and storage capabilities of advanced computer workstations.

Until recently, the development of an all-digital HDTV system has been ruled out as the technology was considered unavailable in time to compete with the analog-based HDTV systems. But the General Signal proposal has effectively forced the other contenders to completely overhaul their HDTV proposals and change towards an all-digital capability.

Already the proposal sponsored by the NBC/Thomson/Philips consortium has announced plans to replace its current proposal with an all-digital one. Zenith officials also said they are considering such a move. Only the proposal submitted by NHK, Japan's national broadcast authority has ruled out changing its proposal.

Microprocessor inventor strikes again

Gilbert Hyatt, the obscure inventor who was recently awarded a patent for the microprocessor has been awarded a new patent that will vastly increase the processing speed of DRAM memory chips without increasing the cost of making the chips. Hyatt said personal computers and other system makers will be able to build the technology easily into their systems with little additional cost. He added that he is currently negotiating with a number of computer makers interested in licensing his technology.

The patent was awarded only three months after the Patent Office stunned the semiconductor industry by awarding the microprocessor patent to Hyatt, more than 30 years after the inventor first filed a claim for the patent.

Maxtor, Amdahl expand in Ireland

Silicon Valley high-capacity disk drive maker Maxtor is following many of its customers in opening a European production facility in Ireland.

The 77,000 square-foot plant, the first disk drive operation in Ireland, is located in Bray — just south of Dublin — and will produce Maxtor's 3.5" high-capacity Winchester disk drives which are used in high-end PCs and workstations. The Bray facility used to house a Nixdorf printed circuit board operation. The plant is scheduled to come on line in the first quarter this year and will employ some 1500 people running at full capacity.

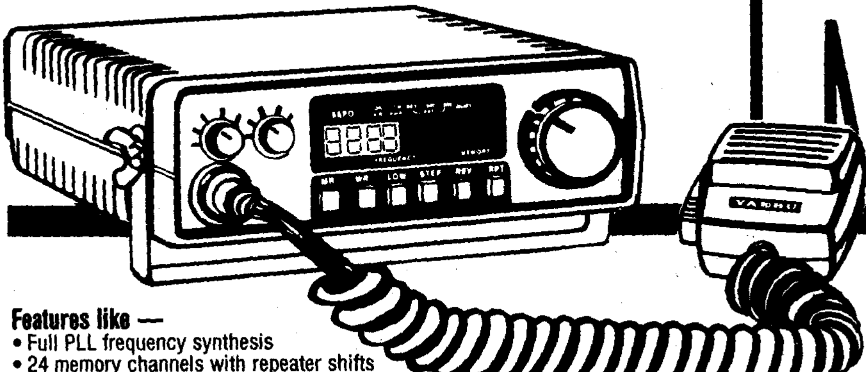
Meanwhile, mainframer make Amdahl, which was one of the first US computer makers to set up an Irish manufacturing facility, announced it is investing another US$90 million to expand its Dublin facilities. ■

KITS

Available Soon!

ALL NEW 2M VHF FM TRANSCEIVER

This outstanding high performance FM transceiver can be used as either a mobile or base station on the 144-148MHz amateur band. It must be one of the easiest transceivers of its kind to build yet it comes loaded with advanced features.



Features like —
- Full PLL frequency synthesis
- 24 memory channels with repeater shifts
- 25W or 5W switchable output
- 5kHz or 25kHz tuning steps
- Microprocessor control system
- Excessive SWR safety shut-down circuitry
- 0.15uV sensitivity at 12dB SINAB
- 30kHz selectivity at -60dB
- -60dB image rejection

At this price you can afford to take the challenge! Kit includes all components, hardware, heatsink and a pre-punched silk screened front panel. Microphone is not supplied. YAESU D-2110 or D-2105 are recommended.

Cat K-6400

$399.95

EA Feb '90

NEW!

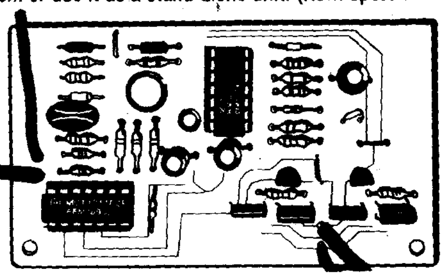
ALARM SIREN MODULE

Need an extra module for your home or car alarm? This is the perfect addition. Some car and house alarms can be disabled simply by cutting the power off. But not this one! It monitors its supply voltage for fluctuations. If the external supply is cut, or varies excessively, the siren is triggered. You can add this module to your existing system or use it as a stand alone unit. (Horn speaker not supplied)

Cat K-8250

$12.95

EA Oct '90



TRANSISTOR TESTER

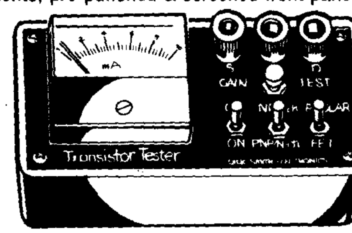
This low cost instrument will become an invaluable piece of your test equipment!
- Tests bipolar transistors, diodes, F.E.T.s, S.C.R.s & P.U.I.s
- Powered by a 9 volt battery (not supplied)
- Includes 50mm meter, all components, pre-punched & screened front panel, and case

Cat K-3052 EA July '78

$39.95

Was $46.95 Before Christmas!

Limited Stocks!



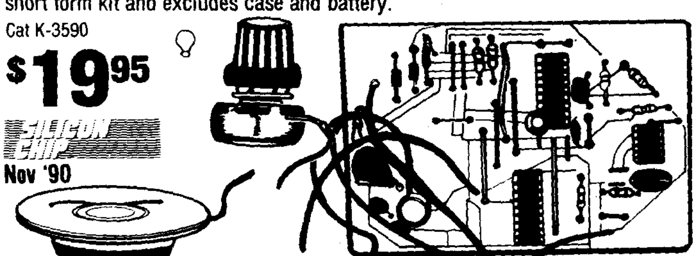
EGG TIMER

The egg that keeps time — from around 3 minutes to 17 minutes! This entire circuit is designed to fit inside a Pavlova Mix 'egg shell' pack. It even ticks while counting and gives a musical chime when your time is up. This is a short form kit and excludes case and battery.

Cat K-3590

$19.95

SILICON CHIP Nov '90



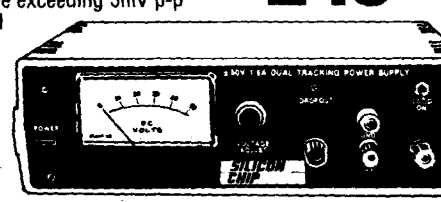
DUAL TRACKING +/- 50V POWER SUPPLY

SILICON CHIP

This switch mode power supply can really deliver the goods with variable output from 0 to 100 volts DC! Ideal for TV servicing.
- Current output is 1.7A @ 0-87V & 1A @ 100V
- Voltage is variable from 0-100V
- LED indicator for ripple exceeding 5mV p-p
- Short-circuit protected
- Pre-punched & screened front panel
- This kit is supplied complete

Cat K-3465

$249.95

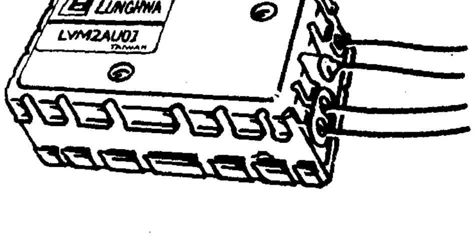


VIDEO MODULATOR

Convert your video or computer output to VHF TV signal with this single module. Comes aligned and pretuned plus it's output is switchable to either VHF Ch.1 or Ch.0. Can be PCB mounted, includes a built-in voltage regulator and RCA output socket. A data sheet for this product is available on request.

Cat K-6043

$9.95



Originally $19.95!

Kits marked with this symbol involve mains power wiring. Take extreme care when working with this equipment.

Degree Of Simplicity — Simple / Intermediate / Detailed

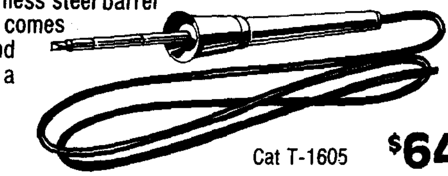
DICK SMITH ELECTRONICS

SCOPE SOLDERING IRONS

150 Watt Superscope

SCOPE

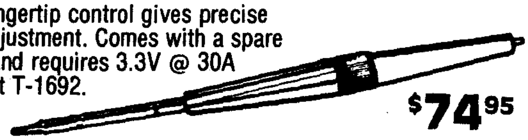
Select the temperature you want and the Superscope will deliver it from cold in just 6 seconds! Uses a non-corrosive stainless steel barrel for longer life and comes with a spare tip and element. Requires a 3.3V @ 30A transformer Cat T-1692.



Cat T-1605 **$64.95**

10-70 Watt Miniscope

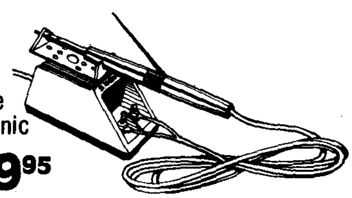
Lightweight, fingertip control gives precise temperature adjustment. Comes with a spare tip & element and requires 3.3V @ 30A transformer Cat T-1692.



Cat T-1660 **$74.95**

3.3V @ 30A Transformer

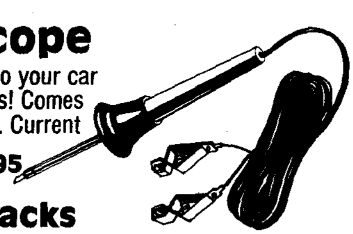
A low voltage transformer for Scope soldering irons. Includes an electronic shield for extra protection.



Cat T-1692 **$79.95**

12 Volt Superscope

A 30-150 watt iron that connects to your car battery and heats in just 3 seconds! Comes with a 6m lead with alligator clips. Current drain is 45A.



Cat T-1635 **$84.95**

Replacement tip packs

T-1601/3 **Only $10.95**

SCREWDRIVER BIT SET

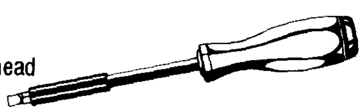
Push-Action

- 6 & 8mm flat blades
- No.1 & 2 Phillips heads
- 2 hole reamers

Cat T-4512 **$9.95**

Magnetic

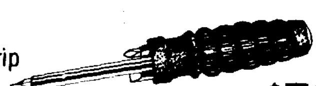
- Fully insulated with magnetic head
- 4.5 & 6mm flat blades
- No.1 & 2 Phillips heads
- No.1 & 2 Pozidrive heads



Cat T-4505 **$9.95**

5 Bit Set

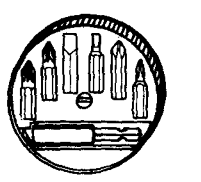
- Large rubber handle for extra grip
- 1.2, 6, 6.5 & 7mm flat blades
- No.1 & 2 Phillips heads



Cat T-4500 **$5.95**

Universal Bit Set

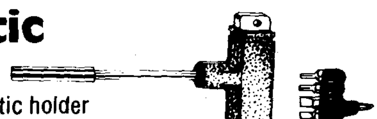
- For manual or electric drivers
- 4.5 & 7mm flat blades
- No.1 & 2 Phillips heads
- No.1 & 2 Pozidrive



Cat T-4518 **$3.95**

T-Bar Magnetic Screwdriver

- With 6 magnetic bits & plastic holder
- 2 Phillips, 2 flat, and 2 Torx bits



Cat T-4515 **$5.95**

TOOLS

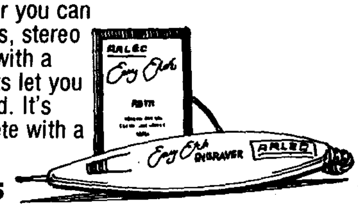
Heat 'n Strip Gun

A great tool to have around the house. Ideal for heatshrink work, removing old paint, drying... you'll find hundreds of uses for the Arlec Heat 'N Strip gun. It's mains operated & light and easy to use.

Cat T-4845 **$59.95**

Easy Etch Engraver

With the Arlec Easy Etch Engraver you can easily and quickly mark your tools, stereo equipment and household goods with a permanent identification. Steel bits let you engrave on metal, plastic, or wood. It's easy to handle and comes complete with a 12V plug pack and long cord.

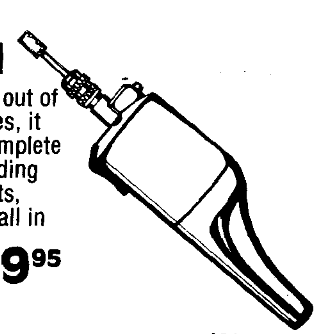


Cat T-4753 **$39.95**

Perfect For PCB Work!

ARLEC Supertool

The Arlec Supertool takes the hassle out of working on PCB's. It sands, it polishes, it drills, it engraves, it mills. Comes complete with wire brush, milling cutters, grinding wheel, high speed drills, chuck collets, eraser sticks and plug pack adaptor-all in a handy carry case.



Cat T-4754 **$79.95**

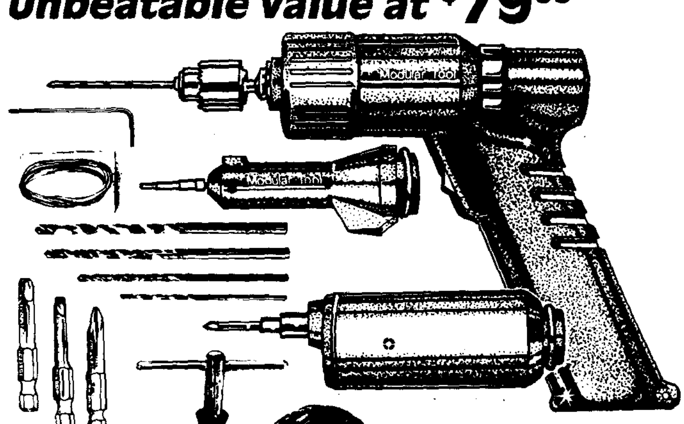
The One Tool That Does It All!

3-IN-1 Modular Tool

- It's a drill plus drill bits
- It's a Soldering Iron plus solder
- It's a Screwdriver plus drivers
- And it's rechargeable too!

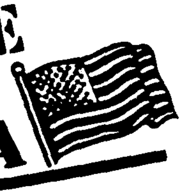
Cat T-5712

Unbeatable value at $79.95



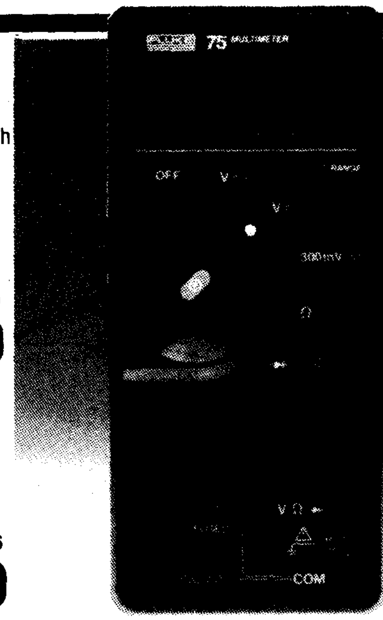
DICK SMITH ELECTRONICS

B1088/TI



MADE IN USA

3 YEAR WARRANTY!



Fluke 73

Uncompromised quality at an affordable price. The superb autoranging FLUKE 73 is just the thing to withstand the rough and tumble of everyday use.

- 3.5 digit, 3200 count multimeter
- 31 segment bargraph
- Autoranging & automatic polarity
- High energy overload protection
- Every feature on one rotary dial!

Cat Q-1602 **$179**

Fluke 75

With all the features of the FLUKE 73 plus diode and audible continuity testing!

- 3.5 digit multimeter
- 31 segment bargraph
- Autoranging & automatic polarity
- Audible continuity testing
- Diode test
- Dirt and moisture resistant case

Cat Q-1604 **$289**

The Incredible Fluke 87

You'll wish that all your test equipment could perform so well, last so long, and give you so much flexibility!

- 4.5 digit & Analogue Bargraph readout
- Auto & manual ranging
- Frequency & true RMS
- Capacitance
- Min/max average recording
- Overload protection
- Continuity & diode testing
- Touch hold
- Back-lit display plus lots more!

Cat Q-1610 **$699**

Fluke 77

The feature packed FLUKE 77 is the top of the line 70 series multimeter with advanced features like Touch Hold and superior accuracy (0.3% for 3.2 to 320V).

- Autoranging & automatic polarity
- 3.5 digit plus 31 segment bargraph
- Touch Hold with 'beep' indicator
- Continuity & diode test
- Superior accuracy across most ranges
- Hand carry holster

Cat Q-1606 **$399**

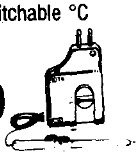
Genuine Fluke Accessories

Universal Temperature Probe

A P-N junction probe. Converts any DMM to a thermometer. Air, surface and liquids from -50°C to 150°C. Switchable °C and °F.

Cat Q-1680

$279



Air Probe

For air and other gases. Protected probe with perforated stainless steel baffle. Range: -196°C to 816°C.

Cat Q-1686 **$119**

Immersion Probe

For liquids and gels. Fully protected by Inconel sheath. Range: -196°C to 927°C.

Cat Q-1684

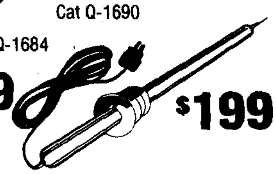
$89

High Voltage Probe

Extends your measurement capabilities up to 40K volts using a division ratio of 1000 to 1.

Cat Q-1690

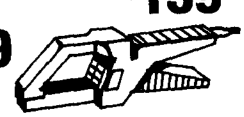
$199



AC Clamp Meter

Hall-effect clamp metre accessory with its own battery. Measures currents from 1 to 400A and fits conductors up to 30mm dia.

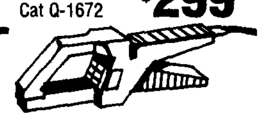
Cat Q-1670 **$159**



AC/DC Clamp Meter

Battery powered Hall-effect meter for conductors up to 30mm dia. Measures currents from 5 to 400A at frequencies up to 400Hz.

Cat Q-1672 **$299**



Deluxe Test Lead Kit

Standard shrouded banana plug leads with interchangeable tips in a soft carry pouch. Comes with alligator clips, spade lugs, standard pointed tips, and one retractable hook tip.

Cat Q-1658 **$59.95**

Industrial Test Lead Set

1.6m silicon insulated test leads with interchangeable stainless steel test probes and safety alligator clips.

Cat Q-1652

$79.95

Soft Case

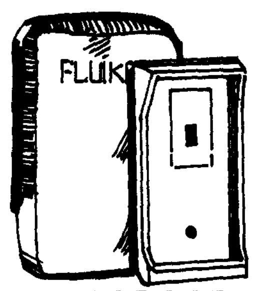
Protective case for FLUKE meters. With water resistant zipper and pockets for leads. Even fits FLUKE holster!

Cat Q-1664 **$49.95**

Holster

With lead and probe pouch plus tilt stand and belt hook. Suits any of the FLUKE 70 series DMMs.

Cat Q-1663 **$32.95**

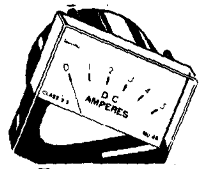


Store Locations

NSW • Albury 21 8399 • Bankstown Square 707 4888 • Blacktown 671 7722 • Brookvale 905 0441 • Bondi 387 1444 • Campbelltown 27 2199 • Chatswood Chase 411 1955 • Chullora 642 8922 • Gore Hill 439 5311 • Gosford 25 0235 • Hornsby 477 6633 • Hurstville 580 8622 • Kotara 56 2092 • Liverpool 600 9888 • Maitland 33 7866 • Miranda 525 2722 • Newcastle 61 1896 • North Ryde 878 3855 • Parramatta 689 2188 • Penrith 32 3400 • Railway Square 211 3777 • Sydney City 267 9111 • Tamworth 66 1711 • Wollongong 28 3800 • **ACT** • Belconnen (06) 253 1785 • Fyshwick 80 4944 • **VIC** • Ballarat 31 5433 • Bendigo 43 0388 • Box Hill 890 0699 • Coburg 383 4455 • Dandenong 794 9377 • East Brighton 592 2366 • Essendon 379 7444 • Footscray 689 2055 • Frankston 783 9144 • Geelong 232 711 • Melbourne City 399 Elizabeth St 326 6088 and 246 Bourke St 639 0396 • Richmond 428 1614 • Ringwood 879 5338 • Springvale 547 0522 • **QLD** • Brisbane City 229 9377 • Buranda 391 6233 • Cairns 311 515 • Chermside 359 6255 • Redbank 288 5599 • Rockhampton 27 9644 • Southport 32 9033 • Toowoomba 38 4300 • Townsville 72 5722 • Underwood 341 0844 • **SA** • Adelaide City 223 4122 • Beverley 347 1900 • Elizabeth 255 6099 • Enfield 260 6088 • St. Marys 277 8977 • **WA** • Cannington 451 8666 • Fremantle 335 9733 • Perth City 481 3261 • Midland 250 1460 • Northbridge 328 6944 • **TAS** • Hobart 31 0800 • **NT** • Stuart Park 81 1977

DICK SMITH ELECTRONICS

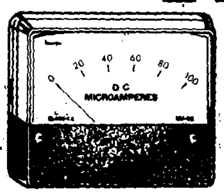
PANEL METERS FOR EVERY PROJECT

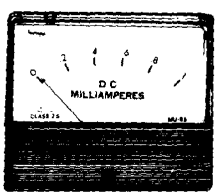
LARGE RANGE

Scale size: 96x49mm
Overall size: 100x82mm

0-100uA
Large MU-65 Type (3500 ohms)
Cat Q-2070 **$21.95**



0-1mA
Large MU-65 Type (200 ohms)
Cat Q-2060 **$21.95**

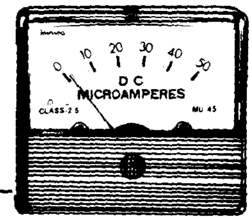


STANDARD RANGE

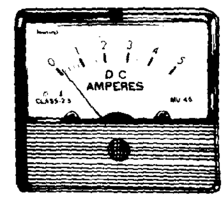
Scale size: 55x30mm Overall size: 58x52mm **$16.95 each**

0-1mA
MU-45 Type (200 ohms)
Cat Q-2010

0-50uA
MU-45 Type (3500 ohms)
Cat Q-2020

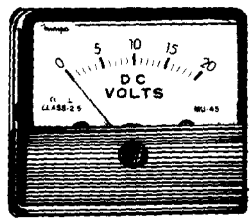


0-5A
MU-45 Type (0.02 ohms)
Cat Q-2030

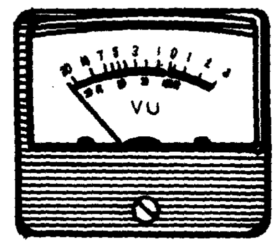


0-20A
MU-45 Type (0.005 ohms)
Cat Q-2035

0-20V
MU-45 Type (1k ohms/V)
Cat Q-2040

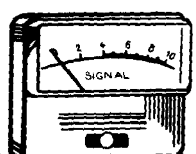


VU Meter
MU-45 Type -20 +/-3VU
(1.228V/0dB)
Cat Q-2050



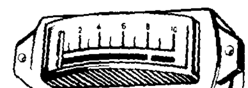
SPECIAL PURPOSE LEVEL METER

Scale size: 34x17mm
Signal Strength
250uA FSD
Cat Q-2100 **$8.95**



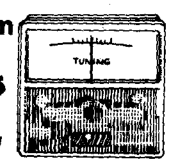
EDGE LEVEL METER

As used in many imported cassettes & amplifiers
Scale size: 32 x 10mm
500uA FSD
(450 ohms shunt)
Cat Q-2110 **$8.95**



CENTRE ZERO METER

Scale size: 34x17mm
Cat Q-2095
Limited Stock! **$2.95**
Great Value!



DICK SMITH
ELECTRONICS
PHONES
TOYS & LEARNING
SECURITY
AUDIO
COMMUNICATIONS
COMPUTERS
HOME ELECTRICALS

DS XPRESS PHONE & MAILORDER SERVICE
Outside Sydney (FREE Call) 008 22 6610·Sydney And Enquiries - 888 2105
FAX: (02) 805 1986 or write to DS XPRESS, PO BOX 321 N/RYDE NSW 2113
All Major Credit Cards Accepted. O/Nite Courier Available.
24 HOUR DESPATCH OF ALL ORDERS

MAJOR DICK SMITH ELECTRONICS AUTHORISED STOCKISTS:

N.S.W.: ARMIDALE: New England Electronics 711655 BALLINA: Ballina Electronics 867022 BEGA: OZTECH Electronics 923933 BOWRAL: F.R.H. Electrical 611000 BROKEN HILL: Hobbies & Electronics 884098 COOTAMUNDRA: Cootamundra Music & Lite 422561 COFFS HARBOUR: Coffs Harbour Electronics 525684 DENILIQUIN: Deni Electronics 813672 DUBBO: Chris's Hi Fi 828711 FORSTER: Forster Village Electronics 545006 GLEN INNES: John Sommerlad Electronics 323661 GRAFTON: Repairs and Spares 421911 GRIFFITH: Miatronics 624534 INVERELL: Inverell Electronics 221821 KEMPSEY: P&L Leonard 631134 LEETON: Leeton Audiotronic 532800 LIGHTNING RIDGE: Cycle & Sound 290579 LITHGOW: Douroy Photographics 513173 LISMORE: Decro Electronic Services 214137 MOREE: Moree Electronics 522091 MUDGEE: Headware 723895 NARRABRI: Namoi Computer Service 923274 NELSON BAY: Nelson Bay Elect & Hobbies 813685 NOWRA: Nowra Electronics 210722 ORANGE: Central West Electronics 626491 PARKES: Strad Music Centre 623366 PORT MACQUARIE: Hastings Computer Service 834574 RICHMOND: Silicon Crafts 784101 TAREE: Brads Electronics 526603 WAGGA WAGGA: Phillips Electronics 216558 WELLINGTON: Wellington Service 452325 WINDOR: Silicon Crafts 776722 YASS: Warmington Electrical 261116 YOUNG: Keith *Donges Electronics* 821279 **VIC:** BAIRNSDALE: LH & LM Crawford 525677 COLAC: Colac Electronics 312847 MILDURA: Pullman Auto Pro 232882 MORWELL: Morwell Electronics 346133 SHEPPARTON: Andrew Guyatt Electronics 219497 SWAN HILL: Nyah District TV Service 329303 TRARALGON: Traralgon Electronics 741699 WARRAGUL: Roylaine 234255 WARRNAMBOOL: Koroit St Elec Services 627417 **QLD:** AYR: Delta Electrix 831566 BOWEN: Bowen Electronics 861656 BUNDABERG: Bob Elkin Electronics 521785 CALOUNDRA: Electro-mart 918533 DYSART: Dysart Videotronixs 582107 INGHAM: Masons Electronics 763188 INNISFAIL: Innisfail Hi-Fi 612014 MACKAY: Stevens Electronics 511723 MARYBOROUGH: Keller Electronics 214559 NAMBOUR: Nambour Electronics Shop 411604 PIALBA: Keller Electronics 283749 STANTHORPE Granite Belt Communications 813333 **TAS:** BURNIE: Electronic City 314760 DEVONPORT: A.I.Electronics 248322 **SA:** MT GAMBIER: Hutchesson's Communication Centre 250400 PORT LINCOLN: Basshams *TV & Comp World* 822788 WHYALLA: Eyre Electronics 454764 **WA:** ALBANY: Micro Electronics 412077 BUNBURY: Micro Electronics 216222 GERALDTON: Batavia Lighting & Electrical 211278 KALGOORLIE: Today's Electronics 215212 KARRATHA: Daves Oscitronic 854836 MANDRAH: Micro Electronics [illegible] PORT HEDLAND: Ivan Tomek the Elect 732531

ORDER BY PHONE OUTSIDE SYDNEY (008) 22 6610 FREE CALL — SYDNEY AREA 888 2105

YOUR EIGHT SPECIALTY STORES IN ONE!

B1088/MS

The Serviceman

The strange cases of the hiccupping twins and the amp that kept going BANG!

This month we have an intriguing story from one of our regular contributors, plus a couple of stories from my own bench — one of which involved identical faults in two different but closely related colour TV sets. I also have to apologise for having overlooked a simple explanation, in a previous story. What more could you ask for?

I had a really odd coincidence in my workshop recently. The story is not all that involved, but it does provide an opportunity to discuss some fault-finding tricks that might be useful to readers.

A customer brought in a middle-aged Kriesler colour television one morning. It was a 59-09 model and one that I hadn't struck before.

His definition of the fault was 'It doesn't go'. This was a reasonable conclusion for a customer, but not for a serviceman. The set was certainly 'going', although not in any way that would please an owner. It was hiccupping!

In Kriesler sets — and in their close cousins from Philips — hiccupping is generally caused by overcurrent in the deflection circuits. The most common faults are shorted line output transistors or triplers. Both of these items are easy to test. A simple continuity test from the line output transistor collector to ground will show if this component is sound or not. The resistance should be many thousands of ohms. Anything less than 5000 ohms should be suspect, and is grounds for the transistor to be changed.

Removing the overwind lead to the tripler and then switching on will soon show if *that* item is faulty. If the set starts up normally, but without a picture, then the tripler is crook.

On the other hand if the set continues to hiccup, then the tripler is probably OK and one must search elsewhere for the problem.

In these sets there are a whole range of positive and negative secondary voltages generated from the line output stage. A short on any of these will load the power supply to the point where it will start hiccupping.

A fairly common problem is a short circuited feed diode to the 250V rail. This allows raw AC to reach the filter capacitor and does nasty things to that component as well.

Usually, a hiccupping power supply shows that the supply is working and is doing its job properly. The hiccup is a safety measure that protects the set from dangerous currents in the event that a short circuit develops in one of the output stages.

Just the same, I have found a supply that hiccupped by itself and this turned out to be a shorted diode between the two halves of the main filter capacitor. But power supply faults are very rare and it's best to look around the line output stage for the real cause of the trouble.

The problem with testing in a set that is hiccupping is that the main rail voltage is jumping up and down, and this makes any meter readings meaningless. The main rail in this Kriesler should be 155V, but will only reach about 80V before the supply switches off and allows the rail to drop back to about 20V.

In some cases you will be able to see the auxilliary rails coming and going with the hiccup, but the lower voltage rails generally don't have enough energy to deflect a meter. And digital meters are usually too slow to respond at all.

About the only test instrument that has any real use in this situation is the oscilloscope. This can give some idea of the line output waveform, and with experience this can point to the cause of the trouble.

Unfortunately, the waveform only appears briefly as the supply voltage rises, so one needs to know exactly what to look for. One also needs to know the proper settings to put on the 'scope, because the trace will not be present for long enough to make 'real time' adjustments.

In the subject of this story, the waveform showed an unusual double spike. There should have been a single, narrow, 1000 volt pulse but this one was preceded by another 400 volt pulse, as shown in Fig.1.

At first I thought that my scope was not being properly triggered, but no combination of settings would change the pattern.

I couldn't imagine what I was looking at, because the usual indication of a fault in the line output stage is a weak main pulse followed by severe ripple right up to the next pulse — as in Fig.2. This pattern wasn't anything like that.

I had by this time tested all the

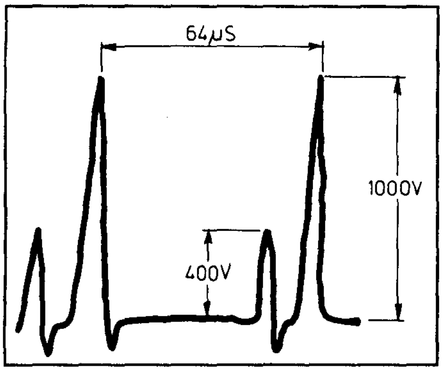


Fig: 1. In the faulty Kriesler, the usual 1kV pulse was preceded by a similar 400V pulse. (Or perhaps the small pulse lagged 50us behind the main pulse!)

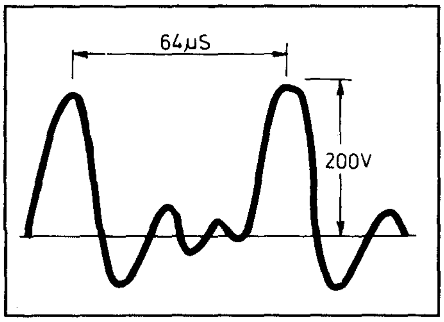


Fig: 2. Most line output stage troubles produce this kind of distorted pulse.

diodes and filter caps on the subsidiary rails and I had checked for shorts on everything that could possibly cause the hiccupping. I came to the conclusion that the fault was only present under load, and that called for a different approach to fault finding.

What I needed was a steady supply voltage. It need not be the full 155V but it must not be subject to the variations that result from a hiccup. In the past I have used a crude external DC supply for this purpose and I planned to do the same in this case.

But before that, I decided to try one trick that works in some other types of circuits.

I have found, in sets using a series regulator type power supply, that feeding the set with something like 150 volts AC from a Variac will often output a DC voltage low enough to enable some testing before fuses blow or things start melting. I wondered if this might work in the case of the Kriesler. I don't know why I decided on this test, because there was no reason why it should work.

The Kriesler uses a chopper type supply, designed to output standard voltages despite wide fluctuations in mains input. It will usually work down to 170-180 volts AC input and strictly speaking, should shut down at anything less. But it was worth a try.

In fact, the supply continued to run, but stopped hiccupping when the input got down to 160 volts. What's more, the smaller pulse in the line output waveform disappeared at the same time, leaving only a single, slightly reduced main pulse. I half expected a shrunken picture to eventually appear, but nothing of that kind happened.

The set continued to work on like this for five minutes or more. I was able to measure most of the voltages around the chassis and found them all to be lower than expected, by approximately one third.

I wasn't surprised by their value, seeing that the input was down by one third, but I was surprised that they were there at all! It was as though there was nothing wrong with the set!

While I was standing there, gazing into space and pondering the problem before me, I saw a tiny, threadlike wisp of something drifting up from the interior of the set.

By changing my position to get the wisp in front of a darker background, I could see that it was smoke and it was coming from the direction of the line output transformer.

I let the set run on and the smoke got a little thicker every minute. After a quarter of an hour it was quite obvious that it was coming from the transformer and that the transformer was defective. So out it came!

The overwind was a bit warm to the touch but no warmer than I would have expected from any transformer that had just run for 20 minutes or so. But the clincher was a small black hole on the side of the overwind.

This Kriesler was fitted with a Philips KL9A chassis, and these are not all that common on my patch.

I certainly didn't have a replacement transformer for it, so I moved the set into storage and placed an order for a new tranny.

That was before lunch. After lunch, a customer brought in a Philips TV which he said was 'ticking'. This was a CJ631, again fitted with a KL9A chassis.

To save me typing in the second story in all its finnicky detail, you should read the previous thousand-odd words again, substituting the name 'Philips' for 'Kriesler'.

It was exactly, *precisely* the same story — even down to the small black hole in the same place on the line output transformer. As I said earlier, KL9A's are not all that common around here, but I had to get two of them with the same fault on the same day!

And of course I had to place another order, for another transformer!

Camera revisited

Now to my second story. In the June 1990 edition of *EA*, I related a story about the local pub's CCTV camera and the difficulty I had in restoring proper focus after fitting a new camera tube. There's been an inexplicable follow-up to that story.

Last week I called in to the bottle shop to pick up my regular order and the manager told me that the CCTV system was not working too well. "It's very fuzzy", he said.

I wandered up into the Bar and found the monitor turned off. The barman said that the picture was so bad that the staff preferred not to use it.

When I turned the monitor on, I found the picture to be every bit as bad as they said it was. The focus was grotesque.

Back in the bottle shop, I connected the camera to my portable monitor and proceeded to adjust the focus.

I had the feeling that the trouble might be the electrical focus, but that control was tucked away inside the casing. So I tried the mechanical focus first, because both controls were easier to get at than the internal one.

The front focus, on the lens mount, had no effect on the picture. The image did change, but so little as to be quite ineffectual.

At the back focus control, I had the choice of making the adjustment in either of two directions.

Murphy saw to it that the direction I chose was the wrong one, and he also saw to it that I'd misinterpret the result of that adjustment.

What I had done was to move the tube forward, and, as it was already so far forward that the picture was totally blurred, there was no apparent change on the monitor. From this, I assumed that either it was the electrical focus after all, or else the new tube had dropped its bundle (and just a month out of warranty, too!).

I was about to remove the camera from its position among the $50 and $100 bottles when I realised that I still hadn't tried the last remaining adjustment — the opposite to the one I had just done.

And as I pulled the tube mounting backwards the picture started to become clearer. So the problem was mechanical after all! I continued winding the back focus knob until the tube was some two millimetres behind its original setting. And at this point the picture was perfect.

Now, if you remember the June story, I had to move the tube *forward* two millimetres to get good focus. This time I had to move it *backward* two millimetres to get the same effect.

I suppose it's possible that someone in the hotel had been fiddling with the camera, resulting in the out-of-focus condition. But then how come the readjustment needed was exactly the opposite to that which I had had to make in my workshop some months previously? I don't know if there is a Gremlin in that camera, but there *is* something in there playing ducks and drakes with my adjustments!

And while I'm on the subject of CCTV cameras, I have to admit to a slightly red face over an item in the August column.

You will remember the story from a reader about the camera that kept flipping the image upside down. At the time we assumed that the provision of the inverted mode was to accommodate 'terrestrial' lenses where these might be fitted to the camera.

Several readers have asked why the mode could not have been provided to allow the camera to be mounted upside down, under a shelf or ledge etc.

Of course there is no reason at all why this isn't so, but I just couldn't see it. I suppose my years as a practical photographer blinded me to any possibility other than the inverting lens one.

Sorry about that. I'll try to keep my prejudices to myself, in future!

'Exploding' amp

Our contributor for this month is L.K., of Daintree in Queensland. He is no stranger to these pages, having supplied several stories over the past year or so. His yarns usually show a droll sense of humour and are a lot of fun to read. This one conjures up all sorts of amusing pictures:

I answered the phone myself, as Mrs L.K. had slipped out of the shop for a few minutes, apparently to appease the Bank Manager.

The female voice at the other end of the phone was requesting a service call on a hi-fi system. In answer to my query as the particular complaint, she replied "It goes BANG!", with astonishing emphasis on that last word.

I could faintly hear music in the background, and asked if it was coming from the offending equipment.

"Yes", she answered, "and if you wait a moment you should be able to hear it. The music distorts just before the noise and it's beginning to distort now".

At that moment a noise came through the earpiece with unbelievable violence. I could scarcely believe a telephone to be capable of such a response.

Transferring the receiver to what was now my only good ear, I requested that she turn the set off immediately, adding that I would call later in the day but with the prospect that the amplifier at least would have to come to the workshop.

It was fairly late when I arrived at the house. The woman who had phoned was out, but her two teenage sons had been instructed to expect me. They ushered me towards a rather elaborate rack mounted system, connected to two column speakers taller than myself.

Judging by the heatsink area of the amplifier, it would have done justice to a Rock band. I estimated that it would be capable of around 100 watts per channel. I switched it on, with the volume control turned well down.

It was of some obscure make and while I awaited the action, I enquired as to it's origin. "Dad brought it back from the USA a couple of years ago", one of the boys answered. "It makes a WOW of a noise when it goes off!"

I could detect an air of youthful exuberance in the tone of voice which I did not share, as I waited in trepidation for the event to come.

After only a few minutes the sound began to distort, as I had been warned. Although braced for the noise, I still reeled as both columns let go simultaneously.

Some seconds later, when the ringing in my ears had subsided, I realised that the set had returned to normal and was issuing forth soft music again, as if nothing had happened. "It will do it again soon", the boys laughed.

I turned the thing off immediately, considering the episode as a resounding tribute to the speaker designer — whoever that may have been. I removed the amplifier to the workshop where I had a hefty dummy load for assistance. There was no way my old ears and nerves could stand investigating the problem live.

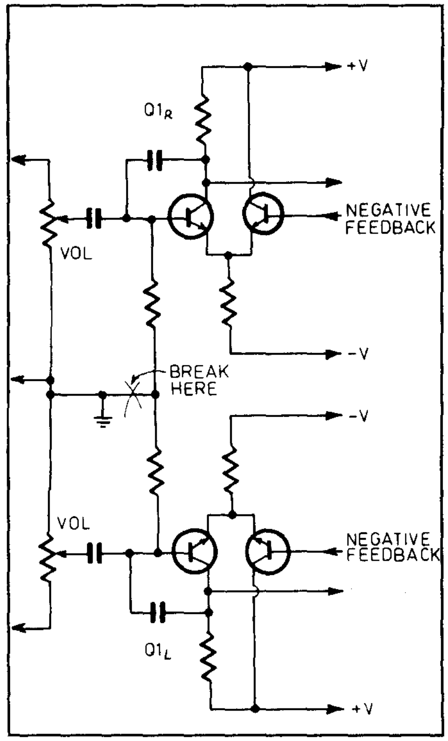


Fig:3. A simplified schematic for the input circuitry of the amplifier, subject of L.K.'s current story.

Some days later, with the set laid bare on the bench, it proved to be a rather impressive construction — comprising all discrete components and with excellent accessibility.

With the problem apparent in both channels, and almost certainly after the volume control, I suspected some intermittent in the power supply as I reckoned this to be about the only section common to both left and right amplifiers.

Alas, each amplifier had its own supply with + and - 110V rails, and a single transformer as the only other component. I felt that a fault in that massive unit was a bit remote.

With no better idea in mind, I hooked the thing up to the dummy load, attached the oscilloscope to one output, backed the volume control right off and sat back to await developments. I half expected it to be a non-event with the covers removed, but not so.

After about five minutes the output voltage began to drift slowly negative until it reached around the -100 volt mark, and the dummy load began to glow alarmingly! I was about to hit the panic button when the voltage *shot violently in the opposite direction before returning to zero. I felt quite unique — I had just witnessed the 'Big Bang'!*

It was while I was pondering the data and wishing for a circuit diagram to help me open the feedback loop that I spotted a blob of green corrosion. It looked quite out of place on the otherwise immaculate main board. After clearing it away with an old toothbrush dipped in CRC, I could see a distinctly jagged gap in the copper track.

The temptation was too great. I bridged the fault and tried the amplifier again, not really expecting a cure. After an hour or so without any sign of a bang, I decided to sketch out that particular section of the circuit, hopefully to establish how the fault occurred — but more particularly how it affected both channels at once.

The corrosion occurred at the point marked X on the diagram. This was the first stage of the power amplifier, which was direct coupled through to the speaker. The base resistors of Q1R and Q1L were earthed at the end of a copper track, by which sundry other components were also grounded. I presume some chemical action at the break caused an ever increasing resistance to occur, gradually cutting off Q1R and Q1L and thereby causing the distortion referred to earlier. At some point, and for reasons best known to itself, the open circuit suddenly corrected itself and produced the violent return to normal operation.

Perhaps one of your readers can entertain us with a more detailed explanation. In an amplifier as elaborate as this, I would have expected some form of protection circuitry.

If it did have such a circuit, and if it was working properly, I shudder to think of how big a bang would be needed to set it off!

For my part, the end result was a satisfied customer and that's the bottom line in any business.

What a story! I can just imagine those two teenagers running the amplifier continuously just to hear the noise it made. They probably objected loudly when L.K. brought the unit back repaired!

Still, that only goes to show that a good many faults can be found and repaired without the service manual. A knowledge of circuit operation and careful observation can often work wonders.

I hope you'll join me again next month, with further tales from the service bench. ■

Fault of the Month

Hitachi CTP2065

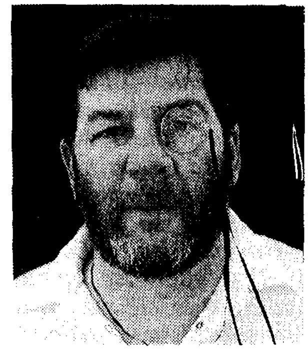
SYMPTOM: A white line appears about 75mm (3") down from the top of the screen. Above the line the picture is stretched vertically, while below the line the picture is quite normal.

CURE: C608 (22uF 160V electro) had gone low in value. This capacitor bypasses the supply rail to the vertical output transistors, and is the cause of the non-linearity when it loses capacity.

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.

Moffat's Madhouse...

by TOM MOFFAT



Range rat reminiscences

Careers in electronics can come about in several ways. You can go do your tech or uni course, and then sign on with some big company, or maybe Telecom or one of the power authorities. In to work in the morning at 8:30, out at 5:36. An hour lunch in the works canteen. The rest of the time spent at a desk, or in front of a computer. It's a good civilized way of life - security, decent hours, weekends off. Neighbours say "he's successful; he's got a steady job, a new car, a nice house".

Well, that's one way to go about it. I've only experienced that life in short bursts, appearing successful on the surface but working for fly-by-night outfits with two dollars declared capital. Here today, but if there's a little downturn in profitability — vrooom! You're gone. Such jobs can only be considered temporary at the best.

If you're going to be insecure, you might as well be insecure properly. If you're prepared to go on contract instead of permanent employment, there are jobs going begging all over the world. In the outback, on some island, or in another country. The British magazine *Wireless World* used to have pages and pages of ads for these jobs, in places like Kuwait and Saudi Arabia. As well as the insecurity, there as hazards as we all know; such as being held hostage by Sadaam Hussein.

A safer alternative is to take up employment offered by your own country, perhaps within the defence industry. Although many people may be philosophically opposed to making weapons of destruction, much of the work at these places is pure research having little or nothing to do with making war. In Australia, Woomera first comes to mind; previously wound back, but now apparently becoming active again.

My own time was spent at the American equivalent of Woomera, the Nevada Test Site, with a couple of stints on the islands of Bermuda and Hawaii. There is a common name that applies to all these places: 'test range'. The American contracts usually run for 18 months, during which time you can kiss civilization as we know it goodbye. A very few people will spend their whole working lives stringing 18-month contracts together, one after another. They are known in the business as 'range rats'.

A test range is a place where they shoot things off — be it rockets, or high speed aircraft, or chemical explosives or even nuclear bombs. Test ranges are always in isolated areas for obvious reasons. In the case of things that fly through the air, the place where they shoot them off FROM is known as 'uprange'. Where they shoot them TO is called 'downrange'. A big test range, such as the Pacific Missile Range, can be several thousand kilometres long. A smaller one could extend no more than 100km or so.

On a big test range like the PMR, most of the good technical jobs are downrange, where it's necessary to collect data from objects as they re-enter the atmosphere. On a smaller test range you could find yourself either on the shootin' end or the comin'- back-down end, depending on the project.

In almost every flight test, the object being studied is carefully followed by a tracking radar. The radar projects a pencil-thin beam of short pulses more or less at the moving aircraft or missile. The beam is 'wobbled' slightly to give an error indication of when it is exactly on, or slightly off the target. The radar has a computer which uses the error information to steer the main antenna, so it follows the object. The computer also measures the delay between when each pulse is transmitted and when it is refelected back, giving an accurate indication of the distance the object is from the radar.

During a critical operation, or test, the auto-tracking feature is usually disabled and real people take over the job of following the object. One operator tracks azimuth and elevation with a hand on each control wheel, watching the object through an optical system that follows movement of the antenna. The other operator tracks the slant range, or distance, by watching an indication on an oscilloscope.

Unexpected return

I remember one classic incident where the shootin' end and the comin'-back-down end turned out to be the same place. A test was being conducted with a beam-following missile. The plan was to lock onto an aircraft with the radar and then fire a missile up along the radar beam, to intercept the aircraft (which was an unmanned drone). The missile had a radar antenna and the necessary electronics to figure out when it was in the middle of the beam. It could then correct its course to stay there until it reached its target. The missile launcher was quite near the radar so the missile could join the beam as early as possible.

The launch went without a hitch, and the missile quickly locked into the radar beam and streaked out toward the aircraft. All went well until the range-tracking operator reported a fault: for some reason the indicated range was decreasing, instead of increasing, as the missile flew along the beam. The guy on azimuth and elevation tracking also said the missile was looking bigger, instead of smaller.

Oh-oh. Could it be? Had the missile somehow executed a U-turn? Was it still faithfully following the beam, but in the wrong direction? The order was quickly given to 'abandon ship' from the radar site, as several pairs of legs scurried into the desert at warp-9 speed. And a few seconds later, BLAM! The beam follower worked perfectly, right into the radar van. There was no explosion as such because the missile wasn't armed, but the several hundred kilos of metal flying at the speed of sound certainly made a mess of the radar. It was a complete write-off.

Running like hell is sometimes an occupational hazard on the test range, but strangely enough I can't recall anyone ever getting hurt from an operation going bung. I guess we all just kept on our toes; after all most of the work was experimental, and you never knew exactly what was going to happen.

One of my major assignments was on a project to assess the usefulness of nuclear explosives for large civil engineering works, such as dams and canals. This was done by a modelling technique, using conventional chemical explosives in tests, and then scaling up the results to nuclear size. We used pressure transducers to measure the blast effects, and high-speed cameras to photograph the explosions.

Even though they were models, the chemical explosions were still quite substantial. They always consisted of a row of 10 charges, each weighing 20kg. For each experiment the distance between the charges was varied, as were the depth they were buried at, and the timing between their detonations. I was always in the box seat to watch the fun, as the operator of the high-speed cameras about 30 metres from ground zero.

Dramatic effect

For a fixed amount of explosive, there was an amazing variation in results from one test to the next. Sometimes the explosion went off with a gentle 'whump', and the earth just rose slightly and then settled. Other times there would be a great gush of earth straight up, which then fell back into nice neat piles on either side of the trench. An instant, tidy ditch - just the result we were looking for.

But one time, with just the right combination of depth, spacing, and timing, the earth rose in a continuous slab to what seemed to be 100 metres in the air. There it dispersed into football- sized clods, before raining down on the whole area. It was all in slow motion, like a dream, and I had plenty of time to hightail it into the photographic caravan before the stuff came back down.

Through the window I could see the clods falling and exploding as they hit, and one came down square on top of the film magazine on one of the cameras, right where I'd been standing. The clod split cleanly in half; the magazine was unharmed. What if it had been my head? As for the caravan, it spent the rest of its days with some lovely dents in its roof.

Sometimes there were days when there were no operations scheduled. It was quite permissible to declare such days 'bludge days'. I could do a bit of maintenance, perhaps clean wads of dirt out of some pressure transducers, and then be off! The test range was located in high desert surrounded by even higher mountains, and it was declared off-limits to anyone who didn't work there.

It was also mining country, and back in the early part of this century little towns sprung up around the many silver mines in what was now the test range. There they lay abandoned and untouched, because the public was banned. This left us range people with our own personal fossiking grounds, and we spent many happy afternoons poking through them or just driving around the desert looking at the snow or the wildflowers.

My own expeditions were almost always solo, since I liked the feeling of knowing I was 40km from the nearest other human. There was no danger though, because the whole test range was covered by a good radio network. The radios of course provided their own diversions.

Many of the operations were conducted at night, and operators had to drive a fair distance to get to their tracking stations. Night operations also involved the use of giant magnesium-filled flash bulbs for photography; they were the same bulbs press photographers used back in the 1950's. These monsters put out an enormous flash that could blind you for several seconds.

It used to be good fun to tape a big flash bulb to the radio antenna on top of your jeep, and then when another car was coming the other way, hit the transmit button. The RF energy would cause the bulb to erupt from total darkness, blinding the other driver, and sending him spinning off into the desert.

This was really a harmless prank; since the road was in the desert, there was nothing to run into. The other driver would unleash a string of abuse over his own radio, but you'd be long gone by the time he could see again. Anyhow we were just kids back then — I wouldn't dare do such a thing nowadays, of course (would I?).

In the centre of the test range was a string of dry lakes — clay pans. When it rained or snowed, these became as slippery as ice, and we liked to use them as skid pans. We'd have competitions to see who could charge onto one at top speed and then spin the most times before stopping.

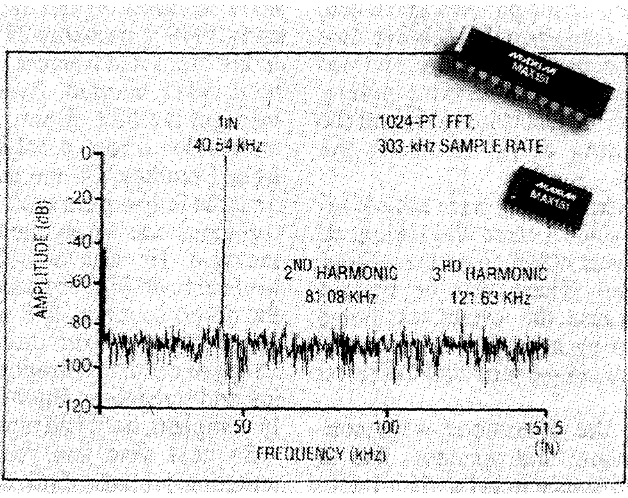
During dry periods the dry lakes made fine places to test our personal cars. Most of us were prosperous enough to have sports cars back then, and we used to run them across the lakes at top speed while a friend tracked them on radar. My own Austin Healy clocked over 200kph in this way, after an extra special tune-up.

Sound fun? You'd better believe it! Although the job security was zilch, the pay was great, and if I had my time over I'd do it all again, and more. It is habit forming, you know.

I remember one old fellow who'd been working on test ranges since the early 1940's; probably 25 years. He was in his fifties and because of his isolation he'd never married. Eventually loneliness got the best of him, and he took a mail-order bride: a roly-poly fraulein from Germany. On the day of the wedding the fellow even took a bath, and the ceremony was surely the social event of the year. He was besotted, head over heels in love. But his fraulein didn't love the desert so much, and soon the happy groom's range-rat days were over. Dragged off to civilization he was, kicking and screaming. But he couldn't really complain, he'd had a pretty good run.

So next time you see one of those tempting job ads, think carefully about it. It surely beats the pants off working in an office! ■

300kHz 10-bit CMOS A-D converter



The MAX151 is a CMOS 1.9us 10-bit analog-to-digital converter (ADC) with onchip reference and track-and-hold (T/H). The DC specifications for fast data acquisition systems and dynamic specifications for digital signal processing (DSP) applications are 100% tested and specified.

The use of a two-step, half flash technique and laser trimming result in a total unadjusted error of +/–1LSB with an input range of 0V to +5V. Alternatively, high-speed AC signals can be digitised at 300kHz throughout rates with up to 58dB signal-to-noise ratio. The internal voltage reference, built with a low-drift (60ppm/°C) buried-zener diode, and the fast on-chip T/H (5MHz full-power bandwidth) make the MAX151 a complete, easy-to-use solution that saves board space and cost while increasing system performance and reliability.

The MAX151 interfaces directly to microprocessor via a memory location or input/output port with read and chip select inputs controlling the three-state outputs. Two interface memory modes ensure compatibility with most microprocessors.

For further information circle 279 on the reader service coupon or contact Veltek, 22 Harker Street, Burwood 3125; phone (03) 808 7511.

5th-order low-pass filter

Maxim's MAX280 high accuracy low-pass filter overcomes many disadvantages of earlier designs. The switched-capacitor lowpass filter is claimed to provide 1% cutoff frequency accuracy, while literally eliminating DC offset errors. These breakthroughs make it an ideal choice for removing noise in precision measurement applications such as with weight, pressure and temperature transducers. Previous monolithic filters were not suitable for such high accuracy applications.

The filter cutoff frequency is clock tunable from DC to 20kHz and only one external resistor and capacitor are required for all applications. A buffered output is also provided in the eight pin device.

Applications include precision voltmeters, weigh scales, audio filters, and data loggers.

For further information circle 281 on the reader service coupon or contact Veltex, 22 Harker Street, Burwood 3125; phone (03) 808 7511.

High isolation video multiplexer

Maxim's MAX310 and MAX311 CMOS analog multiplexers were designed specifically for switching RF and wideband video, audio and digital signals. The MAX310 is a 1-of-8 multiplexer, while the MAX311 is for 2-of-8 (four channel differential) applications.

The significant specification for video multiplexers is 'off' isolation. The MAX310/311 features an enhanced series-shunt-series T structure which provides 76dB typical (66dB min) single channel 'off' isolation at 5MHz. This parameter quantifies the ability of an 'off' switch to block signals between one input and the output. 'All channel isolation' is also exceptional, at 63dB for 5MHz signals.

Unlike other monolithic video multiplexers, the MAX310/311 will operate with +/–4.5V to +/–18V power supplies, and will handle analog signals in the range of –15V to +12V with +/–15 supplies. The channels ON-resistance is typically 150 ohms (250 max), and the power consumption is a low 1.1mW. Break-before-make switching is guaranteed.

All control inputs are fully compatible with TTL and CMOS logic. Decoding is standard BCD format, and an enable input is provided to simply cascading of devices.

For further information circle 280 on the reader service coupon or contact Veltek, 22 Harker Street, Burwood 3125; phone (03) 808 7511.

NPN silicon phototransistors

Quality Technologies, formerly General Instrument Optoelectronics Division, has revived its range of infra red components. Included in this range are the MTS350 and MTS370 NPN silicon photoresistors, featuring a side view plastic package; an infra red built-in filter; protection against ambient light; and a black coloured case.

Absolute maximum ratings are as follows. Collector-emitter voltage is 70V and emitter-collector voltage is 7V. Collector current is 50mA. Power dissipation is 100mW, while maximum junction temperature is 100°.

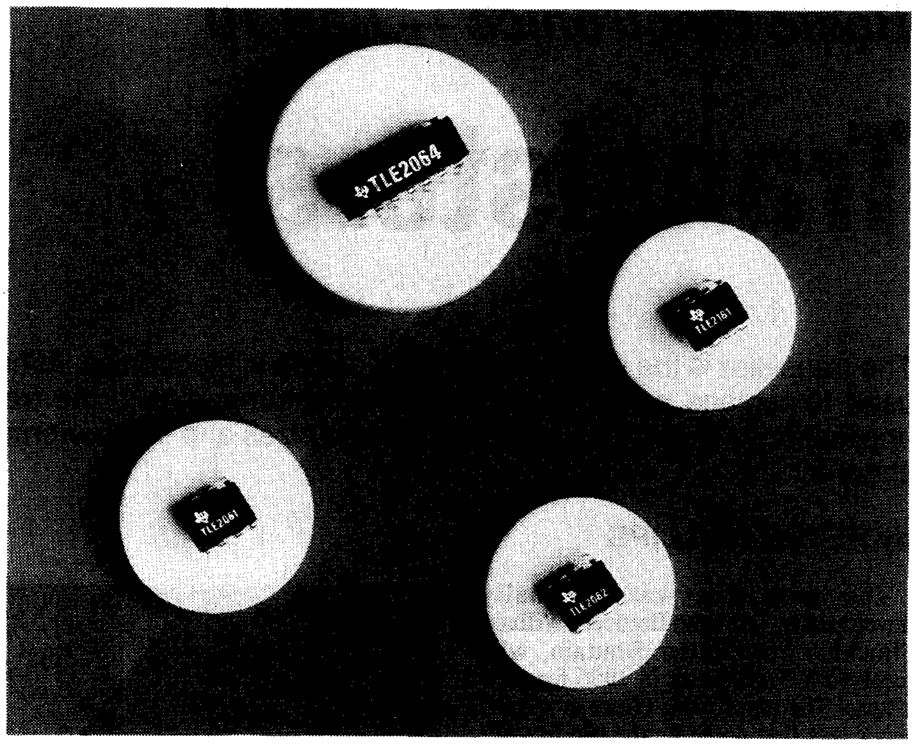
For further information circle 289 on the reader service coupon or contact Dice Engineering, PO Box 278, Lilydale 3140; phone (03) 739 5455.

JFET-input high output op amps

TI's Excalibur' TLE2061/2/4 op amps and TLE2161 decompensated op amp combine high-output drive capabilities with low distortion, making these JFET-input precision op amps useful in a variety of applications.

"In working with several customers, we identified the need for a medium-speed, low-power op amp with very good drive capability," said Brad Whitney, product manager for operational amplifiers. "Low power and high drive capability have been considered mutually exclusive, but the voice-transmission applications we were studying needed the ability to drive 100-ohm loads. Low harmonic distortion and noise specifications were required, as well."

To compliment high drive capability, the TLE206X op amps offer distinct advantages such as improved speed, precision and stability while maintaining traditional JFET advantages of low bias and offset currents. Capable of operating from a wide supply range of 13.5V to +/–22V, the TLE206X devices are well suited for power supply and other high-side monitoring and control applications.



The TLE206X series have an input offset voltage of 500uV and are capable of processing input voltages which include the positive rail. Other industry standard devices offer a limited common mode range which limits their use in these applications.

For further information circle 276 on the reader service coupon or contact Texas Instruments Australia, 6-10 Talavera Road, North Ryde 2113; phone (02) 887 1122.

Toshiba introduces 16Mb EPROM

Toshiba Corporation has introduced the world's first 16-megabit EPROM module. The new device is designed to support development of new products in such areas as advanced electronic musical instruments and laser beam printers.

The new module is pin-compatible with Toshiba's 42-pin 16M mask ROM (TC5316200P), so that users are assured of being easily able to replace the module with the less expensive mask ROM without any design modification, when they finish examining equipment functions and start volume production.

The module is fabricated with CMOS technology. Its advanced circuit technology provides high speed and low power consumption, with an average access time of 200 nanoseconds and a maximum operating current of 240mA/8.3MHz. The module is packed in a 42-pin standard ceramic package, and is organised as 1M words of 16 bits or 2M words of 8 bits. It operates from a single 5V rail and is TTL compatible.

Mass production is scheduled to begin in January 1990 at 1000 units per month.

Broadband UHF power transistor

Motorola has introduced a UFH power transistor designed for 12.5 volt operation in the frequency region of 440 to 512MHz. Important characteristics of the MRF650 include high output power of 50 watts, collector efficiency in excess of 55% and over 5dB gain while operating from a 12.5 volt supply.

The MRF650 is claimed to offer outstanding broadband characteristics and extreme ruggedness. It is Motorola's first RF device to offer guaranteed gain and efficiency specifications at three frequencies – 440, 470 and 512MHz. Survival is guaranteed for severe load mismatches even when the device is simultaneously subjected to both high supply voltage and input signals up to 2dB above normal.

The exceptional ruggedness of the MRF650 makes it well suited as a final amplifier in mobile radios. Other applications include 12.5-volt base station amplifiers and commercial and industrial amplifiers operating from 12.5 volt in the UHF band.

For further information circle 274 on the reader service coupon or contact Motorola Semicondctor Products, 673 Boronia Road, Wantirna 3152; phone (03) 887 0711.

Wide bandwidth signal multiplier

Burr Brown's MPY600 is a low-cost, low noise, wide bandwidth, four-quadrant analog signal multiplier. Its output is equal to the algebraic product of the X and Y input voltages.

Up to 30MHz, an on-board op-amp provides a low impedance voltage output. Current outputs extend the bandwidth range to 76MHz. The Burr Brown device offers improved performance over conventional circuits. It can be used for 2-quadrant or 4-quadrant applications and requires no external components.

Differential X, Y and Z inputs may be connected in a variety of useful configurations such as squarer, divider, modulator or square-rooter. The MPY600 is housed in a standard 16-pin DIP package and is available on short delivery.

For further information circle 286 on the reader service coupon or contact Kenelec, 48 Henderson Road, Clayton 3168; phone (03) 560 1011.

Basic Electronics — Part 10

Transistors

The transistor is the single most useful device in electronics. Although integrated circuits are being used to replace whole sections of an electronic circuit, the transistor is still essential in many applications. They come in all shapes and sizes and can perform many tasks as we explain in this chapter.

by PETER PHILLIPS

The transistor was originally developed by Drs John Bardeen, William Shockley and Walter Brattain, who received a Nobel prize in 1956 for their efforts. The amplifying effect of a transistor was first noted by the trio in 1947 during their research at Bell Laboratories, and the invention was announced in 1948.

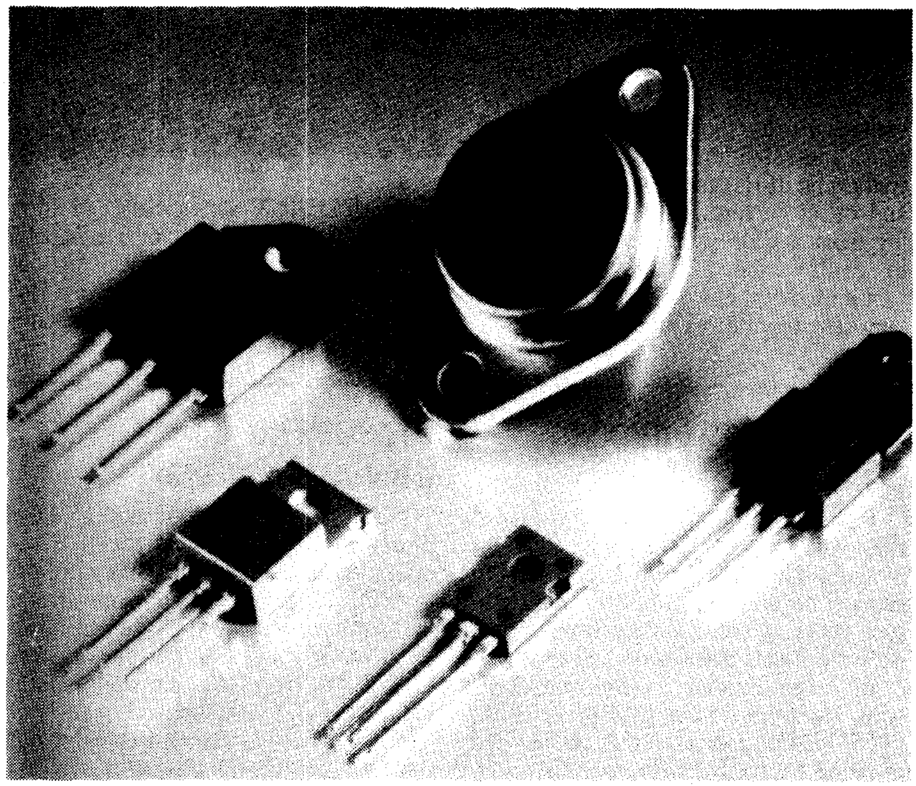
Now, over 40 years later, the transistor forms the basis of most integrated circuits. Although some believe that the individual or 'discrete' transistor is now obsolete, a look at virtually any piece of electronic equipment will soon show that transistors are still a vital component, particularly where high voltages or high currents are required.

Transistors are used in virtually every audio amplifier, radio and TV set; they're found in tape recorders, video recorders and car burglar alarms; so the list goes on.

A scan through a few issues of *Electronics Australia* will show that most construction projects need transistors, so suggesting they are obsolete is perhaps wishful thinking by those with shares in an IC factory.

The term 'transistor' really refers to a *family* of devices that includes the bipolar junction transistor (BJT) and the field effect transistor (FET). The programmable unijunction transistor (UJT) borrows the name, but actually belongs to a different family of devices. In this chapter we examine the operation of the BJT which, conforming to common usage we'll simply refer to as a transistor. In future chapters the FET and other devices will be described.

There's lots to explain, including how the transistor works, what it can do and the types available, so let's get on with it...



A brief recap

A bipolar junction transistor contains two PN junctions, hence the name *bipolar*. We explained the operation of the PN junction in chapter 7, along with a description of the term semiconductor. You might like to refresh your memory by referring back to this chapter, although a short recap is in order anyway.

There are two basic semiconductor materials in common use: silicon and germanium.

Silicon is by far the most popular, and we'll confine ourselves to this material. A semiconductor can be *doped* by adding an impurity to the basic material, which dramatically changes the characteristics of the semiconductor.

By suitable doping, P type and N type semiconductors are formed, and when these are combined a PN junction is formed.

As we described in chapter 7, a PN junction has the property of allowing current to flow one way only, and a semiconductor diode is simply a PN junction. An important characteristic is that before conduction can occur, the *barrier* voltage needs to be overcome, which for silicon is around 0.6 to 0.8V.

That is, if current is to flow in a PN junction, a voltage of at least 0.6V must be applied as *forward bias* — that is, positive at the P junction and negative at the N junction. Put another way, if there is a 0.6V drop across a PN junction (with the polarity described), current will be flowing in that junction.

If this polarity is reversed, no current flows and the junction is said to be *reverse biased*. Having made that important reminder, we can now move on to the transistor.

Transistor construction

To obtain two PN junctions at least three pieces of doped semiconductor are required, two of one type of doping and one of the other. There are two possible combinations, as shown in Fig.1. The first is shown in (a) which gives the so-called *NPN* transistor, and the other (b) is the *PNP* transistor. The symbols are also shown, along with the names given to the three terminals.

An obvious question is what is the difference between the outer pieces of semiconductor, labelled as the *collector* and the *emitter*? The answer is 'not much', and most transistors will work if these leads are interchanged. However, the transistor won't work as well, as there is usually a difference in the construction of the two junctions, determined during manufacture.

The centre piece of semiconductor material, labelled as the *base* terminal is always thinner than the outer pieces, which is essential to the operation of the transistor. Another way of looking at it is to say that the two junctions must be very close to each other in the one piece of silicon crystal — so you can't make a transistor simply by connecting two diodes together.

The first type of transistor was constructed by attaching two fine wires to a piece of germanium crystal. By ensuring the wires were very close to each other, a *point contact* transistor was fabricated. Since then, other construction techniques have been used, including the *alloy junction* type and the now popular *silicon planar* type. These construction methods are shown in Fig.2.

We'll have more to say about the characteristics of a transistor, but first let's examine how they work.

Transistor operation

To make a transistor work as an amplifier, the base-emitter junction must be forward biased and the base-collector junction reverse biased as shown in Fig.3. In this diagram for an NPN transistor, a voltage of 0.6 is applied across the base-emitter junction with positive to the base and negative to the emitter. This will cause a current to flow in the base-emitter junction, as it is forward biased.

Another higher voltage is applied between the collector- emitter terminals, with the positive potential to the collector. Because the collector is *more positive* than the base, the base is now negative compared to the collector. In other words, the base-collector junction is reverse biased.

The effect is simple enough, though rather complex to explain. When an NPN transistor is connected as shown in Fig.3(a), currents flow as shown in (b). The miracle is that the *small current flowing in the forward biased base-emitter junction allows a much larger current to flow between the collector and emitter terminals.*

If the base current is varied, the collector current will vary, and because a smaller current is controlling a larger current, an amplifying device has been created.

Why this occurs is a subject dear to the heart of many a physicist, but the fact is the important thing to understand. It all relies on the carriers within a doped PN junction, and is a quite complex piece of theory.

A PNP transistor works exactly the same way, except all the voltage polarities are reversed. And now you can see why the arrow is used in the emitter symbol, as it indicates the direction of current flow. In an NPN transistor, cur-

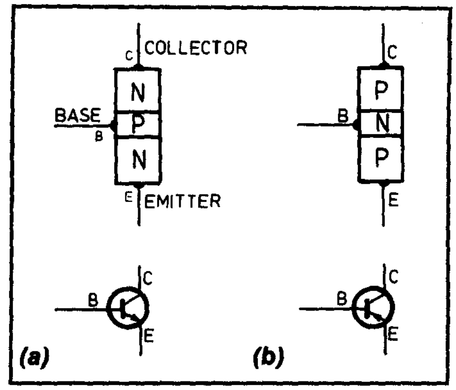


Fig.1: An NPN transistor is shown in (a) and the PNP type is shown in (b). The symbols for both are also shown and the arrows indicate the polarity of the transistor.

rent flows out of the emitter terminal and in a PNP transistor, as shown in Fig.4, current flows from the emitter terminal to both the base and collector terminals.

Now that we've explained the basic principle of a transistor, we can describe how a transistor amplifier works. In an amplifier, a *voltage* rather than a current generally needs to be amplified, requiring the addition of resistors.

Basic amplifier

To explain the transistor amplifier, let me again remind you that a PN junction needs at least 0.6V before it can conduct a current. Because a base current is required to cause a collector- emitter current, a *bias* of 0.6V is needed across the base- emitter junction.

So where does this 0.6V come from? It might come from the input voltage being amplified — but what if this voltage is smaller than 0.6V? The answer is to derive the 0.6V from the power supply to the amplifier. There are various methods of doing this, but the usual way is shown in Fig.5(a).

In this diagram, four resistors are connected around an NPN transistor. Their values aren't shown, although they can be calculated easily enough as we'll

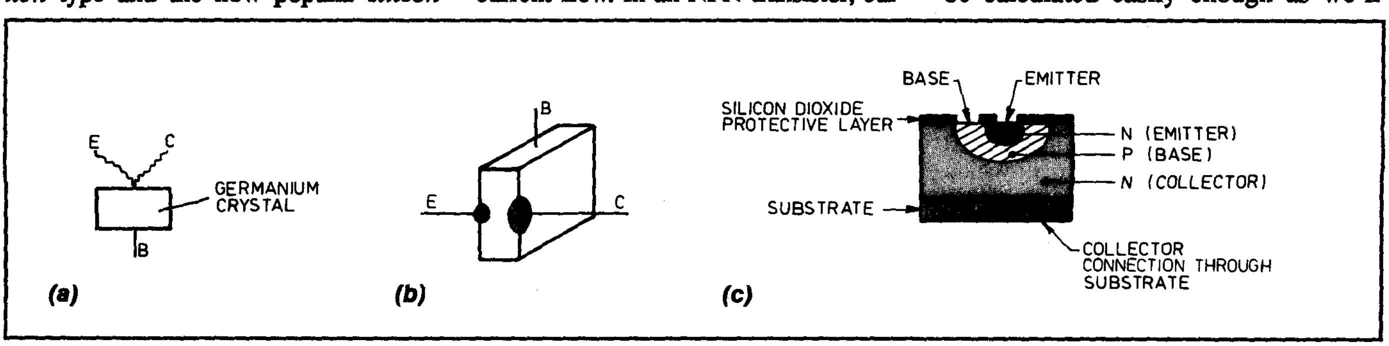


Fig.2: Most transistors are constructed using the silicon planar technique shown in (c) above. Earliest construction methods used the point contact (a) and the alloy junction (b) bypes. In all cases, the basic layout shown in Fig.1 is obtained.

show in the next chapter. The important point is that the values are chosen so that:

1. The collector voltage is approximately *half* the supply voltage to the circuit.
2. The emitter voltage is about *one tenth* of the collector voltage.
3. The base voltage is *0.6V higher* than the emitter voltage.

With this circuit, the 0.6V bias for the base-emitter junction is created by resistors R1 and R2. The current that flows in the base-emitter junction of the transistor causes a larger current to flow from the collector to the emitter. This current also flows through resistors Rc and Re, giving voltage drops that can be calculated using Ohm's law. The voltage drop across Rc will be 5V, giving 10-5 or 5V at the collector. The value of Re is chosen to give the 0.5V emitter voltage. Note that all these voltages are compared to the common line.

Because there is 0.5V at the emitter, a voltage of 1.1V is needed at the base to give the 0.6V difference between the base and the emitter terminals and R1 and R2 are selected to provide this voltage.

Now that the DC conditions are established, all that's required is to connect an input signal and to obtain an output signal.

This is achieved by connecting the input signal with a capacitor to the base terminal and extracting the output signal from the collector, again through a capacitor, as shown in Fig.5(b).

The capacitors are needed so that the DC voltages at the collector and the base terminals are isolated from the AC input signal source and the AC output load.

The circuit works on the principle that the input voltage causes the base current to vary. When the base current changes, the collector current also changes — causing the voltage drop across the collector resistor RC to change. The voltage available at the collector will therefore vary, giving the output signal of the amplifier.

For the circuit shown in Fig.5(b), the output signal is larger than the input, and also has the opposite polarity, in which the output voltage falls when the input signal rises. This is referred to as a 180° phase shift.

To understand why the phase change, consider what happens when the input signal increases from 0V to a positive value. Because the input voltage adds to the base voltage provided by R1 and R2, the total voltage at the base will increase from 1.1V to some higher value. This will cause more base current, which in turn makes the collector current increase. Because more current is flowing in Rc, a greater voltage drop will occur across this resistor. As the collector voltage is equal to the supply voltage minus the voltage drop across Rc, an increase in the drop across Rc will leave a smaller voltage at the collector.

That is, when the input voltage rose, the output voltage dropped. The same reasoning applies when the input signal drops below 0V. This time the output voltage at the collector will rise, due to the smaller value of collector current producing a reduced voltage drop across Rc.

The amplification of the circuit is found by dividing the output voltage swing by the input voltage swing. If an input signal of 1V peak to peak gives an output voltage of 10V peak to peak, the gain of the circuit is 10. In the next chapter we'll show how the gain of a transistor amplifier can be calculated, and we'll also examine some other amplifier circuits.

The main thing to realise about the circuit of Fig.5(b) is that resistor Rc has been used to convert a current change to a voltage change. A transistor is essentially a current amplifier, and as most electrical signals are voltages, resistors play a big part in an amplifier circuit.

The next important aspect is the transistor itself. We've described its principle of operation and shown how it can be used to amplify a signal. But a quick glance at a transistor data book will show there are literally thousands of different transistors on the market, all with their particular features.

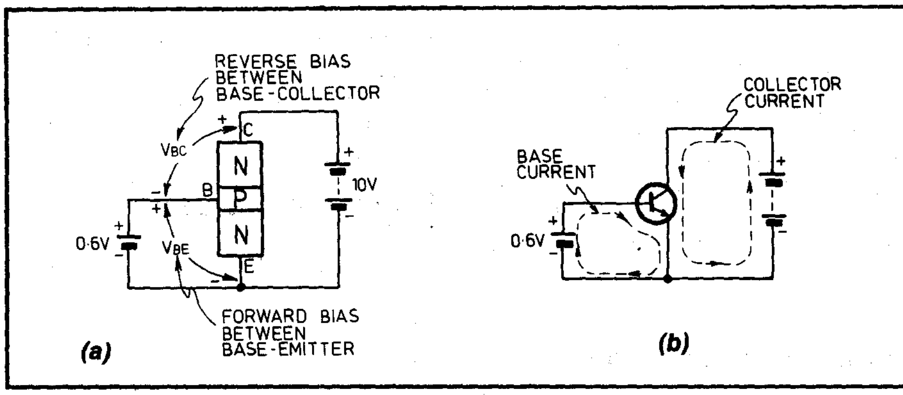


Fig.3: In (a) an NPN transistor is shown with its base-emitter junction forward biased and its base collector junction reverse biased. The operation is illustrated in (b); a small current flowing in the base-emitter circuit causes a larger current to flow in the collector-emitter circuit.

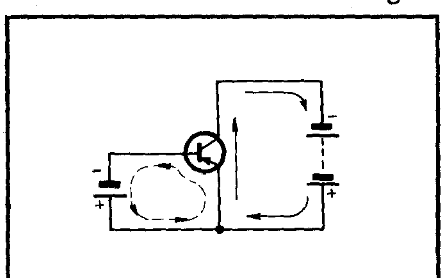


Fig.4: A PNP transistor operates the same way as the NPN type except all voltage polarities and current directions are reversed.

Characteristics

In some cases, the most obvious difference between various transistors is their physical size. Logically a larger transistor can handle higher power dissipations than a smaller one, which raises the questions: how much current can the transistor pass and how much voltage can it withstand. These are ratings that are also applied to a diode, as described in chapter 7.

Apart from current and voltage, there are quite a few other specifications applied to a transistor.

Briefly, these include its current gain, power dissipation capability, the range of frequencies it can amplify, the capacitance of the base-emitter junction and so on. In addition, the transistor case outline and its pin connections are essential information and also whether it is an NPN or a PNP transistor.

Usually unless otherwise stated, it is safe to assume a transistor is silicon, although some catalogues still include germanium types.

We'll summarise the more important specifications and explain their significance. As you become more familiar with electronics you will see that in many cases it is possible to substitute one type of transistor with another, providing you are certain the replacement type is equal to or better than the original.

Voltage ratings

Transistor specifications always state the maximum voltage a transistor can withstand, usually specified as $V_{CEO}max$. This translates to the 'maximum voltage between the collector and emitter terminals with the base open circuit'. For an NPN transistor, the collector will be positive compared to the emitter, (negative to the emitter for a PNP type), and can range from 20V to several thousand volts.

The maximum reverse voltage is often not stated, as it is unusual to operate a transistor with the supply voltage reversed.

For most small silicon planar transistors the reverse voltage is somewhere around 8V, which may seem rather low. This fact is often not fully appreciated, although some circuits use a transistor connected in reverse to act as a zener diode.

Transistor data sheets will often specify the maximum reverse voltage that can be applied across the base-emitter junction, and for most silicon planar transistors this is around 5V.

This means that if the base of an NPN transistor is at -5V compared to the emitter, current will flow in the opposite direction to the normal flow, creating all kinds of problems. Protection against the reverse bias being exceeded is essential in a circuit where there is a likelihood of this happening.

Current ratings

The fundamental current rating you need to know about a transistor is the maximum collector current it can handle. This of course, is the current that flows in the collector-emitter circuit, and for a small transistor may be around 100mA, rising to 15A or more for the larger types.

The base current to cause this is not stated in the data about the transistor, but can be determined by knowing the *current gain* of the transistor. The current gain of a transistor is the ratio of its collector current and the base current and is usually referred to by the rather obscure term h_{FE}. At one time the current gain was also known as the *beta* of the device, which is really the DC current gain of the transistor.

The term h_{FE} is the AC current gain, which is more important as most transistor circuits, such as an amplifier, operate with an AC signal.

The term h_{FE} comes from an analysis technique that uses *hybrid parameters* in a mathematical process to predict the characteristics of a circuit. Hence 'h' stands for *hybrid*, 'F' for *forward* and 'E' for *emitter*. Don't worry — we're not going to launch into high power maths, but it's interesting to know how the term comes about.

The current gain (h_{FE}) of a transistor is usually stated as being between two limits, often ranging from as much as 150 to 600. The reason for the wide range of values for a given type of transistor is that manufacturing techniques are not sufficiently refined to guarantee that all transistors of that type will have the same current gain.

So it's pot luck whether the device you purchase has a gain of 150 or 600, and the only way to tell is to measure it. Because the current gain also depends on the value of collector current, data sheets usually define the collector current that applies for the range of quoted gain figures.

As we will show in the next chapter, providing the current gain exceeds at least 100, knowledge of its actual value is generally not important.

Cases & connections

There are a wide range of case styles for transistors and other devices — some of which have become standard, others of which are in-house to a particular manufacturer.

Rather than try and explain the whole thing, we've reprinted a Reference Notebook page on case outlines originally published in the January 1989 issue of *EA*.

Transistors are identified by a type number, and the best way to figure out which lead is which is to use the case outline diagram for that device.

Over the years the same case outline has been used with different lead configurations, and this is explained on the Reference Notebook page.

Perhaps the most common transistor of all is the BC547, an NPN, small signal transistor in a TO-92 package, listed as variation 4. But notice how there are six variations for this package. Confusing! Yes...

Another well known transistor is the 2N3055, which comes in a TO- 3 package. This transistor is able to pass currents of up to 15A, and the collector terminal is the case of the device. Other popular case outlines for transistors are the TO-220, the TO-128 and the TO-18.

Other specs

Transistors are often classified according to a typical use, such as switching, high frequency amplifier, general purpose, power and so on.

A characteristic that is often important to know is the maximum frequency the device can operate to. Data sheets usually give a value called f_T, which is the frequency when the current gain falls to unity.

For example if a transistor is specified as having an f_T of 300MHz, don't assume it can happily amplify such a frequency.

In fact, its useful range is probably not much better than 3MHz, as the current gain will still be an acceptable value of 100.

The *power rating* is important as this identifies how much current can flow in the collector for a given collector-emitter voltage.

A transistor can never operate at both its maximum collector voltage and collector current, as multiplying these will always exceed its power rating.

Usually a heat sink is needed as well, as the power rating will be stated for a given temperature. For temperatures higher than 25°, the power rating needs to be reduced or *derated*.

This covers the important basic characteristics of a transistor, and in the next chapter we'll describe how to test a transistor and design a simple amplifier. ■

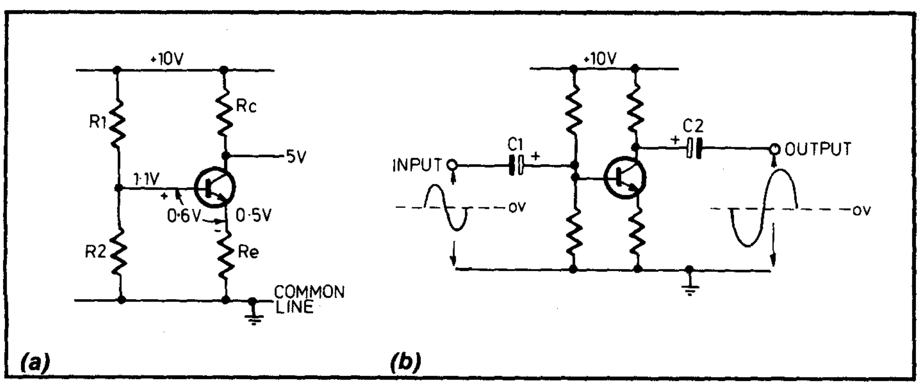


Fig.5: In (a), the resistor values are chosen to give the voltages shown in which the base-emitter junction has a forward bias of 0.6V. An input signal is connected to the base via capacitor C1 and the output is taken from the collector using C2 as illustrated in (b). This circuit is a basic transistor amplifier.

TRANSISTOR CONNECTIONS

The TO-92 dilemma

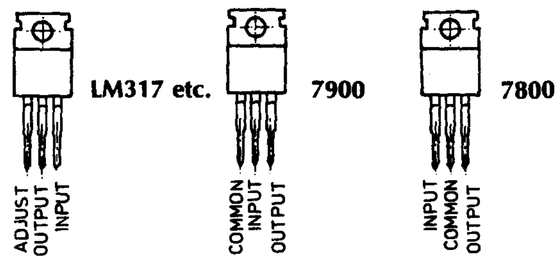
The TO-92 package is very common, but has at least six variations on the lead connections and has numerous lead forms. Transistor data books vary in their method of referring to the particular variation of the package, and some data books even leave out the variation altogether, and just state that the transistor is in a TO-92 package. A little like giving your address as 'Australia'.

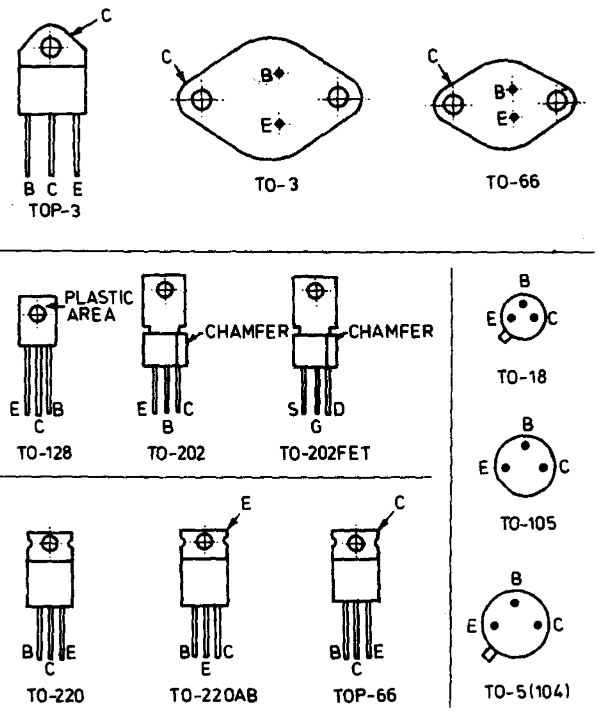
The package is used for transistors, FETs, SCRs and other devices including regulator ICs, PUTs, UJTs etc. Each pinout variation is usually shown with the terminals marked for both transistors and FETs, although not all variations have pinouts for both devices.

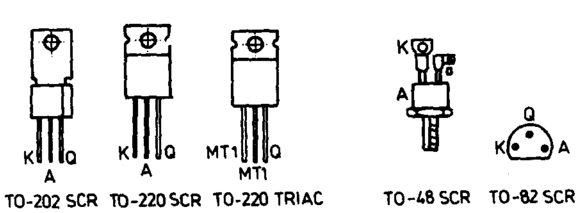
One variation is known as the standard, but it is not the most common variation. Some transistors come in two variations – for example, the BC182B has a totally different lead configuration to the BC182L, even though both are in a TO-92 package. We have even found variations referred to in data manuals that don't exist, that is, no drawing showing the lead connections could be found in the manual.

Obviously there is a slight(?) possibility of confusion – perhaps our summary below will help. Each variation that we could find is shown in two ways; as viewed from the bottom and as seen when mounted on a PCB. Next to each drawing is a listing of some transistor types that apply to that variation. We have not included FET example types, although the FET pinouts are included where applicable.

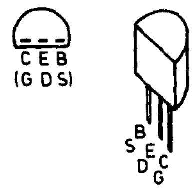
Voltage regulators



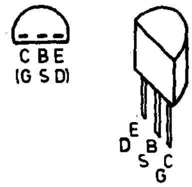




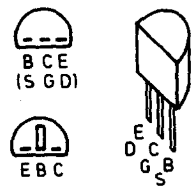
TO-92



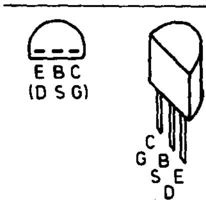
Variation 1
Also called variation 71, 96 etc.
Includes the following transistor types:
MPS6542, '6543, '6546, '6547.
MPSH10, '11, '19, '20, '24, '30.
PE3100, BF233.



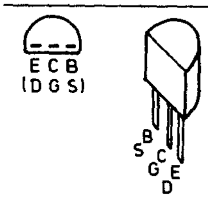
Variation 2
Also called variation 72, 92 etc.
Known as the 'standard'.
2N3641, '3642, '3643, '3903, '3904.
2N3905, '3906, '4400, '4403, '5401.
BC170, '171, '172, '173, '174, '317.



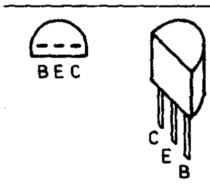
Variation 3
Also called variation 74, 94 etc.
TIPP31, '32, '11O, 117.
BC182L, '183L, '213L, '214L, '257.
BC258, '259, '635, '636, '639, '640.
2N3702, '2926.



Variation 4
Also called variation 77, 97 etc.
The most common type.
BC237B, '307B, '327, '328, '337.
BC338, '415, '485, '546, '547.
BC548, '549, '556, '557, '558.
BC559, '560. BF936, '324.

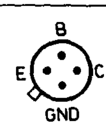


Variation 5
Also called variation 76.
2SC710. Mainly used for FETs.

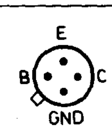


Variation 6
Also called variation 98.
BF194, '195, '196, '197, '198, '199.
BF237, '238, '240, '241, '254, '255.
BF450, '451.

TO-72

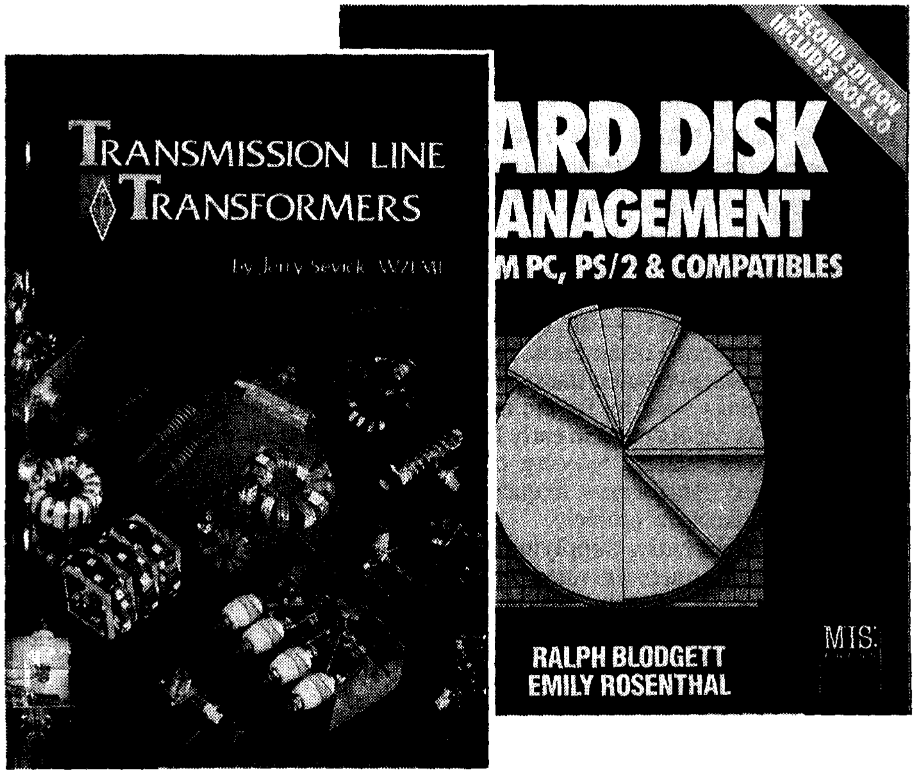


BF180
BF200



BF115
BF167
BF173
BF184
BF185

NEW BOOKS



RF line matching

TRANSMISSION LINE TRANSFORMERS, by Jerry Sevick, W2FMI. Second edition, published by the American Radio Relay League, 1990. Hard covers, 236 x 160mm, 24mm thick (pages not cumulatively numbered). ISBN 0-87259-296-0. Recommended retail price $40, including postage within Australia.

Jerry Sevick is a very well-known US radio amateur, having written many articles for the ARRL's *QST* magazine — including a very popular series on short vertical antennas. He is also a very experienced radio engineer, who worked for almost 30 years at AT&T's Bell Labs after getting his PhD in applied physics from Harvard. He has held many positions in the IEEE, and is also a technical advisor to the ARRL.

This second edition of his very well received ARRL monograph on transmission line transformers has been extensively revised and updated. In response to requests from readers of the first edition, it now includes a lot more analytical data and also details of practical designs, many of them influenced by the work of Ruthroff and Guanella — whose configurations, although they've been popular in Europe, have until recently been largely ignored in the USA.

There are 15 chapters in all, headed Analysis; Low-Frequency Characterisation; High-Frequency Characterisation; Transformer Parameters for Low-Impedance Applications; Transformer Parameters for High-Impedance Applications; 1:4 Unbalanced-to-Unbalanced Transformer Designs; Unbalanced-to-Unbalanced Transformer Designs with Impedance Ratios Less Than 1:4; Unbalanced-to-Unbalanced Transformer Designs with Impedance Ratios Greater Than 1:4; Baluns; Multimatch Transformers; Materials and Power Ratings; Simple Test Equipment; Hints and Kinks; Summary Statements; and finally, a list of the author's references.

The treatment throughout is both comprehensive and very thorough, with a good balance between both theory and practice. Very obviously the author not only 'knows his stuff', but has also built and thoroughly tested all of the transformer designs he presents. He also goes to considerable lengths to show exactly how they're built, so that the reader can duplicate them with confidence.

In short, it's now a really excellent reference on this specialised but very important area of radio transmission and reception, not just for radio amateurs but for engineers and technicians as well.

The review copy came from Stewart Electronic Components, of 44 Stafford Street, Huntingdale 3166 (PO Box 281, Oakleigh 3166), who can supply it by mail for the price quoted. (J.R.)

Hard disks

HARD DISK MANAGEMENT FOR IBM PC, PS/2 & COMPATIBLES, by Ralph Blodgett and Emily Rosenthal. Second edition, published by MIS:Press. Soft covers, 235 x 185mm, 316 pages. ISBN 0-943518-82- 2. Recommended retail price $49.95.

Not a highly technical book, this one; more a step-by-step guide to efficient use and organisation of your PC's hard disk, for the intelligent user who doesn't *want* to get bogged down in technicalities. Coauthor Ralph Blodgett is a prolific US writer on personal computing, with over 300 published articles and 11 books, while Emily Rosenthal is an accountant who has specialised in developing business applications software. She has also published two previous books on computing.

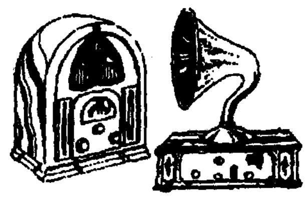
Essentially the present book is designed to show users how to choose and organise their hard disk, how to master DOS, how to instal and maintain popular applications packages, how to make use of batch files and so on. This second edition has been updated to cover DOS 4.0, and well as the newer PS/2 family of machines.

It's written in clear, down-to-earth prose, and should therefore be of considerable value to the person who wants a basic non- technical guide to hard disk operation.

The review copy came from the Australian distributor for MIS:Press, WoodsLane Pty Ltd, of 2/315 Barrenjoey Road, Newport 2106. Copies should be available at all larger bookstores. (J.R.) ■

Vintage Radio

by PETER LANKSHEAR



The curse of audio transformers

Next to valves and electrolytic capacitors, the most likely cause of a fault in old valve receivers is an open-circuited winding in an audio transformer. Many of the inter-stage audio transformers used in battery sets are particularly prone to this problem, along with early speaker transformers.

Few faults are more effective in silencing elderly receivers than open circuited transformer windings — an unfortunately all too common occurrence. Valve failures and defective audio transformer primary windings were by far the most common faults encountered in early battery receivers. Later, moving coil speaker output transformers frequently suffered from the same problem.

Until quite recently, supplying replacement transformers provided winding firms with steady incomes, especially from districts exposed to high humidity. But unfortunately for the vintage radio enthusiast, in most areas this service no longer exists.

Troubleshooting

First, a couple of hints on transformer troubleshooting, especially for beginners. Output transformers are often labelled with a resistance value like 7000 ohms. This can be a trap. It does NOT refer to the resistance of the winding, but to the reflected voice coil impedance that the transformer presents to the output valve. The resistance measured with a multimeter is unlikely to be more than 10% of the impedance.

The beginner may not be sure if he has a transformer problem, but a resistance measurement with a multimeter will soon find an open circuited winding. A good loudspeaker transformer primary will have a resistance (depending on size) of somewhere between 350 and 750 ohms, and interstage transformer windings are unlikely to measure more than 5000 ohms.

CAUTION: Do not try to operate a receiver with an open circuited output transformer primary. To do so can damage the output valve, because the absence of anode current can cause the screen grid dissipation to become excessive.

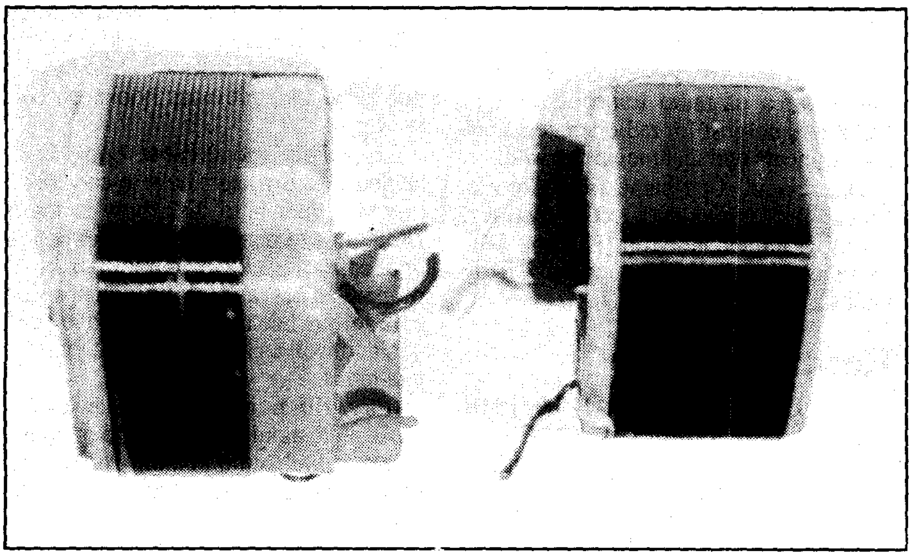


Fig.1: Two partially dismantled speaker transformers with traditional interleaved windings. That on the left shows the heavy secondary winding and interlayer paper. At the right, the secondary has been removed to show the fine primary wire. Acid reaction with the copper via pinholes in the insulating enamel frequently caused open-circuited primary windings.

Various insulations

Long before the advent of radio, winding wires were commonly insulated with natural fibres, such as silk or cotton. The threads were wound spirally along the wire, frequently in two counter-directional layers, giving rise to the descriptions Double Silk Covered (DSC) or Double Cotton Covered (DCC). Cheaper and less reliable wire used single layers of insulation, SSC and SCC.

Silk is costly, but, being finer, takes up less space than cotton. Often dyed green, it complimented the handsome appearance of the brass and mahogany 19th-Century instruments.

Generally cotton was left undyed, but completed windings were varnished or shellaced to keep out moisture. Later, synthetic fibres reduced the cost of 'silk' insulation. The most common radio applications for DCC and DSC wire were not in audio transformers, but tuning coils and large gauge windings on mains transformers.

Multi layer windings using textile insulated wires are evenly wound, layer upon layer, with very reliable results, but these wires are very expensive to produce, and in the finer sizes, the insulation occupies a large percentage of the winding space. With the 20th Century came advances in electrical technology and an increasing variety of applications for electrical windings; accordingly efforts were made to produce insulations that were more economical in space and cost.

Coating the wire with enamel proved to be a satisfactory answer. Enamel is much cheaper and thinner than silk or cotton and can be applied quickly. However early enamels had problems. Inevitably, there were pinholes, and the

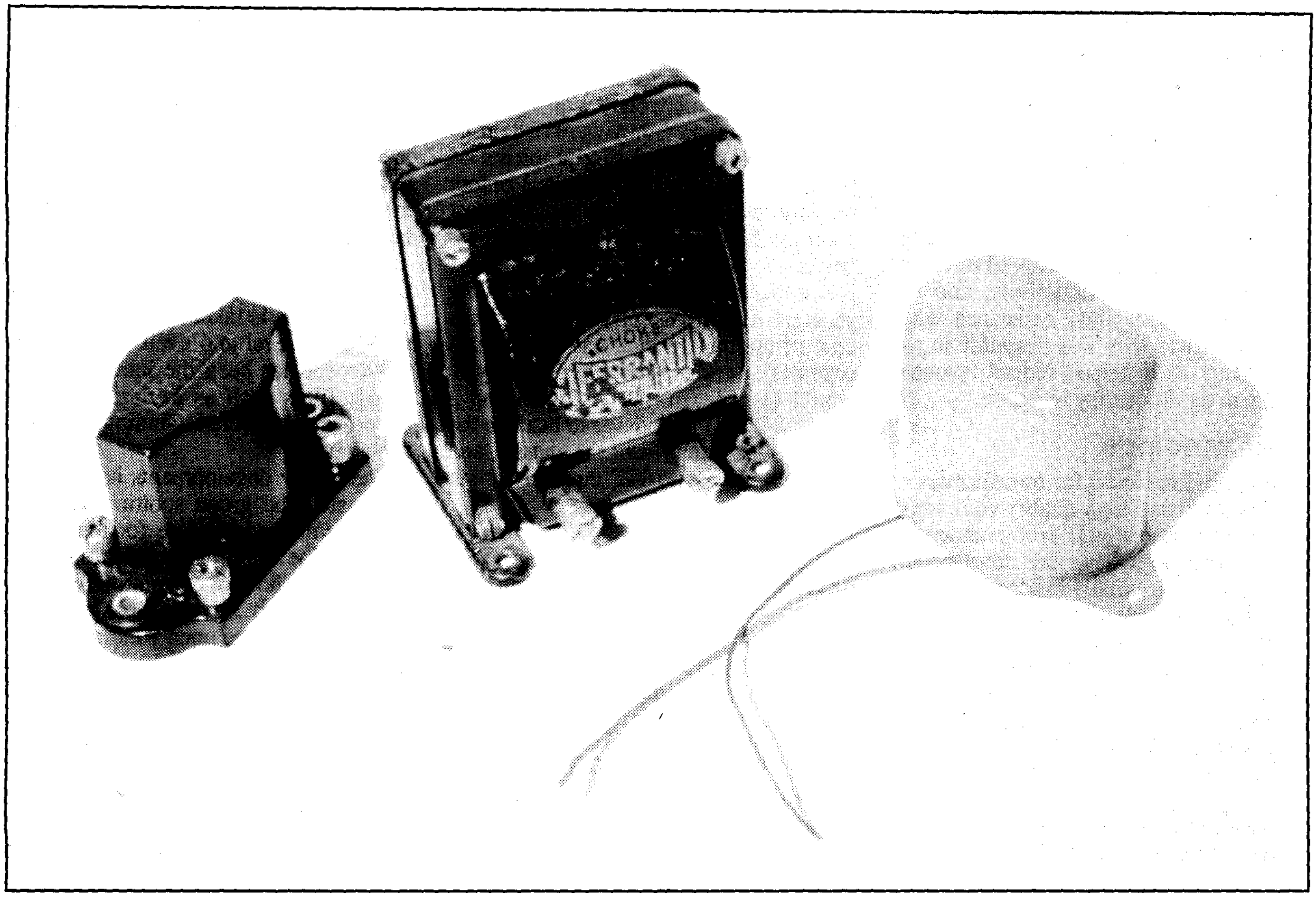


Fig.2: Representatives of three different approaches to the problem of 'green spotting'. The Philips interstage transformer on the left has a silver wire primary and an alloy resistance wire secondary; the Ferranti in the centre uses windings in narrow random-wound 'pies', not requiring interlayer paper; while the Rola 'Isocore' speaker transformer on the right uses conventional winding methods but has the core connected to the HT supply, insulated by potting it in the can with pitch.

breakdown voltage was much lower than that of the earlier coverings. The answer was to interleave each layer with 'craft' paper and then impregnate with wax or varnish. The likelihood of adjacent turns having pinholes is remote and the paper prevents interlayer breakdown.

The large numbers of mains transformers wound in this manner that are still sound after half a century confirms that enamel insulation with paper interleaving can be a very satisfactory method of construction.

Enamel, paper problems

The combination of enamel and paper was an obvious choice for the interstage audio transformers used in early radios. Not only was it cheap, but the reduction in wasted winding space resulted in more compact windings with improved high frequency response. To further reduce size as much as possible, these transformers were wound with very fine wire — commonly 44swg, which is only 0.08mm in diameter!

Unfortunately, there were serious problems not found in transformers wound with heavier wire. Audio transformers became notorious for failing, often before receivers were out of guarantee. Invariably the fault was an open circuited winding, and an autopsy always revealed the same problem: a spot of corrosion had eaten right through the thin wire. This condition was soon to be called 'green spotting'.

Eventually, the cause was found. Provided the enamel insulation was intact, there was no problem. However, pinholes were practically unavoidable, and could permit bare copper to be in contact with the interleaving paper — which, despite being made specially for transformers, still contained traces of acid.

It was usual to leave batteries permanently connected, and as switching the high tension supply was unnecessary, the primary windings had a constant positive voltage present, causing leakage through the bare spot to the paper. Although the currents involved were microscopic, a form of electrolysis resulted and unfortunately the copper suffered. Significantly, green spotting was less common in grid windings where the voltage was negative.

Various remedies

Naturally, remedies were researched. Attempts were made to exclude moisture. Sealing the assembly in pitch only locked moisture in. Saturating each layer of wire with varnish would have been more successful, but to stop a winding machine to apply a coating dozens of times to each transformer would have been prohibitively expensive. The next best thing was to impregnate the windings after completion with varnish or wax. This was a good idea and helped, but the impregnant could not be relied on to penetrate all layers.

Following on from this, windings were heated in an evacuated tank to expel all moisture and then hot wax was run in. Although this method improved reliability further, and was about as far as many manufacturers went, there were still too many failures.

Philips solved the problem in a novel

but somewhat expensive way, for their interstage transformers, notably the type 4003. On the assumption that if you couldn't keep the copper and paper apart, they reasoned that the best way was to eliminate the copper! This they did by winding the primaries with silver wire, which has good conductivity, and the secondaries with alloy resistance wire. The resistance wire was desirable in another way as it helped reduce resonant peaks in the frequency response.

'Pie' windings

The windings used for transformers in professional and high quality equipment minimised electrolysis problems in another way. Borrowing the construction method used originally in spark coils, the windings were sectionised into narrow vertical 'pies', whose chief purpose was to improve the high frequency performance. As the pies could be random wound without paper, the risk of corrosion was minimised — but of course the labour involved made these transformers very expensive too.

With the adoption of pentode output valves in the early 1930's, the interstage transformer became unnecessary but the problem hadn't gone away entirely. Speaker transformers were still necessary, and although wound with wire several gauges thicker, they were still prone to the same green spotting problems — so much so that open circuited output transformers are still one of the most common faults encountered in valve receivers.

Another approach proved reasonably successful. The reasoning was that if the core of the transformer was at the same potential as the winding, electrolysis would be reduced. Philips again had a remedy. Their method was to insulate the output transformer from the chassis, and connect its core to HT through a high value resistor.

A local solution was the 'Isocore' system used by Rola. The core was connected to the HT supply and the assembly sealed into a steel shroud filled with pitch. Failures of Isocore windings certainly seem to be fewer than with traditional methods, although not entirely eliminated.

Improved insulation

After about 1950, major improvements in enamel insulation permitted different transformer construction methods to be used. Not only are the new coatings more uniform, but they are incredibly tough. One popular demonstration is to twist two lengths of medium gauge wire together and then flatten them with a hammer. Even after such brutal treatment, a test with a 500 volt megger is unlikely to indicate a contact between the wires!

Fine gauge windings can now be piled on without the need for layer winding, although care is taken that they are kept reasonably level and even. Another improvement has been the introduction of plastic films such as Mylar, to replace paper where layered windings are still necessary.

These new developments have finally eliminated the green spotting problem, but they arrived too late for the classic valve radios. As replacement transformers are now no longer commonly available, restorers have a problem with receivers that have open windings.

Transformer rewinding is regarded by many as a black art, but in fact it a straightforward exercise, well within the capabilities of most vintage enthusiasts.

In the next of these articles I will describe how to rewind output transformers using simple equipment of the type available in many home workshops. ■

WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ...

Circuit & Design Ideas

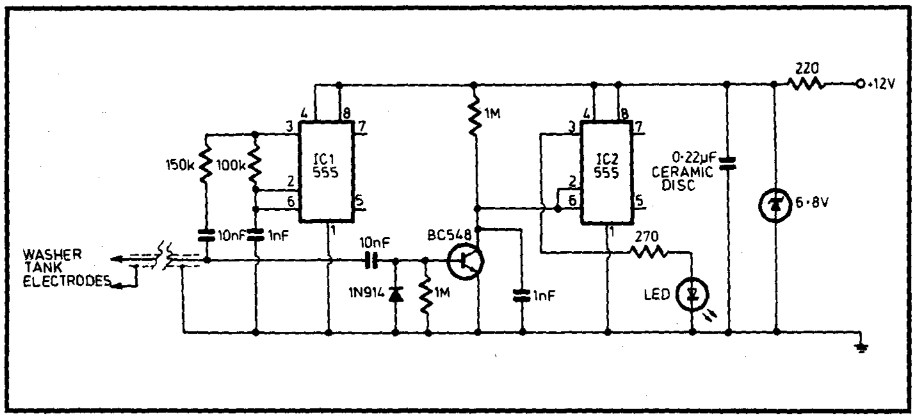
Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

Windscreen washer tank monitor

I developed this circuit to eliminate the problem of trying to use my car's windscreen washers and getting only an intermittent spray of useless froth because the washer tank was empty. Sound familiar?

The most practical way of detecting the presence or absence of washer fluid is to insert a pair of electrodes into the washer tank, a suitable distance from the bottom and monitor the resistance between them. But if DC is used to do this, various electrolytic and plating effects will occur — hence this circuit.

IC1 functions as an oscillator at about 6kHz which is applied to the tank electrodes via a DC blocking capacitor and the 150k resistor. The wash fluid resistance and the 150k resistor form a voltage divider, the output of which is coupled to the BC548 via another DC blocking capacitor which ensures that electrolytic effects cannot disturb its operation as a signal detector.



When the electrodes are uncovered, the BC548 conducts on positive half cycles, discharging the 1nF filter capacitor; IC2 is connected as a simple Schmitt trigger, which switches the LED on. The 6.8V zener diode ensures that a stable voltage is applied to the 150k electrodes voltage divider, as well as protecting the 555's from voltage spikes on the 12V supply.

For the tank electrodes I bored small holes in the plastic and screwed a pair of approx 3 x 15mm brass screws, about 15mm apart, into them. I used audio coaxial cable to connect the circuitry to the electrodes (to ensure the signal detector didn't pick up electrical noise) and terminated the cable with alligator clips which attach to the screws.

The original was built on a small piece of matrix board, wrapped in foam plastic. It is housed in a plastic 35mm film canister under the dashboard, with the LED connected via a length of light speaker cable.

If necessary the sensitivity can be adjusted by changing the value of the 150k resistor.

Bob Parker,
Carlton, NSW **$45**

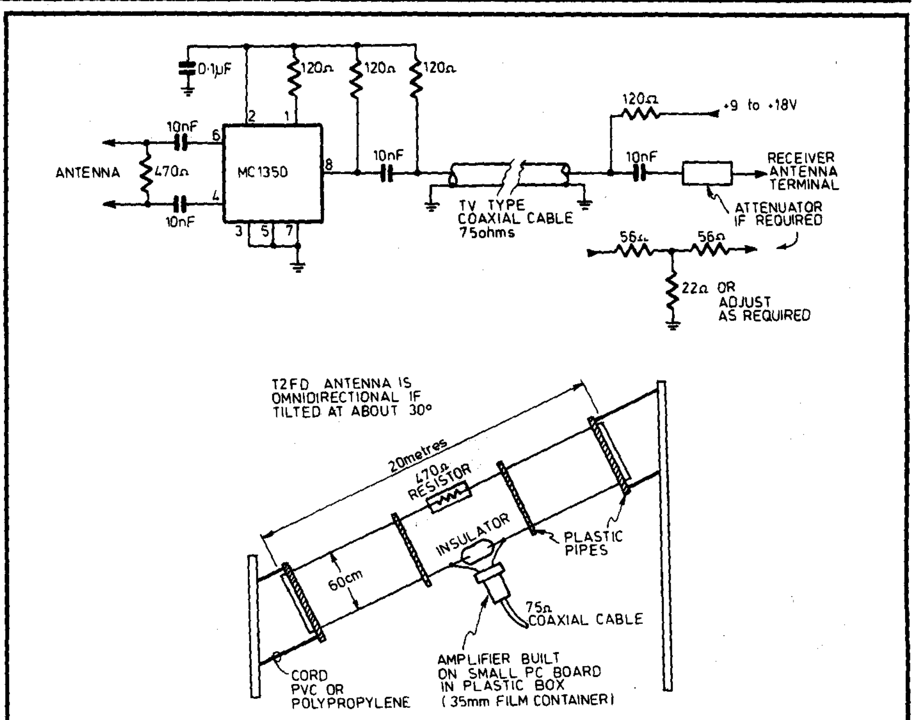
Active antenna balun/preamp

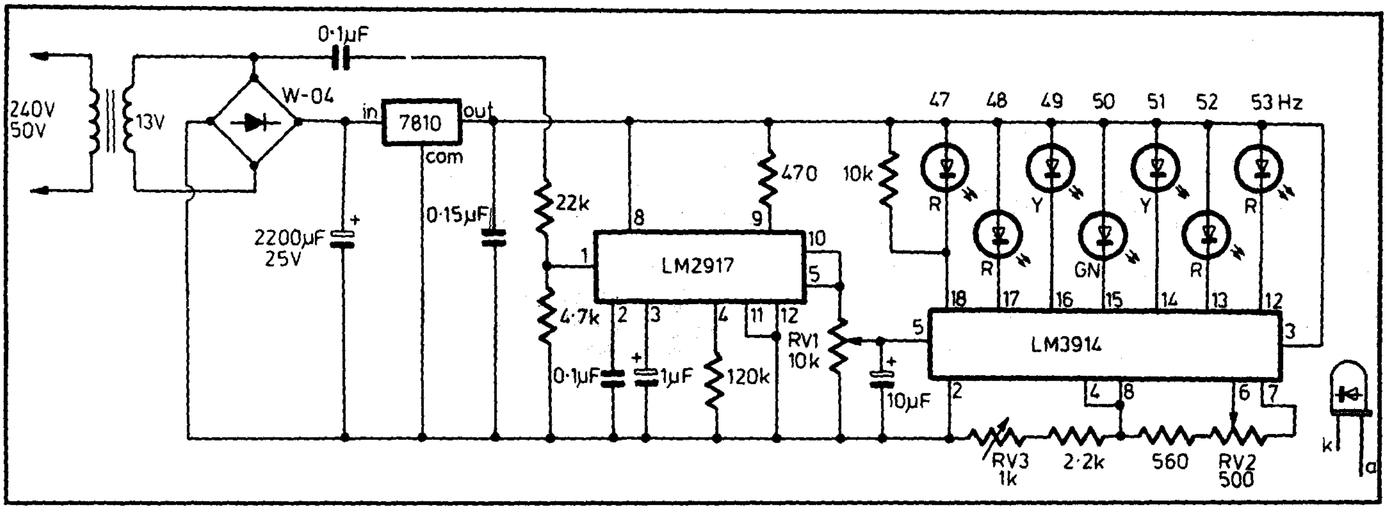
I recently erected a 'T2FD' aerial as described in the World Radio Handbook but my wife objected to it being draped over the swimming pool. So I had to erect it in a remote part of the garden, with a lengthy downlead.

As the aerial has an impedance of 500 ohms, a step-down balun is necessary. I did not have to hand a suitable ferrite ring to construct the balun, so I built an amplifier to replace the balun and counteract loss of signal on the lead in.

The circuit uses an MC1350, fed with DC in 'phantom' fashion from the receiver and via the output lead, as shown. The general physical arrangement of the antenna and balun are also shown. Coverage is 5-25MHz. With some receivers the signal may overload, so an attenuator may be needed.

Stewart Farrant,
Yangebup, WA. **$40**





Mains frequency indicator

This circuit was developed to indicate the exact frequency of a 'standby' mains power supply, as provided by the ubiquitous petrol or diesel driven alternator sets used on farms, camping parks, building sites and so on, and also by more sophisticated 'no-break' computer and medical back-up systems.

For reasons that escape me, almost without exception these devices lack a frequency indicator. Voltage, yes; even current drawn, but seldom frequency.

Bear in mind that a difference of a few hundred RPM in the speed of the customary two-pole alternator can result not only in a voltage differential, but also in a totally different supply frequency. Where inductive loads are concerned, this can be of vital importance.

This simple unit displays any such speed errors and facilitates adjustment of the driving force. It is configured such that the range of adjustment can also cover 60Hz if required.

The unit consists of two IC's and a power supply comprising a small transformer-driven bridge rectifier and regulator to provide 10 volts DC. This voltage is not critical as the ICs will operate cheerfully between 3 and 15 volts. The mains frequency is sampled from the transformer secondary and fed to an LM2917 frequency to voltage converter, via a 0.1uF capacitor and voltage divider network. The output of this IC is a faithful indication, in terms of voltage, of the mains frequency. This voltage is applied to a LED driver operating in dot mode which in turn illuminates the LED appropriate to the supply frequency.

The 10k resistor across the first LED is only required to extinguish the residual illumination due to a 100uA holding current. If ambient light conditions are high this glow may not be evident and the resistor may be omitted.

Of couse a meter may be used instead of the LED display, if desired. For calibration, first determine the level at which it is desired to change LED indication. For example, to indicate 50Hz on the centre LED of seven LEDs with changes taking place in 70mV steps, the centre LED would require 3.5V at pin 5 of the LM3914 when the supply frequency is 50Hz — i.e., 50 times 70mV. Adjust RV1 for this voltage.

Adjust RV2 for 0.7V between pins 4 and 6 of the LM3914. This represents 10 times 70mV, since the IC is capable of driving 10 LEDs, notwithstanding that only seven are used here.

Actually the whole 10 LEDs may be used if desired, or even more LM3914s cascaded to provide a display of any reasonable number of LEDs. Finally, adjust RV3 until the 50Hz LED illuminates.

These adjustments are not interactive. That is to say, one adjustment does not affect the others, and therefore they may be performed in any order.

Using the above figures the LEDs will illuminate progressively at 3.29, 3.36, 3.43, 3.5, 3.57, 3.64 and 3.71 volts representing applied frequencies of 47 through 53Hz. If using a floating input to verify operation, such as from a signal generator, fit a 22k resistor from pin 1 of the LM2917 to ground to pull the input low in respect of its DC component.

The prototype was accommodated in a small plastic case measuring 130mm x 70mm with integral IEC socket to accept the mains input. This gave the advantage of portability. Veroboard was used for mounting the ICs and discreet components and this was mounted across the case in slots provided for this purpose. With careful layout a surprising component density can be achieved by using this method.

A PCB cannot really be justified unless multiple production is contemplated. However if this is your forte, by all means.

A green LED was used for the target frequency, yellow for 1Hz either side of this and the remaining LEDs were red. These were all mounted in an arc formation. But again, layout is entirely optional.

Bob Rochfort,
Maclean, NSW. **$45**

Construction project:

Versatile, low cost Car Burglar Alarm

This new alarm offers all of the features needed for effective car security, but at a far lower price than most commercial units. It's reliable, simple to operate, and can drive a host of different warning devices.

by ROB EVANS

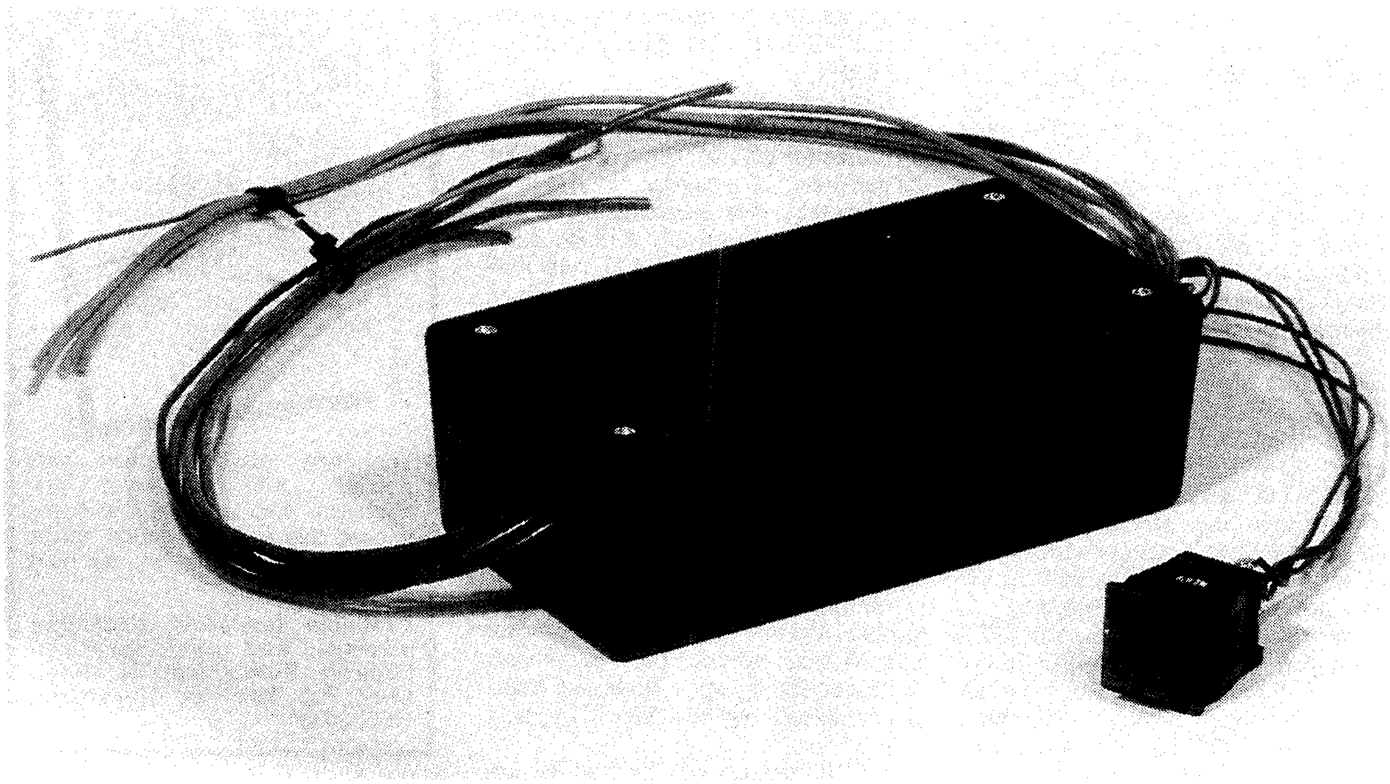
You're probably sick of hearing how many cars are stolen in Australia every few minutes, and how healthy the employment prospects are for the budding car thief. Well, here's your opportunity to both improve these statistics (from the point of view of us honest folks), and not let your car become one...

Enter the *Electronics Australia* Versatile Low Cost car alarm (hereafter known as the VLC car alarm), which will provide an effective deterrent to the most determined thief, without causing serious damage to your bank account.

This last aspect is quite important these days, with the price of commercial alarms heading through the roof and the cost of car insurance following an even steeper curve.

After checking out a number of the 'inexpensive' commercial units, it soon became clear that most units had quite limited functions, and many had the potential to be quite unreliable due to the style of their sensing circuits. That probably explains why we hear so many false alarms in car parks, and inevitably, from the car that belongs to the rotten sod who parked it outside your house or flat for a few hours. Clearly, false alarms are a pain for everybody — including the car's owner. In this light, we've taken considerable effort to ensure that the new VLC alarm will not false trigger when the car is left standing, or when the legitimate user arms or disarms the system.

To activate the alarm, the user simply presses a momentary switch on the dashboard, and then has around 10 seconds to leave the vehicle before the unit is armed — no fiddling with special key



locks or hidden switches. The alarm is deactivated in a similarly direct manner — just turn the ignition key to the accessory position.

The dash-mounted 'on' switch is incorporated into a square alarm-type warning lamp, which is arranged to flash in a number of different ways to indicate the status of the alarm. We have included one flashing sequence to indicate a very important mode: that the alarm has been triggered.

This useful feature is rarely available on commercial alarms, and lets the owner know that either someone has attempted to steal the vehicle or (significantly) that the alarm has false triggered. If this feature was fitted to commercial units, there would certainly be less false alarms, and we would take a vehicle's bleating and wailing a little more seriously. In short, car alarms would then be a much more effective deterrent.

As it stands however, you are still far better off with an alarm installed in your car. The most effective units have a number of levels of security, so that if the audible warnings are ignored or you have parked in a remote location (silly you!), the alarm will immobilise the car and make life generally difficult for the thief. These features (and more) are all available in our new VLC car alarm.

Features

Here's a list of our new alarm's features in point form, so you can scan through and see just what's available from this compact unit:

1. Simple arming and disarming: Dash-mounted push button to arm, and ignition key to disarm. The key must be held in the accessory position for a couple of seconds before the unit will shut down. An illegal user will turn the key straight through to the 'ignition' and 'start' positions, and the alarm will not be disabled.
2. Exit delay: When the alarm is first switched on, all inputs are inactive for about 10 seconds (adjustable) while the user leaves the vehicle.
3. Entry delay: The alarm will not sound for around 10 seconds (also adjustable) when the door is opened, allowing a legitimate user time to disable the alarm.
4. 'Intelligent' warning lamp which indicates various modes of the alarm: Lamp continuously on for the exit delay period; slow flashing rate when the unit is armed and has not been triggered; fast rate when the unit is triggered (during the entry delay), or when the alarm has been previously triggered. Of course, it also functions as a warning light to would-be thieves.
5. Edge driven trigger inputs: The input circuit will react to both rising and falling trigger voltages. This automatically responds to all types of vehicle wiring, and detects switches opening and closing.
6. Instant inputs: Of the four available inputs, three will immediately sound the alarm when triggered. These are suitable for boot, bonnet, tilt switches etc.
7. Reliable alarm time: Circuit uses a digital counter to control the alarm sounding time (nominally 60 seconds), rather than large value RC networks — such circuits tend to become unreliable in a harsh automotive environment.
8. Multiple outputs: Three are available — two offer sets of high current relay contacts, while the other has an open-collector switching transistor. Consequently the alarm can run a variety of devices including the car horn, flashers, a separate siren, ignition killer circuit, fuel cut-off valve or an internal piezo siren.
9. Selectable output switching rates: The drive signal for each output circuit may be chosen from three types, each of which cycles at a different rate. These are: fast (1 second cycle period), slow (8 second cycle) and continuous (the full alarm time). Each drive signal can run up to two of the above outputs, which further increases the number of possible output configurations.

As you can see, the VLC car alarm is indeed versatile and should suit almost all car security requirements. It will work well as a basic system with just the door switches as an input and the horn as an output, or as a full-blown setup using all inputs and a number of outputs to run sirens, lights and engine immobilising circuits.

How it works

At first glance the circuit may seem a little confusing, but it can be readily grouped into a number of discrete blocks which perform quite simple tasks. These are the inputs, alarm timer, clock, power supply and alarm outputs. It's both their operation, and the way the blocks interconnect that gives the alarm so many features from such a small package.

All four inputs are based around the action of the exclusive-OR (XOR) gate IC1. In a nutshell, an XOR gate will drive its output high when the two inputs are *different* — that is, one high and one low.

In the case of IC1:A, the two inputs are tied together by R2, and collectively referenced to V+ by R1 — so in quiescent conditions (when the capacitors fully are charged), both inputs are high and the output is low. If the cathode of D1 is pulled low by a trigger input, its anode will follow suit (ignoring C1 for the moment) pulling pin 9 of IC1:A *low*. C2 will then discharge via R2 and D1, holding pin 8 at a ***high*** logic level for around 80ms. Since the two inputs of the XOR gate are different during this period, the gate will deliver a 80ms pulse at pin 10 in response to the input trigger.

The nice thing about this XOR arrangement is that it will respond to both a negative- and positive-going input trigger, which is quite important for our application. As mentioned above, we want the alarm to trigger when the input changes state in either direction, such as a door opening *or* closing, and to have the ability to handle different vehicle door-switch circuits.

In the other quiescent state the cathode of D1 is normally held at ground potential, which in turn holds the two XOR inputs (pins 8 and 9) at a low logic level and C2 in a discharged state. When the input goes high (say a sensor switch disconnects ground from the cathode of D1), pin 9 is pulled high by R1 and pin 8 is held at a low logic level while C2 charges to V+ via R2 and R1. In this case the XOR inputs are at different logic levels for around 150ms, and the gate output is high for this period.

The 10nF capacitor C1 has been included to act as a high-frequency bypass, so as to reduce the chance of false triggering from stray RF sources such as a nearby radio transmitter — read: taxi cab, or mobile CBer.

The other three input stages are based around IC1:B,C and D and operate in an identical manner. Their outputs are combined by diodes D15, 17 and 19 and sent to the alarm latches IC3:A and B. Input 1 on the other hand, is sent to the alarm latch via the entry time monostable formed by IC2:B and C, which simply delays the 'trigger' pulse by about 10 seconds.

Assuming for the moment that pin 5 of IC2:B is held high, the positive pulse appearing at pin 6 (from D2) will force the gate output (pin 4) low. Since under quiescent conditions both sides of C3 are high, the low level at pin 4 will be instantly transferred to the input of IC2:C (pins 8 and 9), which in turn will drive its output high (pin 10). This voltage then maintains the high level at the monostable input (pin 6), via the pull-up resistor R3.

The circuit will now stay in this

latched state as C3 slowly charges towards V+ via R4. When the voltage at the input of IC2:C reaches the logic high threshold, its output will drive low which removes the sustained input at pin 6, and resets the monostable to its quiescent state.

We thus have a negative-going 10 second pulse, which is then applied to the differentiating network composed of C4, R5 and D4. This circuit simply passes the positive-going trailing edge of the pulse to the input of the alarm latch IC3:A via D5, and shorts the negative-going leading edge to ground via D4.

To achieve a reliable and easily programmed alarm time, the alarm latch allows a 12-stage binary counter (IC4) to count clock pulses generated from the clock generator IC2:D (more of this in a moment).

The latch is simply a D-type flipflop with the data (D) input tied high, and the input pulse applied to the clock (CLK) input. Normally, it's Q output is low — that is, in the reset condition.

When the CLK input of IC3:A receives a positive-going edge from one of the input stages (via D5, D15, D17 or D19), the logic level at the D input is transferred to the Q output — in our case, a high.

All further input pulses are effectively ignored since the output is now (already) high, and will stay this way until a high level is received at the reset (R) input, pin 4.

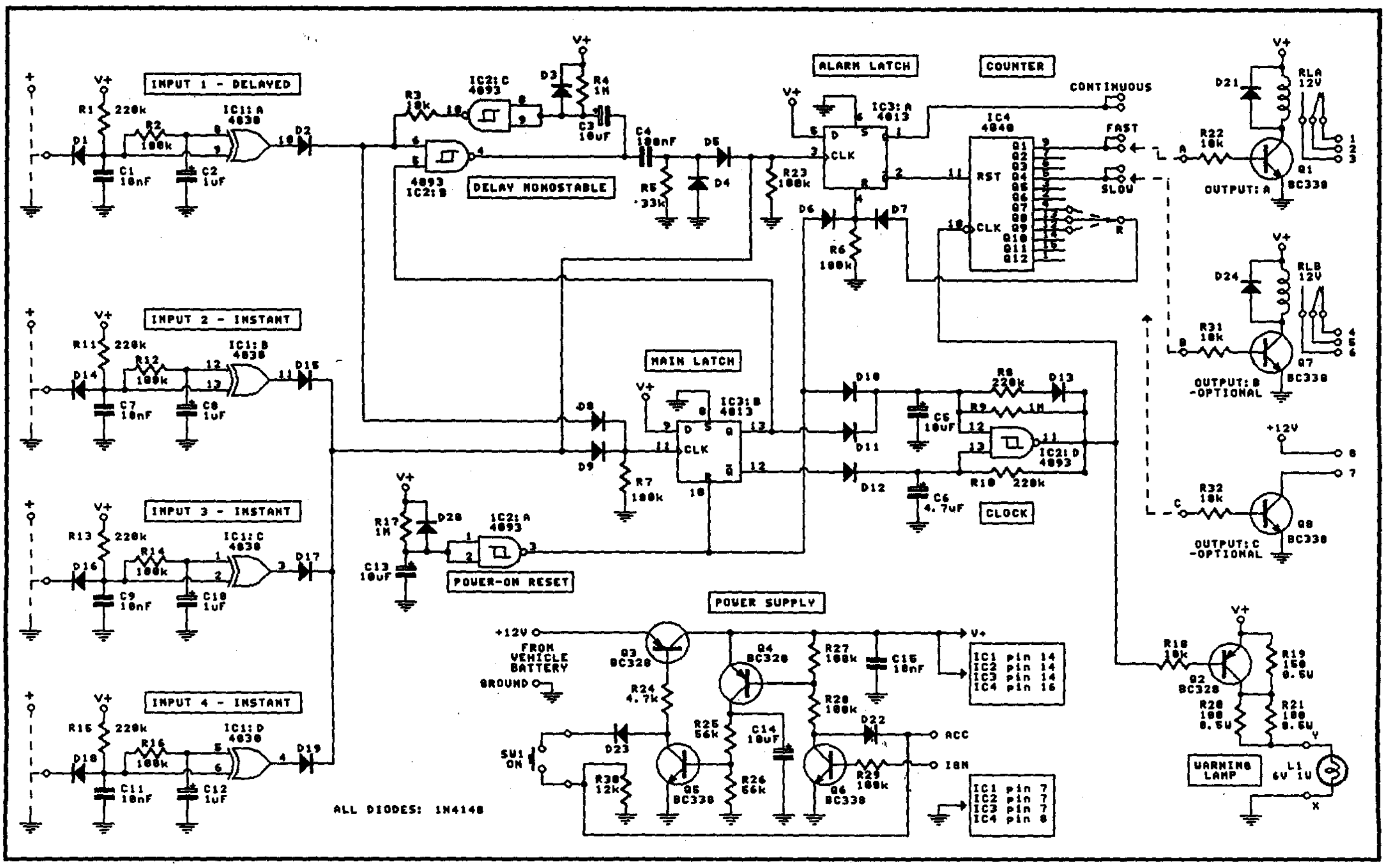
The actual counter (IC4) is normally in a disabled condition (all outputs low), as set by the high level at its reset (RST) input (pin 11), from the Q-bar output of the alarm latch (IC3:A). Therefore, when the latch is set by a trigger pulse, the counter is enabled and begins 'counting' the clock pulses at its CLK input (pin 10).

When the counter's Q8 output (as shown selected in the schematic) eventually goes high, D7 couples this level to the reset input of the alarm latch, which in turn stops the counter and the whole timing process. If the clock frequency is around 2Hz at this time, the Q8 output will divide the clock by 256, resulting in a theoretical output frequency of 7.8 millihertz! Or in more realistic terms, a squarewave with a period of 128 seconds and a low-to-high transition (half a cycle) time of 64 seconds. So it's this positive transition that resets the alarm latch and defines the alarm time at around one minute.

As also shown in the circuit diagram, a couple of outputs are 'tapped-off' the counter to ultimately control the alarm outputs. The FAST output is connected to Q1, or the divide by 2 output, which delivers a 1Hz squarewave when the alarm is triggered — this ultimately controls (say) the vehicle's horn sounding rate. The SLOW output on the other hand, is driven by the counter's Q4 output which has a divide by 16 action. This delivers a waveform with an eight second period (four seconds 'on', four seconds 'off'), which is suitable for ignition killer or siren applications.

All of the above calculations assume that the clock frequency is 2Hz; however this can be changed or 'fine-tuned' as desired (see below for an explanation of the clock circuit). By the way, the CONTINUOUS option is directly driven by the Q output of the alarm latch, which just goes continuously high during the alarm period. Like the FAST and SLOW outputs this can be connected to the output circuits (based around Q1, Q7 and Q8), depending upon what option is required.

The output stages simply act as an interface between the low-powered alarm circuit and the car's electrical system, either directly (in the case of output C)



The schematic diagram: The circuit uses just four common CMOS chips to control the various timing functions and detect trigger signals. The B and C ouput stages are optional.

or via a heavy-duty relay (outputs A and B). Each circuit uses an NPN transistor which is biased hard-on by the selected alarm output (FAST, SLOW or CONTINUOUS), with D21 and D24 protecting Q1 and Q7 respectively from any back-EMF generated by the two relays (RLA and RLB).

So much for the alarm triggering, timing and outputs. You've probably noticed another latch lurking in the centre of the schematic, which we've called the main latch. This both 'remembers' that the alarm has been triggered, and controls the action of the clock circuit (IC2:D).

The main latch can be triggered by any of the four inputs via D8 and D9. Note that D8 is connected *directly* to the output of the delayed input stage at D2, so this latch will be instantly set when *any* trigger signal is detected. Both its outputs (Q and Q-bar) are coupled to the clock circuit, while the Q output (when low) inhibits the entry delay monostable via pin 5 of IC2:B.

This is further insurance against false triggering, since the 'delayed' input (1) must trigger the main latch before the monostable will function — that is, it's disabled until it's actually needed.

However, once the alarm has been triggered the monostable is no longer inhibited, since the main latch will remain in a set condition until the power is turned off.

To the right of the main latch on the circuit diagram is the clock circuit, which at first glance looks rather strange.

Don't be fooled however, it's really just an elaboration of a standard NAND-type RC oscillator where two discrete RC combinations are selected by D11 and D12.

For the moment, consider that the circuit only involves IC2:D, R10 and C6, and pin 12 is tied to V+. If the output (pin 11) is high for example, C6 will charge towards this level via R10, until a high logic level is reached at pin 13 (roughly 8 volts). The output will then drive low and C6 will discharge via R10 until the low logic threshold is reached at the gate's input (about 7 volts) — the output will then go high, and so on.

As it happens, these exact conditions occur when the main latch is in its *set* state, since the Q-bar output is low (reverse biasing D12) and the high level at the Q output is coupled to pin 12 of IC2:D via D11. R10 and C6 are chosen for a 0.5 second oscillator period, which produces the 2Hz clock signal mentioned above.

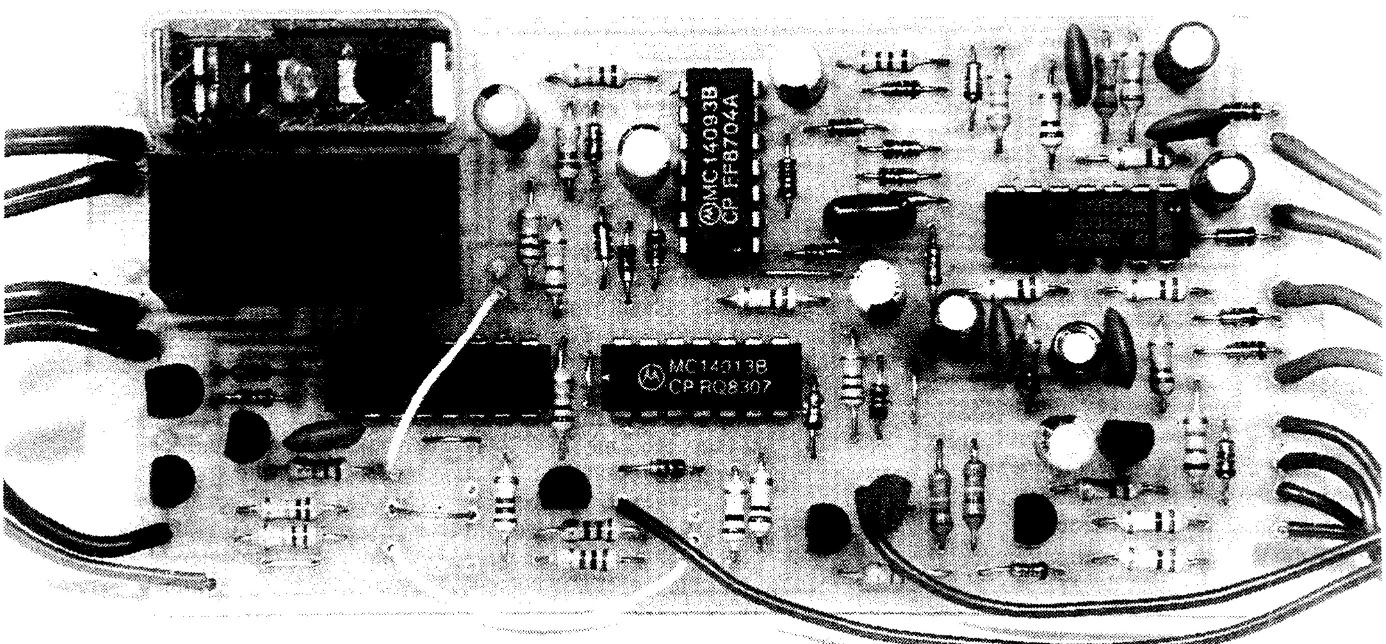
When the main latch is in its *reset* state, the other section of the oscillator is enabled (D11 reverse biased), and the 2Hz section disabled by the Q-bar output, which holds C6 permanently charged via D12. The timing is now controlled by C5, R9, R8 and D13. In this case C5 is charged via R9, which holds the clock output high for around 0.7 seconds, and is discharged by R8 in parallel with R9 (since D13 is now forward biased). This produces a low output for roughly 0.3 seconds, resulting in an overall clock rate of about 1Hz. The clock will stay in this slow mode until a trigger input sets the main latch, which forces the clock circuit into its 2Hz mode.

The clock signal feeds pulses to the alarm timer counter (IC4) and the warning lamp circuit formed around Q2. When the clock output is low, Q2 is forward biased via R18 and provides power to lamp L1, via the current limiting resistors R20 and R21 — these restrict the lamp voltage to its rated 6 volt level. Clearly, if a 12V lamp is used, R20 and R21 may be omitted.

To increase lamp life, R19 is connected in parallel with Q2 so as to provide a small standing current through the lamp, when the transistor is off. This keeps the filament warm and at a higher resistance between flashes, thereby reducing the initial current surge as Q2 is biased on. Normally, the extreme heating and cooling effect in the filament tends to reduce its life due to metal fatigue.

Since the alarm and main latches control the entire operation of our circuit, they must be held in a reset condition when the unit is first powered-up.

This is in fact the exit delay function, and is produced by IC2:A and its associated components. When V+ be-



The completed PCB with all options included. The alarm time and output modes are selected by short wire links between PCB pads.

comes active, C13 charges towards this level via R17, holding pins 1 and 2 below the logic threshold level for around 10 seconds — the output of IC2:A (pin 3) is therefore high for this period.

The resulting pulse resets the main latch directly (at pin 10 of IC3:B), and the alarm latch (IC3:A) via D6. Note that this reset signal is also passed to C5 via D10, which inhibits the slow section of the clock circuit. Since the main latch is also reset at this time, the fast part of the clock circuit is similarly inhibited via D12. The end result is that the clock output remains low for the reset (or exit) period, and the lamp is continuously on — this indicates the exit delay period to the user.

The last part of the alarm's circuit is the self-latching 'power supply', formed around Q3 to Q6. While the circuit is quite simple, its operation is also a little unusual.

To enable the alarm, the user simply presses the momentary action switch SW1, which is housed within the warning lamp assembly. This biases Q3 hard on, by providing a base current path via R24, D23 and R30 — therefore the collector of Q3 goes high, providing V+ to the complete alarm circuit. Note that before the ON switch was pressed, V+ wasn't present and Q4 and Q5 could not conduct.

However with V+ available the emitter of Q4 is now high, allowing it to conduct with a base current path via R28, D22 and R30 (ignore Q6 for the moment). Q4's collector then charges C14 and supplies current via R25 to the base of Q5, which in turn conducts and maintains current to the base of Q3. The circuit is now self-sustaining (latched), and V+ is continuously available — as you would expect, SW1 will no longer effect the circuit.

This latching process cannot occur if the ACC line is high, due to the key being in the ignition or accessory position — say, when you are actually driving the car. In this case, SW1 will pass +12V to the cathode of D23 which is then reverse biased, and doesn't provide a current path for the base of Q3.

By the way, this above circuit operates on the assumption that the accessory line is at +12V whenever the vehicle's key is in the ignition position. We are not aware of any exceptions to this rule, since for example, the radio (which is normally connected to the accessory line) must have power available while the engine is running.

When it comes to turning the alarm off, the key must be moved to the accessory position and remain there for more than a couple of seconds. When this occurs, the IGN line is low and the ACC line is high, which means Q6 is off and D22 is reverse biased. This in turn means that Q4 will immediately turn off, since it no longer has a base current path via R28.

Base current for Q5 (via R25) is now provided by the stored energy in C14, rather than from the collector of Q4. This situation is maintained until C14 has discharged and Q5 turns off, removing the bias from Q3, which in turn shuts down V+. The values of C14, R25 and R26 determine the time that this process takes, or in practice, the time that the ACC line must be high for the alarm to shut down.

On the other hand, if the key is turned to the ignition position without pausing at the accessory position for the required length of time, both the ACC *and* the IGN lines will go high before C14 has discharged. This means that Q6 will be biased on via R29, and since V+ is still available, Q4 can conduct due to the base current through R28 and the collector of Q6. Therefore the circuit remains latched and the alarm active — the ACC line can only reverse bias D22, which in this case has no effect.

Construction

Building the alarm is quite a straightforward process, since all components are mounted directly onto the PCB and the external connections are simply wired to labelled pads.

However the board is rather densely populated, and contains a large number of polarised components which could easily be installed with the wrong orientation.

The answer of course is to carefully follow the supplied component overlay diagram, and double check your work as you go. When examining the overlay, note that IC3 and IC4 have the same orientation, while IC1 faces in the opposite direction (pin 1 towards the left). Also note that there are four small links on the board, plus a couple of short lengths of hookup wire to connect the selected options (alarm time, output drive, etc).

Before commencing construction, check the PCB (code 91alm1) for broken or bridged tracks, and make sure that the corners are sufficiently recessed to avoid the case's lid mounting posts. If any reshaping of the board is necessary, it's much easier to perform before the components are fitted.

Begin the assembly by installing the lowest profile components, and work your way through to the larger items — naturally, the relay(s) should be fitted last. As with any electronics project, take particular care with the orientation of the diodes and electrolytic capacitors. While a mistake may not be apparent when you first apply power to the alarm, it may become embarrassingly obvious some time later.

The CMOS ICs should be treated with some respect due to their very high input impedance, and consequent sensitivity to stray static voltages.

Take sure that your soldering iron is well earthed, and if possible, earth your own body before handling the ICs.

Also, solder the ground pin first so the chip has the correct reference point for its internal protection diodes. While this is the correct manner of dealing with these devices, in practice CMOS ICs are quite rugged and only seem to fail in the most extreme circumstances — in fact, the chance of damage is so small that it's not worth becoming over-anxious about their handling.

PARTS LIST

1 PCB 120 x 58mm, coded 91alm1
1 41 x 68 x 130mm plastic box
1 large momentary action actionSPSTushbutton switch, with integral 6V 1W lamp.
1 standard 12V DPDT relays, 200 ohms or greater.
Light and heavy duty hookup wire

Semiconductors

1 4013 dual D flipflop
1 4030 quad XOR gate
1 4040 12-stage binary counter
1 4093 quad Schmitt NAND gate
3 BC338 NPN transistors
3 BC328 PNP transistors
23 1N4148 (or similar) diodes

Resistors

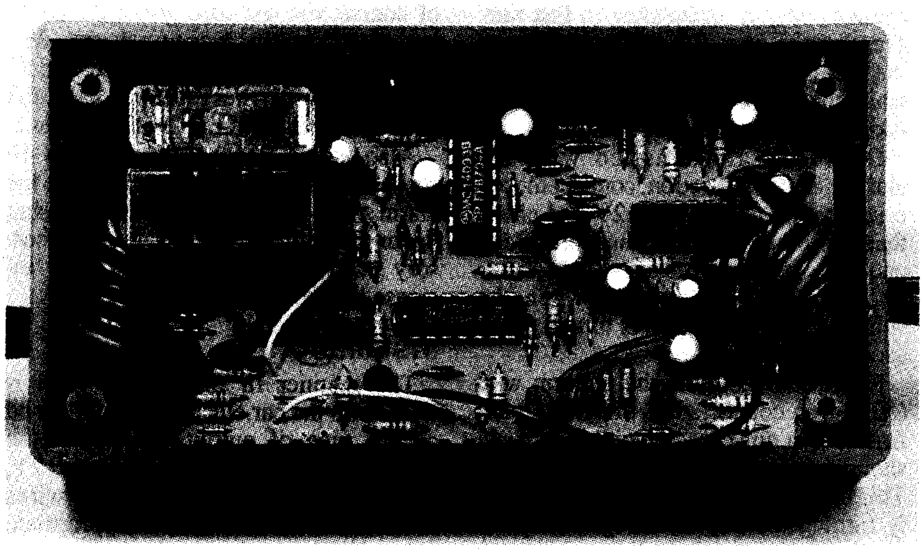
All 0.25W, unless noted:
2 x 100 ohm 0.5W, 1 x 150 ohm 0.5W, 1 x 4.7k, 3 x 10k, 1 x 12k, 1 x 33k, 2 x 56k, 10 x 100k, 6 x 220k, 3 x 1M

Capacitors

5 10nF ceramic
1 100nF metallised polyester
4 1uF 16V PC-mount electrolytics
1 4.7uF 16V PC-mount electrolytic
4 10uF 16V PC-mount electrolytics

Parts for optional outputs

1 standard DPDT 12V relay
2 BC338 transistors
1 1N914 diode
2 10k resistors



The unit fits neatly into a standard 41 x 68 x 130mm plastic case. While mounting bolts are not needed, lay a thin piece of foam in the bottom on the case to cushion the PCB.

The only components which dissipate any significant power are the 0.5W resistors R19, R20 and R21, which are associated with the warning lamp L1. These should be mounted a couple of millimetres above the PCB, to promote air flow and assist cooling. All other components on the other hand, can be pushed down onto the PCB as far as they will comfortably go. Don't forget to install the wire links for the type of output(s) and alarm time that you have chosen.

We would recommend linking the alarm latch reset line (the pad labelled 'R') to the IC4's Q8 output, as shown in the schematic — this produces an alarm time of around 60 seconds. The Q7 output on the other hand, will reset the alarm in about 30 seconds, which may be more appropriate for vehicles which are generally parked in close proximity to their owners.

The Q9 connection results in an alarm period of around 120 seconds, and should only be used in special circumstances — a horn or siren sounding for this length of time is at best downright aggravating, and at worst illegal.

The SLOW, FAST and CONTINUOUS outputs can be hooked up to the output transistors (Q1, Q7 and Q8) in a wide variety of ways. If you are using the car horn as your warning device, connect the FAST output to the 'A' connection and use the contacts of RLA to switch power to the horn circuit.

If fitted, RLB could then be used as an ignition killer by linking the SLOW output to the 'B' pad, and wiring the closing contacts across distributor points (or coil switching transistor) — this intermittently disables the ignition, which is a more effective deterrent and reduces the average power dissipation in the coil.

Alternatively, the CONTINUOUS connection could be coupled to output A or B, and the relay contacts used to power a siren for the complete alarm period — in some cases however, a siren may be better suited to the cyclic action of the SLOW output. The relay contacts could also be used to switch the vehicle's flashers into their hazard mode, which would provide an obvious visual indication of illegal entry.

If a piezo siren is to be used inside the vehicle, output C could run in CONTINUOUS mode and the device connected directly to the switching transistor Q8 (output pins 7 and 8). But note that this output is only suitable for relatively low power applications, where the device draws less than about 500mA.

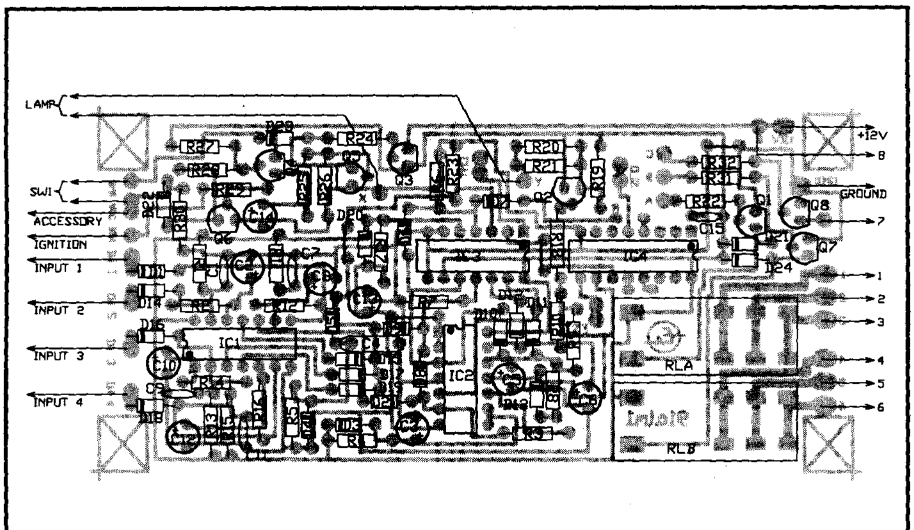
You may notice that each of the SLOW/CONTINUOUS/FAST mode outputs have two connecting pads on the PCB — this increases the alarm's output versatility by allowing any two output circuits to be driven by the same mode. For example you could switch both the A and B outputs with the SLOW drive, and use RLA for a siren output and RLB as an ignition killer.

All in all, there are a wide range of possible output configurations — the one you choose will depend on the vehicle and type of installation.

After the options have been selected, the various external connection wires may be attached to the PCB as indicated in the component overlay. Any wires connected to output pins 1 through to 6 should be of reasonably heavy gauge cable, since they must cope with the relatively high currents drawn by the car's electricals.

As mentioned above, this could be the horn, flashers, ignition coil (the killer option), or even a high-powered siren. The size of the remaining wires is not critical due to the low currents involved. The wires should be collected into two groups at each end of the board, and passed through matching holes at each end of the case. Also, each group should be mechanically held inside the box so that in the event of the wires being pulled, the strain is not directly taken at the PCB terminating pads.

It may seem crude, but tying one collective knot in each bunch of wires (inside the box) provides quite an effective anchor point where they exit through the hole in the case. Naturally, the hole



The component overlay. The input, output and option connections are labelled on the PCB itself.

Car Burglar Alarm

should only be large enough for the wires to neatly pass through.

Testing

Before installing the alarm, the unit's various functions should be tested as thoroughly as possible while the PCB is still accessible. Temporarily connect the lamp/switch unit to the appropriate wires and hook up a 12V supply to the circuit — this could come from a vehicle's battery, or preferably, a workbench power supply.

Activate the alarm circuit by pushing the ON switch and note the action of the warning lamp. It should glow continuously for the exit delay period (around 10 seconds), then begin to flash briefly at about 1.5 second intervals indicating that the circuit is now active.

Next, short one of the instant trigger inputs to ground and check that the lamp illuminates for about a second, then flashes at the faster rate (approximately 1Hz).

The output relay(s) should then close in the correct manner for the selected option. After around 60 seconds (again depending on the selected option) check that the relay action stops, but the lamp continues flashing at the faster rate (indicating that the alarm has been triggered). Then trigger the delayed input in a similar manner, and verify that the alarm relay(s) don't operate until the delayed entry period (about 10 seconds) has elapsed. If the delayed input is triggered when the alarm is in its initial mode (slow lamp rate), the lamp should begin flashing at the fast rate during the entry delay period.

You may notice that the lamp is continuously on for a moment as the clock changes over from its slow to fast rate. This is quite normal, and occurs because the actual clock output remains low while the fast section of the clock circuit takes over from the slow.

Once you are satisfied with the alarm's triggering action, connect the accessory wire (ACC) to +12V and check that the complete circuit shuts off after a one or two second delay — this simulates the disarming action when the vehicle's ignition switch is turned to the accessory position.

Repeat the test with the ignition wire (IGN) also connected to +12V, and confirm that in this case, the circuit will *not* shut down and remains in its active state. This last test imitates the action of rapidly turning the key to the ignition position, without pausing at the accessory mark for the alarm's delayed turn-off period. If you find that the clock frequencies, entry and exit times differ from that of our prototype, don't be too concerned. These rates depend on the values of electrolytic capacitors, which tend to have a wide tolerance in their actual capacitance.

Easy to adjust

Fortunately, the timing rates are quite easy to adjust by altering the value of the appropriate capacitor, and/or its associated resistor.

When altering the entry and exit times don't increase R4 or R17 much above their 1M value, since the timing may become unreliable — a very high value may approach that of the capacitor's own internal leakage resistance.

On the other hand you may wish to alter the alarm's timing to suit a particular situation. For example, the alarm-on time can be fine tuned by making minor changes to the R10/C6 combination, which alters the fast clock rate — of course this will also effect the flashing speed of the warning lamp. Any coarse changes to the alarm time should be made with the link between the counter outputs and the 'R' connection.

Also, some users may find the 10 second entry delay a little tight, since the alarm takes a couple of seconds to shut down after tuning the key to the accessory position. In this case, simply increase the value of C3.

Installation

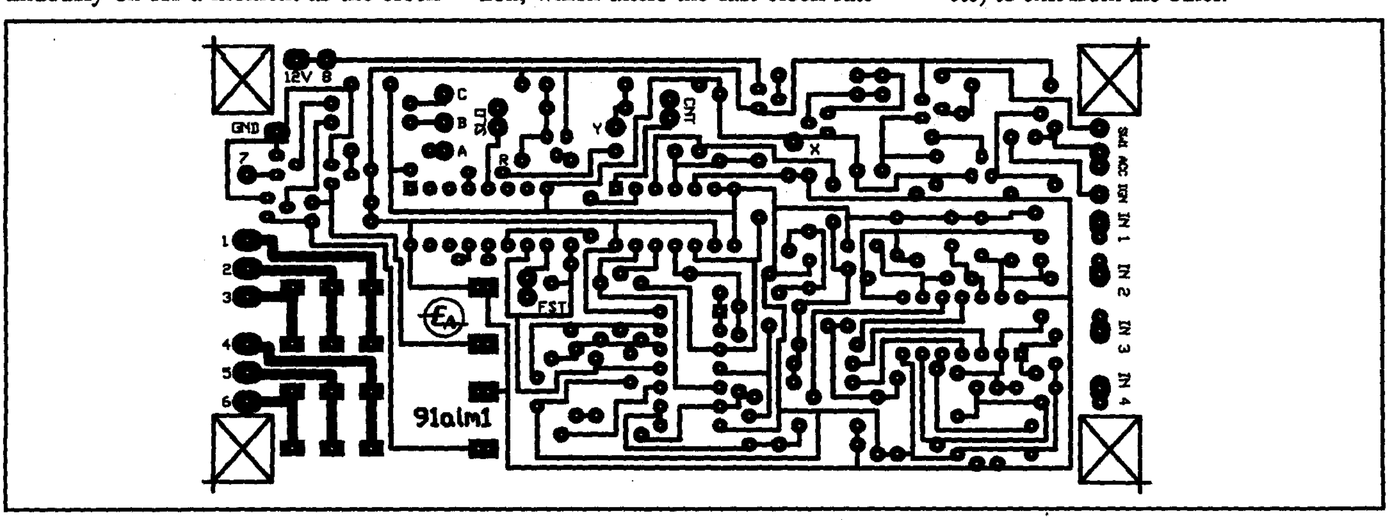
The manner in which the alarm is wired into the car electricals will depend on the type of outputs used, and the vehicle itself. However the +12V, ground, ignition and accessory wires must be connected to the appropriate points if the alarm's most basic functions are to operate correctly.

If you have a schematic of the car's wiring (included in most repair manuals), this job should be quite straightforward. Otherwise, you will need to spend some time probing around in the usual wiring jungle under the dashboard.

When it comes to actually connecting the wires, a couple of packets of automotive cable joiners (the penetrating clamp type) would be a sound investment.

In the physical sense, the alarm can be mounted in any convenient, hidden position. Under the dashboard is probably the most logical place, however the box must be solidly mounted and well concealed — if a thief has time, it's the first place he (or she!) will look.

In this respect, we have arranged for the wires that are critical to the alarm's operation to exit from one end of the case (namely; +12V, ground, and the outputs), and the remaining leads (inputs etc) to exit from the other.



A full size copy of the PCB artwork for those who wish to make the board themselves.

The idea is to mount the alarm so that if the thief manages to find it, only the latter group of wires will be apparent. If these wires are cut, the alarm will continue to sound and/or immobilise the vehicle. As a further step, one of the inputs could also be wired through the hidden end of the box so the alarm can be retriggered.

In general, the easiest way to provide a trigger for the alarm is by connecting input 1 (delayed) to the car's interior lamp switching circuit. While this could be a rising or falling voltage, depending upon whether ground or +12V is being switched, the alarm will trigger on either polarity. The important thing is that the alarm connection must be made at the electrical junction between the lamp and the switch.

By the way, many vehicles also wire the switches to a dash lamp which indicates that a door is open — it may be convenient to tap into this wire as it enters the instrument cluster. When it comes to using the other (instant) inputs, some extra wiring will probably be necessary to connect tilt or remote switches at the bonnet and boot lids.

As with all of the alarm wiring points, these connections must be both mechanically and electrically sound if false alarms are to be avoided. It goes without saying that false alarms decrease the effectiveness of any security system.

You may also wish to connect the ignition circuit to one of the instant inputs, so that any attempt to hot-wire the engine will trigger the alarm. If the actual ignition (ballast resistor, ignition coil etc) is powered via a set of relay contacts, connect the alarm input at this point, since the low-powered section of the ignition circuit (which powers the relay coil) may not be active if the ignition is hot-wired from within the engine bay.

The outputs will have to be wired using reasonably heavy cable, which may be visually obvious from under the bonnet or underneath the car.

The best bet here is to hide the cables in, or beneath the existing wiring loom — this is particularly important for the wires that connect the horn or siren which is used as the audible warning device.

If you are willing to trade off convenience for added security, you could use a hidden switch to turn the alarm off instead of the accessory switch on the ignition lock.

In this case, the switch would be of the momentary action type and wired between the alarm's ACC wire and +12V — note that the entry delay period might need to be increased to allow enough time to locate and operate the switch. Of course, the ACC wire could also be controlled by a separate UHF remote control receiver, which means that the entry delay could be reduced, or completely disabled.

More adventurous constructors could also wire a critical part of the car's electricals through the normally closed contacts of one of the relays. This could be a wire carrying power to an in-line (electrical) fuel valve, or the carburettor fuel cut-off solenoid fitted to many Japanese cars. In both examples, the engine will not run when the alarm is sounding or as a bonus, if the alarm wiring is cut.

As a final security measure, we would recommend fitting a couple of alarm warning stickers at obvious positions on your car windows. These should be of a general type which don't specify what type of alarm is installed.

In practice, it's the warning stickers and the alarm's flashing lamp that provide the vehicle's first line of defence — after that, it's up to the alarm and the quality of your installation work. ■

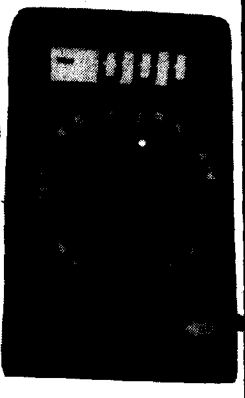
JAYCAR - No 1 for NEW products

Economy Digital Multimeter

17 range DMM at a price that must be the lowest in Australia.

Who would have thought you could buy a quality DMM for under $35!

Compact size which is ideal for tool boxes, glove compartments etc. Uses a 9V 216 type battery for long life (100 hours).



FEATURES

- 3.5 digit LCD display
- 3 range battery checker
- Diode test
- Compact size 116(L) x 70(W)x24(H)mm
- Easy re-calibration instructions supplied

Cat. QM-1430

$34.95

HOT JET

Hot Water for Car Windscreen Washers

This product is not electronic, but it is such a good product we are including it in our 1991 lineup.

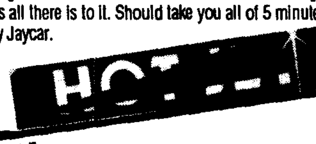
We all know how much better it is washing dishes with hot water compared to cold water.

Now imagine this same principle on your car windscreen which has got road grime, grease, dust, insects, etc., all over it. The difference is chalk and cheese. One wonders why this wasn't thought of before - and it's so simple. You can install it in minutes. The water reservoir mounts on your radiator hose (cable ties supplied) and you simply cut the hoses going to the windscreen washer and re-route through the reservoir. Additional hosing supplied. That's all there is to it. Should take you all of 5 minutes.

Made in England and imported by Jaycar.

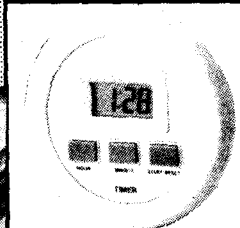
Cat. XJ-2000

$14.95



NEW FOR 1991

COUNTDOWN TIMER



Brand new improved model for 1991. The LCD timer is easily preset from 1 minute to 15 hours 59 minutes. Hit the start button and it will count down the time length desired.

Two alarm signals are sounded, 10 minutes and 5 minutes before time is up. When it reaches "zero" the alarm will sound for 20 seconds. Ideal for a host of things - e.g. PC board etching time, boiling your eggs, parking meter reminder, hose left on reminder, photography, cooking, etc., etc.

Size - diameter 60mm, depth 12mm. Supplied with a tilting ball to standup, a magnet to attach to the fridge and a clip to attach to note boards etc.

Uses a G13 battery supplied.

Cat. XC-0135

$12.95

THE FLYING DUCK

Indoor TV Antenna

This brand new design indoor antenna will pick up almost anything! Well, almost!!

It is omnidirectional and polarised and will pickup AM/FM/VHF and UHF. Frequency range is 100MHz - 960MHz.

It is easily adjusted for either horizontal or vertical polarisation signals - just turn it around.

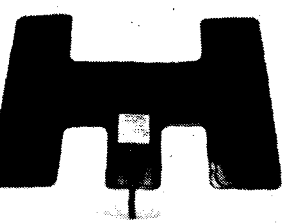
It is supplied with 12 velcro sticky pads on the underside for easy mounting on a wall or window. Size is 280(w) x 240(H) x 12(D)mm.

Supplied with 3 metres of coax and a standard 75 Ω TV plug.

Cat. LT-3135

$37.95

NEW FOR 1991



DIODE BARGAIN

BA318 (Low Voltage 1N914)

Comparison Chart

	VR V	IFmA	trr ns
BA318	50	100	4
1N914	75	75	4

Packet of 100 1N914 sells for $4.95

Stock up now at the bargain price of only $2.95 for 100 pcs.

Cat. ZR-1108

PEDOMETER

Multifunction Step Counter Plus Clock

The new pedometer is a sophisticated device used to measure the total distance travelled by walking or jogging. Simply programme in your stride length and it calculates the rest. It will advise you how many steps you've gone (up to 99999) or how far you have travelled in kilometres. Unit simply clips over the top of your pants and has a top display for easy reading.

Also incorporates a 12 or 24 hour format clock.

NEW FOR 1991

Cat. QM-7225 **ONLY $16.95**

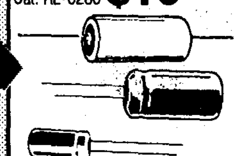
MIXED ELECTROLYTIC CAPACITOR PACK

Back again, after an absence of some months. And it's bigger and better than before.

The pack contains approximately 100 capacitors in RB and RT styles and there's even some Bi-polars and an RP style. The RP style is a 3300µF 80V worth $5 by itself.

This pack represents an absolute bargain. 100 capacitors for $10 is only 10¢ per cap and our cheapest electro costs 28¢.

Cat. RE-6280 **$10**



VHS Video Tape Case

Commonly referred to as a V-O. It's basically a standard VHS video cassette, but without the tape.

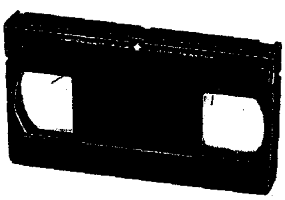
Ideal way to repair a precious tape that has broken, or the case is damaged.

Cat. AR-1435

$3.95

10+ $3.70 each

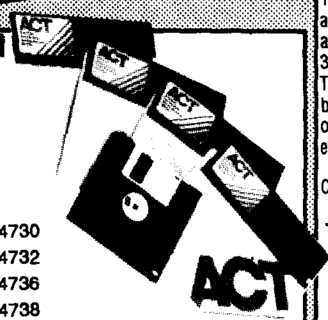
NEW FOR 1991



ACT DISKS AT EVEN LOWER PRICES

Cheapest in Australia?

	Pkt 10	1990 Price	Cat
5.25" DSDD	$5.10	$6.50	XC-4730
5.25" DSHD	$10.50	$15.95	XC-4732
3.5" MF2DD	$9.75	$16.95	XC-4736
3.5" MF2HD	$24.95	$34.95	XC-4738



PROGRAMMABLE TIMER/CLOCK

NEW FOR 1991

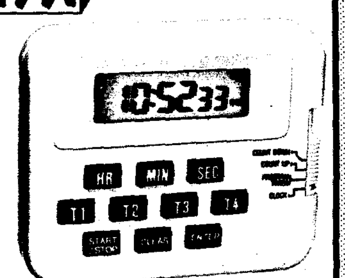
This timer really does the lot. It will count up or down anywhere from one second to 99 hours 59 minutes and 59 seconds. When the time has elapsed an alarm sounds for 60 seconds and the timer counts again from 0.00 with the "Time Up" flag, so you know how long it's been since the alarm sounded.

It has four separate programmable count down time timers. Each will time up to 99 hours and the four can be programmed and set at once for different times., e.g. T1 - 1 hour, T2 2.5 hours, T3 10 minutes and T4 3 minutes all starting at the same time.

The clock shows hour, minute and second together with AM, PM indicator and 12 or 24 hour selectable mode.

Size 70(W) x 60(H) x 15(D)mm. Supplied with a tilting ball to standup, a magnet to attach to the fridge and a clip to attach to note boards etc. Uses a LR44 battery supplied.

Cat. XC-0140 **$24.95**



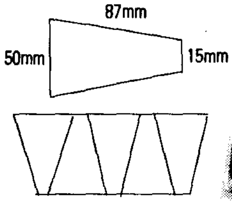
NEW CATALOGUE NEXT MONTH

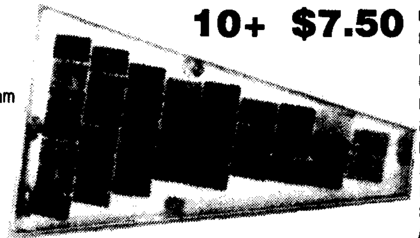
SOLAR CELL BARGAIN

Super high quality 12V 10mA cell. It sits in an aluminium case with perspex cover and is epoxy sealed. Two pins 15mm long on rear are for easy mounting and they have 180mm cables for connecting. See diagram for shape, they will sit next to each other (every 2nd one reversed for easy mounting).
Cat. ZM-9002

ONLY $7.95

10+ $7.50





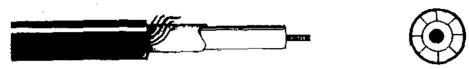
75Ω COAX BARGAIN

AIR SPACED COAX AT $35 100MT ROLL

Yes, that's correct. High quality Benelec brand 0.65mm conductor, airspace PE dielectric, foil shield, 5mm OD sheath, brown in colour air space, 75Ω coax. Save a fortune over normal prices. 70¢ mt for quantities less than 100mt roll.

Cat. WB-2002

$35 - 100 mt roll



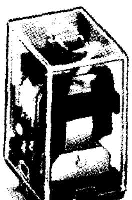
240 VOLT RELAYS AND BASES

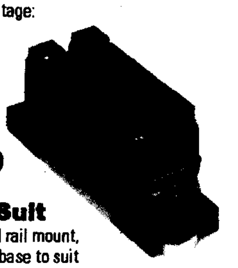
Power Relay

At last, 240V AC, high current relays now available from Jaycar.
Contact form: DPDT
Contact rating: 10A
Voltage: 240V AC
Current: 4.8/5.3mA
Resistance: 18,790ohm
Must operate voltage: 80% max
Must release: 30% min
Max voltage: 110%
Cat. SY-4063

$12.50

10+ $12





Base to Suit

High quality, DIN rail mount, screw terminals base to suit power relay.
Size 72(L) x 29(W) x 30(H)mm.
Cat. SY-4064

Special price $4.95

10+ $4.50

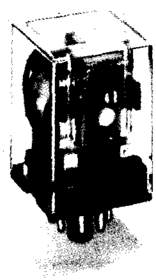
NEW

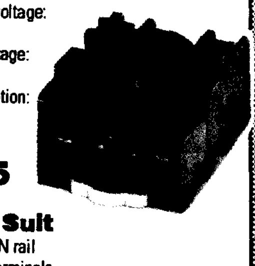
240 Volt Octal Relay

Industrial type 240V AC, 10A Octal Relay now available and they are well below normal price.
Specifications
Coil ratings
Voltage: 240V AC
Current: 9.2mA
Contact current rating: 10A
Coil resistance: 6737Ω
Must operate voltage: 80% max
Must drop out voltage: 25% min
Permissible voltage: 90/100%
Power consumption: 2.7VA
Cat. SY-4022

$15.95

+ $15





Base to Suit

High quality, DIN rail mount, screw terminals.
Size 59(L) x 40(W) x 21(H)mm.
Cat. SY-4021

$6.95

10+ $6.50

NEW

SWITCHMODE POWER SUPPLY

Unbelievably cheap, but there's a catch!

We have obtained a quantity of new (removed from brand new equipment) computer switchmode type power supplies. We offered a smaller version in May 1990 and they went
incredibly quick. This supply is in a case, has a quality 250V 4A rocker switch mounted on a
metal bracket, IEC input socket and lots of power supply compenents.
Typical outputs wil be +5V around 2A, +12V and -12V low current, and 12V around 2A.
Made in Japan.
The problem is that they are 110V powered not 240V. You can use then for parts at this bargain price.
Size 300(L) x 65(H) x 90(D)mm

ONLY $14.95

Cat. MP-3000

PCB RELAY SENSATION

We have purchased a large quantity of DPDT 12V, 3A, high quality Japanese made Omron PC mount relays. These are Telecom approved, plastic sealed with bifurcated crossbar contacts. They conform to International 2.54mm terminal pitch and have a life expectancy of 100,000,000 operations. You would expect to pay around $10 each for these.

Specifications
Voltage DC - 12V
Current - 24mA
Resistance - 500Ω
Contact rating - 3A
Cat. SY-4055

SAVE UP TO 80%

NEW

Buy up now and save a fortune

1 - 9 $2.95 ea
10 - 99 $2.50 ea
100+ $2 ea

VIATEL Units Slashed Further

You've probably seen our ads recently for VIATEL units at crazy prices. Well - to clear them out, we've slashed the price even further. These terminals enable you to connect your phone (some models even have phones supplied), TV or RGB colour monitor to set up a VIATEL in your home or office. Just think, you can access all of that fantastic information on VIATEL without having to pay a fortune for an expensive terminal. You will still need to pay the VIATEL service fee of course! Each videotex terminal contains a fully Telecom approved modem and all electronics to decode VIATEL signals and display them on your TV or RGB monitor. Three models are available:

Model #1

(The cheapest) Features full console, numeric keypad (for entering into and operating the Videotex system) RF out (to your TV) but no phone. You can plug any phone into the socket, provided of course, the phone is only used to access the Videotex number anyway (some phones can be used as keypads, however). This machine is all you really need.
Cat. YV-7075

Was $29.95 NOW $19.95

Model #2

Identical to Model #1 but with a dedicated phone which can be used as a keypad.
Cat. YV-7076

Was $34.95 NOW $22.95

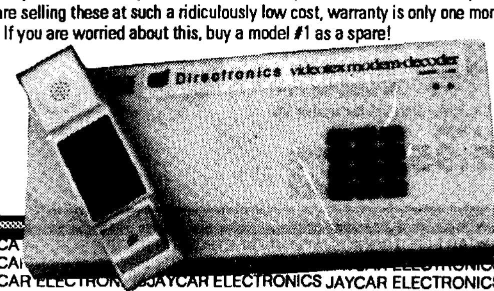
Model #3

As per model #1 but with RF and RGB video output (for better quality on a suitable RGB colour monitor)
Cat. YV-7077

Was $34.95 NOW $22.95

Worth around $250 less than a few years ago!

Note: All models are brand new in cartons with instructions. They are worth far more than this for the parts alone. They contain valuable Philips SAA5020 and 5050 chips because we are selling these at such a ridiculously low cost, warranty is only one month from receipt. If you are worried about this, buy a model #1 as a spare!



JAYCAR

WILL NOT BE UNDERSOLD

WE WILL BETTER ANY ADVERTISED PRICE ON GOODS OF THE SAME QUALITY

PC Board Madness

Double sided fibreglass PC board at about half normal price. Size 365 x 210mm
Cat. HP-9520

Normal price $14.95

NOW ONLY $7.95

10+ $7.50

THE OK SOLDERING STATION

The all new OK Industries soldering station has set a new standard in cost effective soldering stations for the hobbyist, manufacturer. It features a dial up temperature between 315° - 427°C (600° - 800°F). No more constant tip changing to select a different temperature.

Design features include:

- Variable temperature control knob
- LED heater indication
- External calibration ports
- Quality handle
- Ultra flexible
- Externally fused

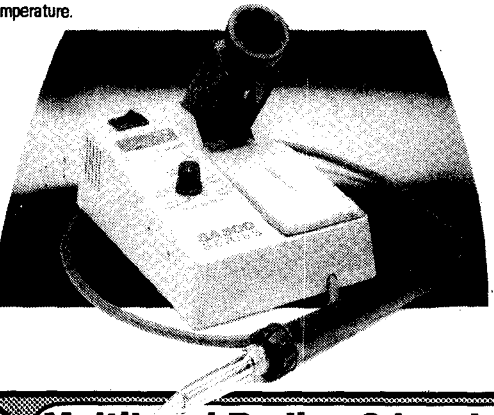
Performance features:

- Closed loop temperature control
- Zero voltage heater switching
- 316° - 427°C (600° - 800°F)
- Better than 2mV RMS leakage, 2Ω tip to ground resistance
- 240V 70 watt iron
- 12 months warranty (90 days on element)

Cat. TS-1600

$159.50

NEW FOR 1991



REPLACEMENT TIPS
All $9.95 each

- CONICAL - Tip diameter 0.8mm Cat. TS-1605
- CHISEL 30° - Tip diameter 3mm Cat. TS-1606
- DOUBLE FLAT - Tip diameter 2mm Cat. TS-1608

REPLACEMENT SPONGE

Cat. TS-1610

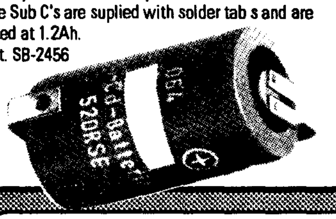
$2.95

Sub C NiCad

NEW

Sub C NiCads are commonly used in battery packs to power RC racing cars and cordless power tools. Up till now, if a battery pack failed - you would need to purchase a new pack from the manufacturer of the product. These battery packs are very expensive. The most common voltage used is 7.2 volts which is made up with 6 x Sub C NiCads. So, instead of being forced to pay $70 - $100 for a replacement battery pack, you can now fix it yourself and save a fortune. The Sub C's are suplied with solder tab s and are rated at 1.2Ah.

Cat. SB-2456



ONLY $5.95 each

10+ $5.50

Multiband Radio - 9 band

Listen to the world

We have rejected every multiband radio sample we have seen, until this one, and this one is a beauty. It features 9 bands. LED tuning indicator, 3" speaker, 6V DC external power jack, earphone jack, tone switch, requires 4 x AA batteries.

Bands:

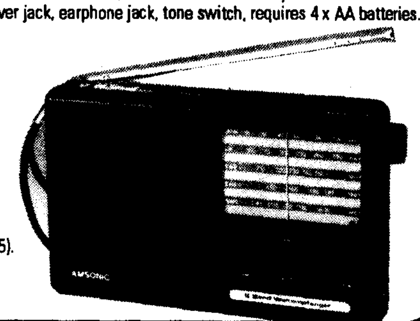
FM 88 - 108 MHz
AM 530 - 1600kHz
LW 150 - 280 KHz
SW1 49M 5.85 - 6.20MHz
SW2 41M 7.10 - 7.50MHz
SW3 31M 9.45 - 9.90MHz
SW4 25M 11.50 - 11.95MHz
SW5 19M 15.10 - 15.55MHz
SW6 16M 17.45 - 18.00MHz

To operate off 240V use our adaptor (Cat. MP-3008 - $15.95).

Cat. AR-2200

ONLY $59.95

NEW



Save 42% on DMM Quality Metex True RMS 3.75 Digit Under $100!!

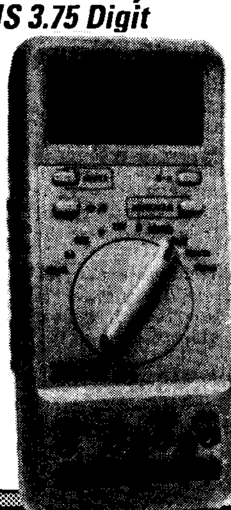
Yes, thats correct. Our QM-1500 metex auto ranger true RMS digital multimeter for only $99.50. Catalogue price $169.50. Save $70.

Cat. QM-1500

Was $169.50

NOW $99.50

Save $70



FM CAR WIRELESS TELEPHONE

Ideal for communication between 2 (or more) vehicles travelling together. Save a fortune over buying CB radios and aerials.

The unit simply plugs into your cigarette lighter (for power) and transmits your voice on FM. Your friends in the other car will hear you on their car radio and visa versa, you can receive their conversation on your car radio. Full set up procedures are supplied with each unit, its easy to tune in to your own car radio and then swap the unit with your friend.

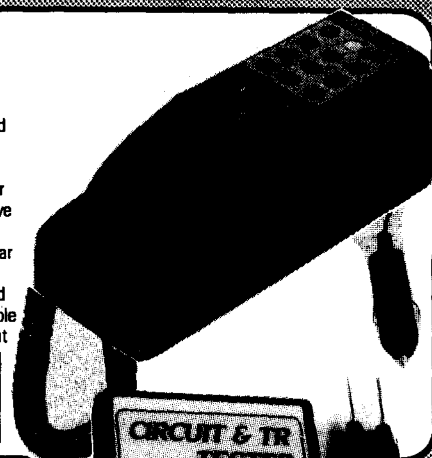
We have tested these and found they work very well, we had clear reception over 0.5 km apart. The frequency is adjustable 88 - 108 MHz. Each vehicle will need one unit. Power output is 48.0 dBμV.

Unit resembles a car phone!!

Cat. AI-5400

$39.95 each

NEW



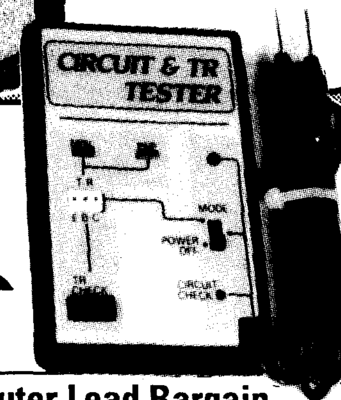
Transistor and Continuity Tester

At last! A pre-built, quality transistor tester. Incorporates a continuity tester with an LED and buzzer. Transistor tester checks both NPN and PNP and also advises if circuit or short circuited. Supplied with multimeter type lead and users 2 x AAA batteries. Size 53(W) x 85(L) x 19(D)mm.

Cat. QT-2250

$22.95

NEW



10mm FLASHING LED

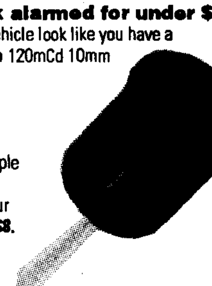
Make your vehicle look alarmed for under $8

The cheapest way to make your vehicle look like you have a burglar alarm. The pack includes a 120mCd 10mm diameter red LED, resistor and a black bezel. The 120mCd LED is as bright as a normal red bezel. Unit requires a 14mm hole and simply snaps in. Add to this a couple of our burglar alarm stickers (Cat. LA-5100 - .95¢ each) and your vehicle looks alarmed **for under $8.**

Cat. LA-5085

$5.95

NEW



1Meg D Ram

1M - 10 100nS

Cat. ZZ-8437

$15.95

10+ $14.50

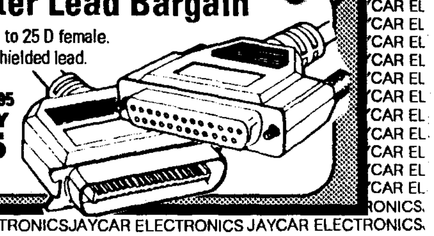
Computer Lead Bargain

Centronics plug to 25 D female.
Length 1.7mt, shielded lead.

Cat. PL-0853

Normally $19.95

NOW ONLY $9.95

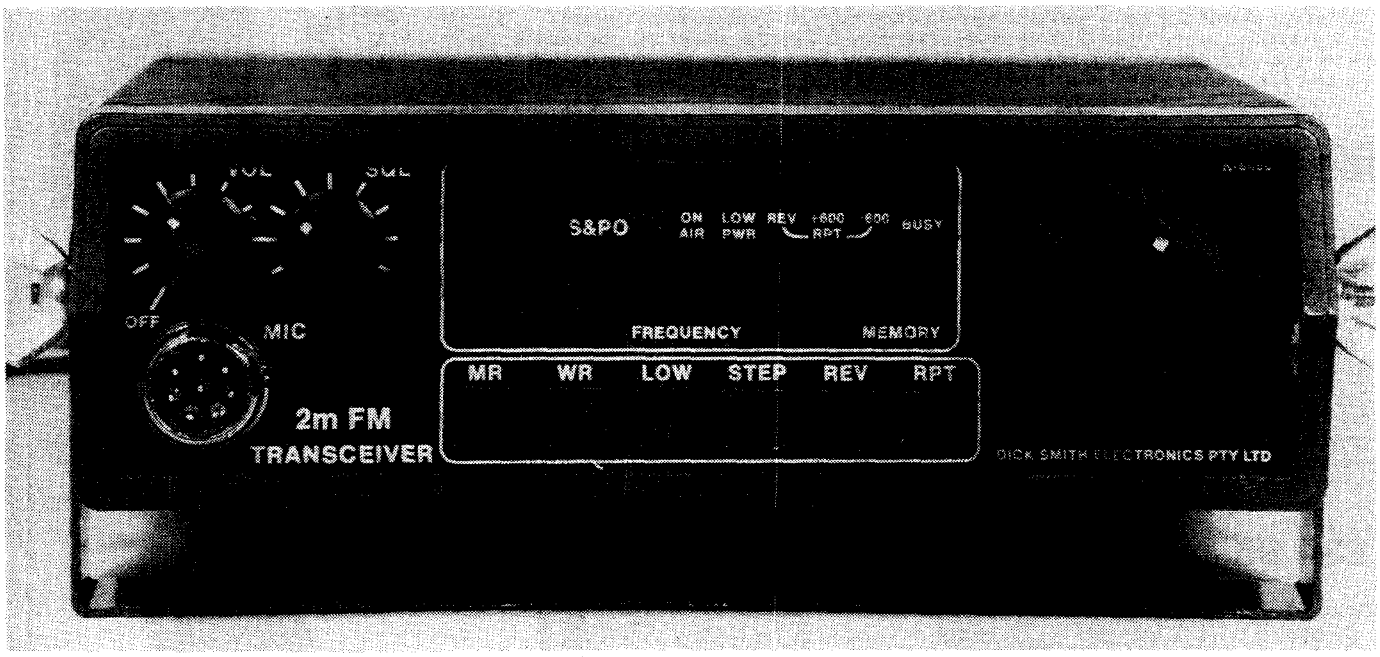


Construction Project:

A NEW 2M FM TRANSCEIVER - 2

The detailed operation of our new Transceiver's circuit was given in the first of these articles, so we are now ready to begin its construction. As with the circuit description, this will be done in easy stages. And by assembling each section in the order described, you can check its operation before proceeding to the next.

by JIM ROWE



First a few words of caution. You will no doubt have gathered from the circuit description that this is not really a simple beginner's project. In order to provide the kind of facilities and performance that are expected nowadays even on the amateur bands, the project has inevitably required a fairly sophisticated design.

This means that there are a number of PC boards, and many small and relatively delicate components to be fitted to them.

You won't be able to 'knock it together' in a couple of hours, and there are various aspects of the assembly that call for considerable care and not a little skill, if components are not to be damaged, and the resulting unit to perform correctly.

So if you're a relative newcomer to electronic project assembly, this probably *isn't* a project to tackle just yet — it might be wise to build up your experience with a few simple projects first.

Now for the good news. For a project of this degree of complexity, the transceiver *is* relatively easy to put together and get going.

The boys at DSE's research and development lab have gone to a lot of trouble with both the circuit and mechanical design, to ensure this.

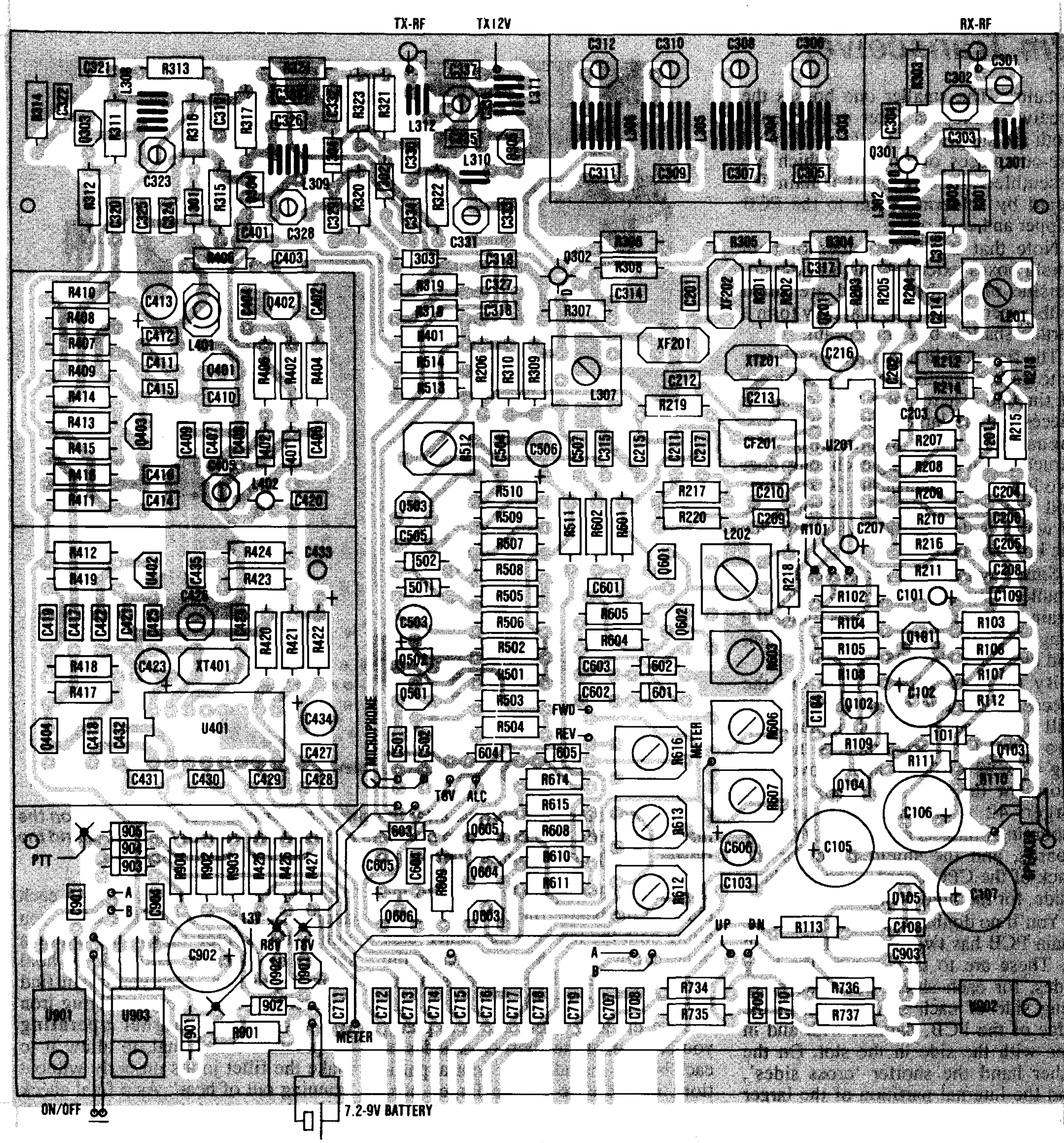
Not only that, but they've also worked out a system of assembling and testing the various circuit sections in order, so that each one can be checked out before you proceed with the next.

So providing you follow the same order, and check out the sections as you go, there's a very good chance indeed that your transceiver will operate exactly to specification.

Needless to say, we're going to be describing the assembly and testing in exactly the recommended order. And as yours truly has been assembling a unit as well, before writing this description, I hope to be able to pass on a little of my own experience as well.

Incidentally before we start, here's the order in which the sections will be described, so you'll know what is coming:

1. Metal shield boxes.
2. Soldering the CPU board to the main board.
3. The power supply circuitry.
4. The CPU and display circuitry.
5. The VCO and PLL circuitry.



Here's the overlay/wiring diagram for the main board of the transceiver, a little larger than actual size. It may look a little daunting, but by wiring in the components for each functional subsystem stage by stage, and testing their operation before you proceed, the project can be assembled with a high degree of confidence.

6. The receiver AF amplifier.
7. The receiver IF amplifier.
8. The low level RF circuitry.
9. The microphone preamp.
10. The S-meter and ALC circuitry.
11. The transmitter PA circuitry.
12. Final checking and adjustment.

We'll be dealing with the first five of these sections in the current article, plus the description of a simple RF probe that will help in making checks and adjustments. Incidentally, due to unexpected problems in sourcing some of the specialised parts used in the transceiver, DSE has advised that complete kits are not at this stage expected to be available until nearly the end of February.

So if you haven't been able to pick up a kit yet, don't panic; you should be able to get cracking shortly. Perhaps you'll still want to read on, to get yourself primed up and ready to roll, when the kits appear.

To begin, then, the first stage is basically mechanical.

1. SHIELDING BOXES

There are two of these, the larger of which is to contain the VCO and PLL circuitry. The smaller one houses the receiver bandpass filter components. Both are supplied in the form of small pre-cut pieces of tinplate, which are assembled directly on the main PC board by soldering them to the PCB copper and each other.

Note that the 'long' sides of both shield boxes extend through to the underside of the board, and are fitted with a second cover so that they form a further shallow box underneath.

The first step in assembling each box is to gather together the correct pieces of tinplate. There are a total of seven pieces for the larger box: two covers, measuring 51 x 80mm and with turned-down lips along each long side; two long sides, measuring 20 x 80mm; and three short sides 15 x 50mm (one of which is the partition which divides the box into two).

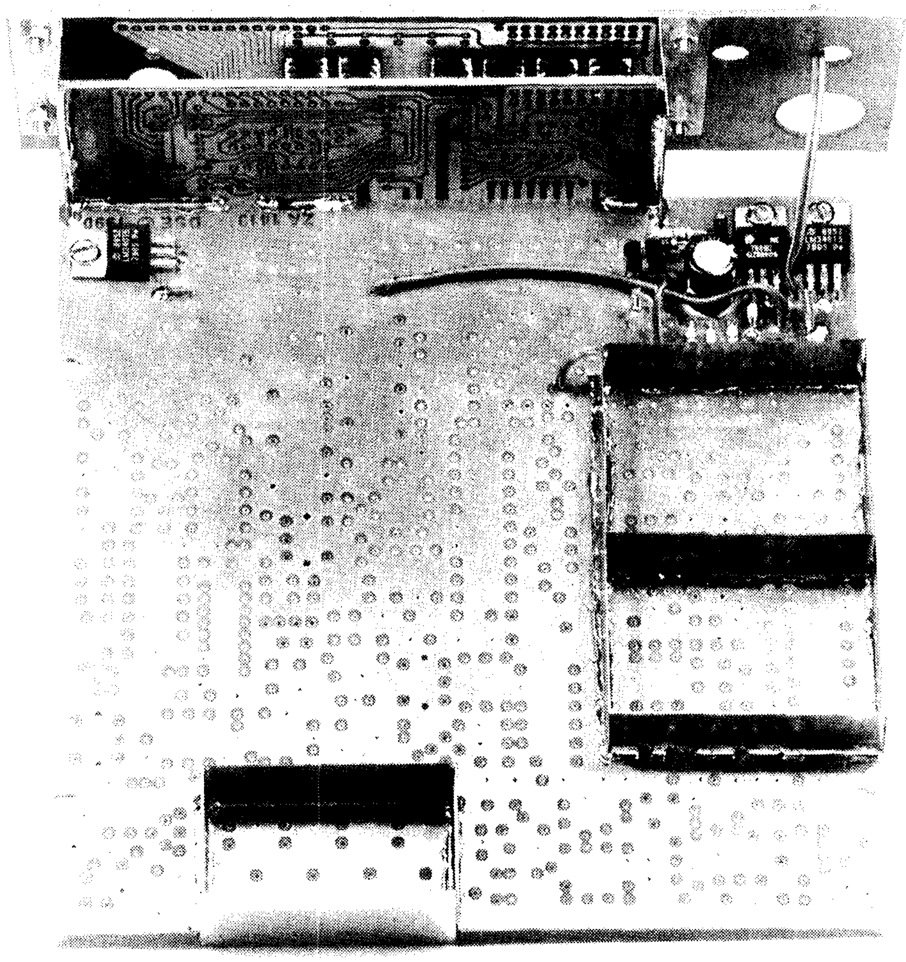
Similarly there are six pieces for the smaller box: two covers 26 x 46mm, again with turned-down lips along the long sides; two long sides 21 x 46mm; and two short sides 25 x 15mm.

By the way, after sorting out the pieces for the two shield boxes, you'll still have three pieces of tinplate left: two small L-shaped brackets measuring 42 x 22 x 10mm, and a cover like those for the two shield boxes, only larger: 42 x 115mm. These are the mounting brackets for the CPU/display boards, and the shield plate for the back of the CPU board — so put them aside, for the time being.

You'll no doubt have noticed that the main PCB has two narrow slots cut in it. These are to take one of the long sides, for each shield box. The other long side of each box mounts at the edge of the PCB, parallel with and in line with the side in the slot. On the other hand the shorter 'cross sides', and the internal partition of the larger box, simply mount on the top of the PCB.

With each box, you start by mounting the long side that fits through the slot. This is first pushed through from the top, and carefully positioned so that its top edge is 15mm from the top surface of the board. You can check this using one of the shorter cross-sides — the top of the long side should be at the same height as the cross-side, at each end.

When you're happy that it's set to the right depth, carefully tack it in place at each end with small blobs of solder. Then, ensuring that it's also sitting in the slot squarely at 90° to the plane of the board, run fillets of solder along both the top, and the 'inner' side underneath (i.e., the one facing the board edge, and which becomes the inside of the shield box).



Here is the author's prototype after the shield boxes had been assembled on the main board, the CPU board and brackets added to the front of the board, and the power supply components fitted — along with the 7-segment displays.

Once the long 'slot' side is in place, you can mount the short cross sides of each box — including the central partition, in the case of the larger box. Again the trick is to position them carefully (using the PCB overlay diagram as a guide to exact location, if necessary), then tack them in place using a small blob of solder at each end, and then finally run a solder fillet along the corners to complete the job. Needless to say as the box takes shape, you have more corners to fillet.

The final step for each box is to fit the second long side, which is pressed hard against the edge of the board so it lines up with the top cross sides.

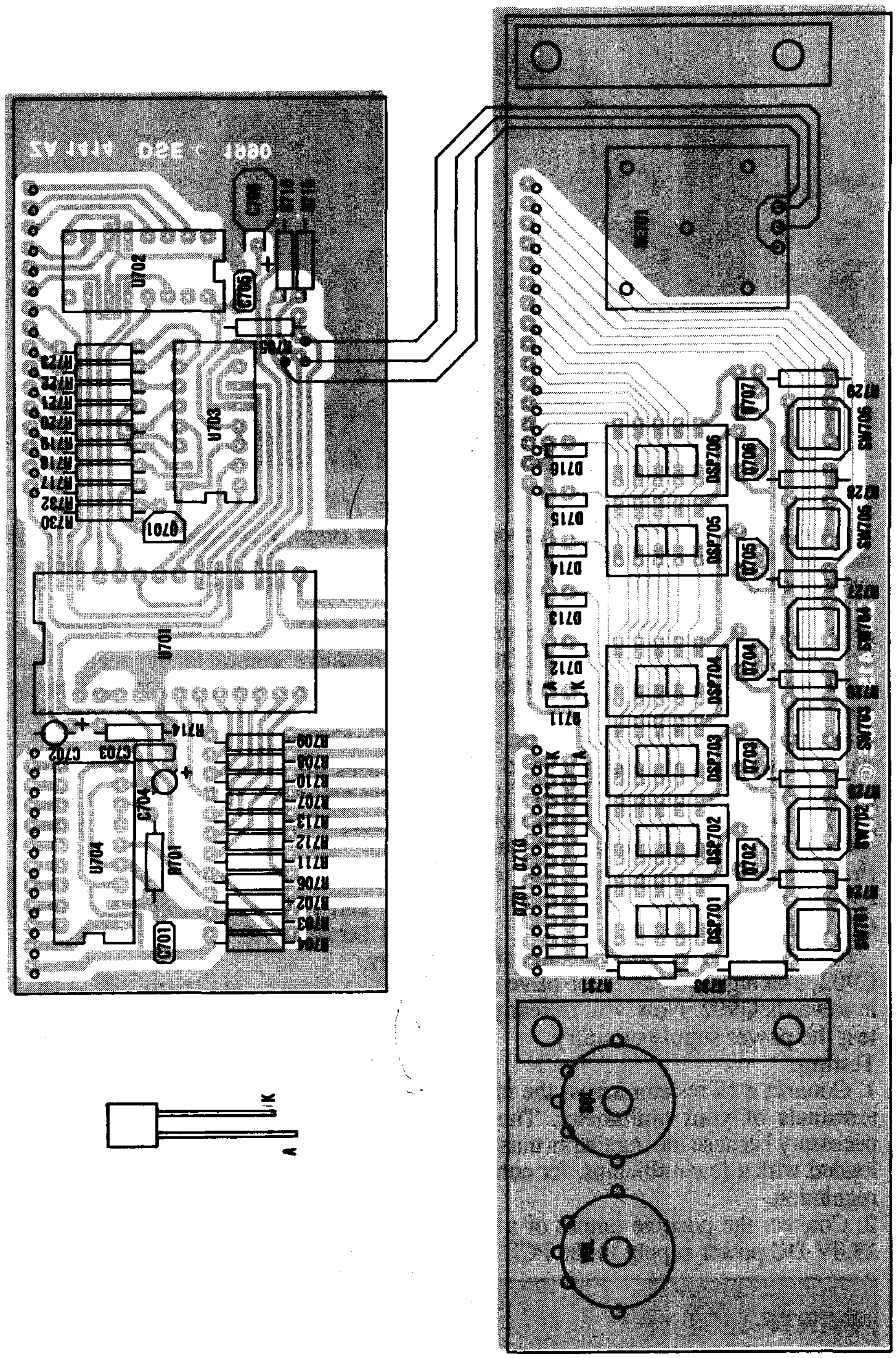
Again tack it in place, and then run fillets along on the inside of both top and bottom.

If you find it difficult to hold each additional box side in place while you apply the solder tacks, try using a couple of blobs of 'Blu-tack' to hold them in position. Also you might find it necessary to set your soldering iron for a somewhat higher operating temperature than usual, to allow it to make the fillet joints properly without 'running out of heat'. As a final check of each shield box, see if the top covers fit on correctly above and below the board. You may need to bend either the covers or the box sides a little, to ensure that they fit on and are not loose.

Now you should be ready for the next stage.

2. CPU/MAIN PCB MATING

This stage involves soldering the CPU board to the main board, along with the mounting brackets for the display board. The trick here is to ensure that everything is lined up correctly, and this is done in the following way.



Here is the wiring/overlay diagram for the CPU and display boards, fairly close to actual size. Note that all of the resistors on the display board are mounted on the rear (copper track) side of the board — they won't fit on the front.

First of all, mount a couple of the push-button switches (from the display board components pack) on the lower front of the display board — one at each end of the row is ideal. These will be used to check the PCB alignment, shortly.

Now fit the two small L-shaped brackets to the back (copper side) of the display board, using 3mm x 6mm machine screws and nuts. Both brackets have their flanges facing towards the ends of the display board, as you can see from the photos.

Then place the CPU board between the brackets (copper side away from it), about 14mm behind the display board and parallel with it (the rows of holes along the top of both boards should line up — check if necessary with a couple of guide wires). Now mount the main board into the lower half of the transceiver case, using the four small self-tapping screws provided.

Then find the front escutcheon panel of the transceiver, and holding it at the front of the display board (using the two push-button switches to line them up), try lowering the complete display/CPU board assembly down into the case, to see if it mates correctly with the main board. The escutcheon panel and the display board must be fitted into the appropriate guide channels, of course.

You may need to move the CPU board back away from the display board close to the display board, for it to butt against the front edge of the main board.

You may also need to bend the brackets slightly, so that the tracks on the CPU board line up correctly with the small etched 'cutouts' on the top front edge of the main PCB.

It's also important at this stage to check that the front push-button switches line up correctly inside the corresponding holes in the front escutcheon panel, with the rear ends of the brackets sitting against the top surface of the main board, and with the front escutcheon panel still sitting undisturbed in its slot (i.e., not kicked up).

If this doesn't happen, you may need to cut small notches in the lower edges of the brackets, until everything lines up correctly.

Once all seems well, you can apply small blobs of solder to tack the brackets and the main board together. Then remove the screws holding the main board into the case, and carefully remove the assembly for final soldering.

The CPU board is soldered first to the underside of the main PCB, with a couple of wires through the holes in the CPU and display boards so that you maintain their alignment.

Make sure that the tracks on the CPU board also align correctly with those on the underside of the main board, and that the boards are squarely lined up, and then run fillets of solder to join both the small connection tracks, and the main earthed copper areas.

Then turn your attention to the top side, and run further fillets of solder again to link the earthed areas of the two PCB's, and also up the ends of the CPU board to bond it to the inside surfaces of the brackets.

You should now have a fairly sturdy PCB assembly, complete with the shield boxes on the main board. This means you're ready to begin the actual wiring up.

3. POWER SUPPLY

This section is that which was shown in the schematic of Fig.2 in the first article, and involves all of the components identified with a '9XX' number (R901, C904, U903 and so on — see parts list 1). These all mount along the front of the main PCB, most of them immediately in front of the large shield box.

As usual, mount the low-profile resistors and diodes first, making sure you fit the diodes with the correct polarity. Then mount the three ceramic/monolithic bypass capacitors. Note that one side of each of these is soldered not only to the copper under the board, but also to that on the top. To allow this to be done neatly if ceramic capacitors are supplied in your kit, you'll need to remove the ceramic insulation from the lead concerned, so that the lead can be soldered close to the component body, with the latter pushed down against the board.

Do this by carefully squeezing the insulation on the lead with a pair of needle-nosed pliers, so that it cracks off. Then clean the exposed lead by lightly scraping it with a small hobby knife, before re-forming the leads with the pliers so that they will pass through the PCB holes.

You may well have to carry out the same operation with many of the other bypass capacitors used in the transceiver, by the way, as many of these also have one lead soldered to the top copper as well as underneath. When soldering to the top copper, you'll also need to use an iron with a clean, fine-pointed bit — so you can make a good joint quickly, without damaging the capacitor itself.

Returning to the power supply circuitry, you can now fit the three three-terminal regulators. Note that two are 5V types, and the third is an 8V type — don't get them mixed. The 8V unit mounts in the 'U903' position, next to D901. All three regulators are mounted flat on the board, with 3mm screws and nuts clamping their tabs to the board, and also have their centre pin soldered to the top copper of the board, as well as underneath.

Next, you can solder in the four PCB pins (shown with an 'X' on the overlay drawing), and fit the two transistors (making sure of their type numbers, and their orientation). Then fit the three pairs of insulated link wires: one pair joining the 8V supply pins to the points adjacent to D603 (not fitted yet!), a second pair which join points 'A' and 'B' together, and a third pair to the two points between U901 and U903, for later connection to the ON/OFF switch.

Finally, fit electrolytic capacitor C902, making sure that its positive end is towards Q902. Now you're ready to test the power supply circuitry.

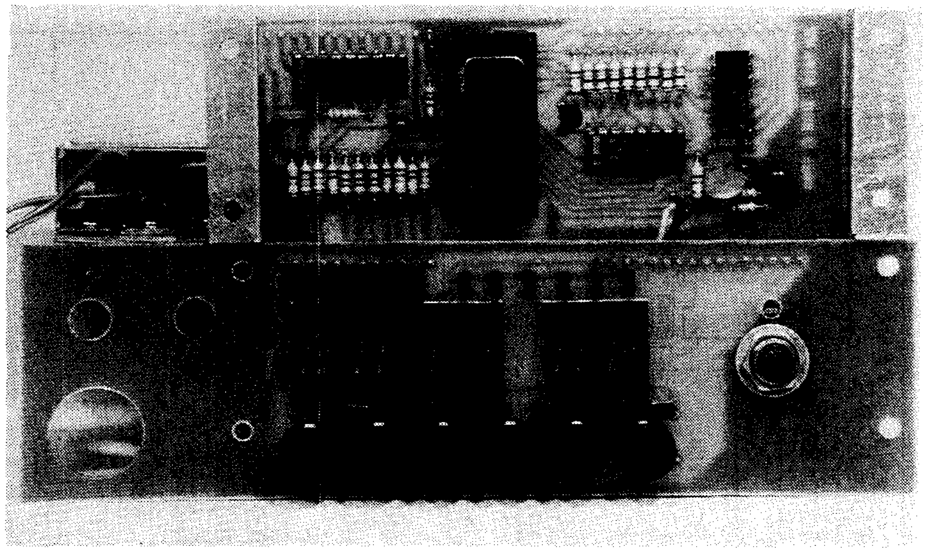
Testing:

1. Connect a 1k resistor across the input terminals of your multimeter. This is necessary because the regulators must be loaded with a few milliamps, for correct regulation.
2. Connect the positive output of a 12-13.8V DC power supply to the PCB pin marked '13V' (to the front of C902), and the negative output to the main board ground plane. Also connect together the ends of the two wires which will go to the On/Off switch.
3. Check the voltages on the output pins of the regulators U901-3. These should measure +5V, +5V and +8V respectively.
4. Measure the voltage on PCB pins R8V and T8V. At this stage they should read between 7.0-7.5V and 0V respectively.
5. Now connect the PCB pin marked 'PTT' to ground, and again measure the voltage on the pins R8V and T8V. The voltages should now have 'reversed', to read 0V and 7.5-8V respectively.
6. Finally disconnect the power supply, and remove the 1k resistor from the terminals of the multimeter. Also disconnect the PTT line from ground.

NOTE: When you next check the voltage (steps 3, 4 and 5) after other circuitry has been soldered into place, there will be no need to connect the 1k resistor across the multimeter. Also note that if you accidently short circuit the T8V or R8V to ground during the above tests, this will probably result in damage to Q902 or Q901. So be very careful!

PARTS LIST 1: Power Supply

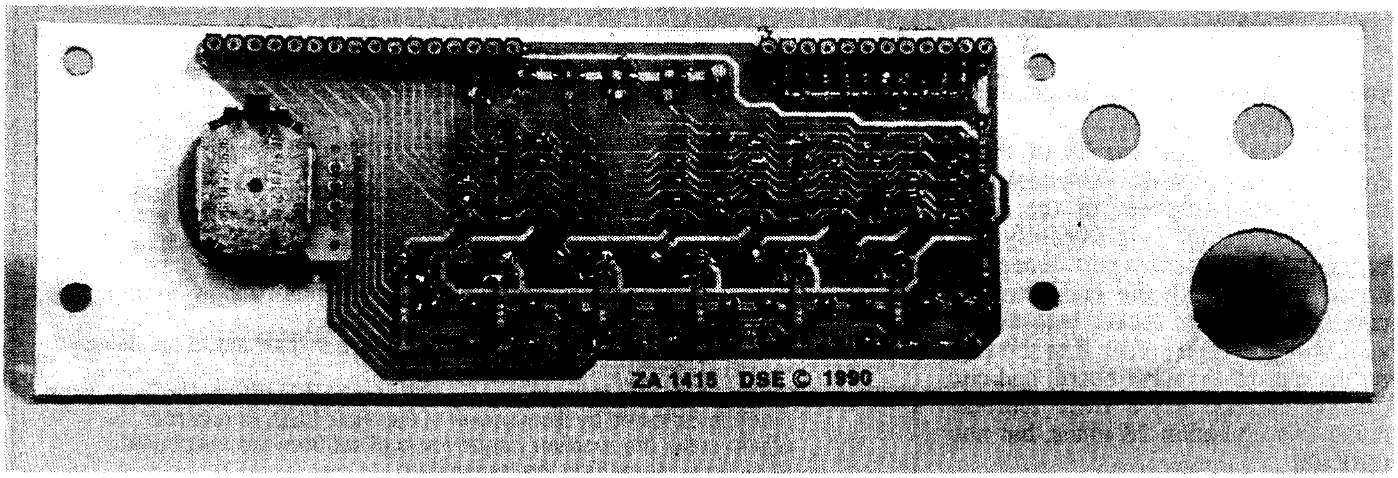
Qty	Description	Location
2	680 ohm 1/4W	R901,R904
1	1k 1/4W	R903
1	100k 1/4W	R902
3	0.1uF ceramic	C901,C903, C904
1	470uF/16V electro	C902
2	1N4002 diode	D901,D902
3	1N4148 diode	D903-905
1	BC328 transisto	Q901
1	BC338 transisto	Q902
2	7805 regulator	U901,U902
1	7808 regulator	U903
3	M3 x 6mm screws and nuts	
4	PCB solder pins	



Here's a shot showing the author's CPU and display boards after all of the components were fitted — but before the two were bolted together, and the SIL connectors and resistor pigtail 'pins' used to make the interconnections.

4. CPU/DISPLAY BOARDS

With the power supply section OK, you're now ready to fit the components for the CPU and display sections of the circuit. These components are all identified with a '7XX' number (see parts list 2), and relate to the 'controller' section schematic (Fig.3) given in the first of these articles. They mount on three PCBs: the display



To help you (hopefully) in wiring up your display board, here is a shot of the copper side of the author's board. Note the resistors and the two SIL connector strips (take care when soldering these in!). The optical encoder shown is an alternative type, with different connections — and rear lugs that must be cut off, to clear the CPU board components.

board, the CPU board and the main PCB.

You'll need to remove the four machine screws and nuts holding the display board to its mounting brackets, in order to wire up this and the CPU board.

I suggest that you tackle the display board first, as in effect you've already started it — with the earlier mounting of the two push-button switches.

Before starting, note that all eight of the resistors that mount on the display board are fitted to the 'rear', or copper side of the board.

There isn't room for them on the front. This allows them to be mounted *after* the seven-segment displays, transistors, LEDs and push-buttons. And I suggest that you fit these components in that order, for easiest access.

Make sure that the LEDs, seven-segment displays and pushbuttons are mounted as close as possible to the board, and in straight lines.

Note that the holes for the LEDs are a bit larger than necessary, to allow mounting these squarely and evenly. Of course, don't forget to watch the LED polarity — as you can see from the overlay diagram, the 10 closely-spaced LEDs (D701- 710) mount with their cathodes towards the top of the PCB, while the six others mount the other way.

Note too that the transistors (Q702-707) should also be mounted with their bodies down fairly close to the board, so that the tops of their bodies are no higher than those of the LEDs.

The leads should be gently splayed to allow this to be done, without straining them.

Take particular care when soldering the pins for the seven-segment displays, as the display board tracks are quite fine, and closely-spaced at this point.

The final steps in assembling the display board at this stage are to mount the rotary optical encoder RE701, and to fit the 12-pin and 16-pin SIL sockets used for the interconnections with the CPU board. Take special care with the latter — like the resistors, they mount on the copper side of the board, and making good joints isn't easy as the socket body is only about 3mm above the board.

You'll again need an iron with a clean, narrow bit, in order to make good joints without causing damage.

Note that the volume and squelch controls are not fitted to the display board at this stage.

Now for the CPU board. This is wired in the usual way, fitting the resistors and small capacitors first, and then the transistor and ICs. (Keep the cut-off ends of the resistor pigtails — you'll need them shortly.)

Watch the polarity of the tantalum electros, and also the orientation of the ICs. Note that tantalum capacitor C706 must be mounted horizontally, to ensure that it clears the rotary encoder when the boards are re-assembled.

The controller chip (U701) mounts in a socket, to reduce the risk of damaging it, but take care with the other chips — two of which are CMOS. A well-earthed iron (and operator) are advisable.

The three-lead cable from the CPU board to the rotary encoder should be fitted to the CPU board, and cut to about 80mm long. It can then be connected to the encoder lugs, with the connections as shown.

By the way, if your rotary encoder is a small round unit with two long lugs extending out of the rear, these will need to be cut off so that they clear U702, C705 and C706 on the display board.

After checking your work carefully, you should now be able to plug the CPU chip U701 into its socket, and bolt the display board back onto the front of the mounting brackets. Then

PARTS LIST 2: CPU & Display section

Qty	Description	Location
2	4.7 ohm 1/4W	R704-05
9	33 ohm 1/4W	R717-723, R731-32
3	1k 1/4W	R711-13
7	4.7k 1/4W	R724-730
5	22k 1/4W	R701-03, R709-10
11	100k 1/4W	R706-08, R715-16, R733-37
1	1M 1/4W	R714
13	1nF cer/mono	C707-719
3	0.1uF ceramic	C701, C703, C705
1	1uF/16V tantalum	C702
2	33uF/10V tant.	C704, C706
1	BC558 transistor	Q701
6	BC548 transistor	Q702-707
1	MC68705P3TRX	U701
1	CMOS 4028	U702
1	CMOS 4511	U703
1	LM3914	U704
16	2x5mm rectan. LED	D701-716
6	7-seg LED display	DSP701-706
6	Pushbutton switch	SW701-706
1	Rotary encoder	RE701
1	28pin DIL socket,	
1	16pin SIL socket,	
1	12-pin SIL socket.	

you're ready to fit the rest of the interconnections.

Here's where you use 28 of those cut-off resistor pigtails. Push each one through from the rear of the CPU board, and gripping it carefully between the boards with a pair of needle-nosed pliers, push the end into the corresponding SIL socket hole as far as it will go. Then solder it to the pad on the rear of the CPU board, and cut off the excess. It's a little tedious doing this operation 28 times, but not difficult!

The final assembly step at this stage is fitting the remaining components to the front of the main PCB. There are four 100k resistors, plus 13 small bypass capacitors — each of which has one lead soldered to the top ground plane. If your kit comes with 1nF ceramics for these capacitors, you'll need to remove the ceramic from these leads as described earlier.

Testing:

1. Check that the wires that will ultimately connect to the On/Off switch are still joined together. Then apply 12-13.8V DC as before, from a power supply. The display should now indicate '7000'.

2. Test all the functions of the display and control LEDs by activating the keyboard, rotary encoder and PTT line (see Table 1).

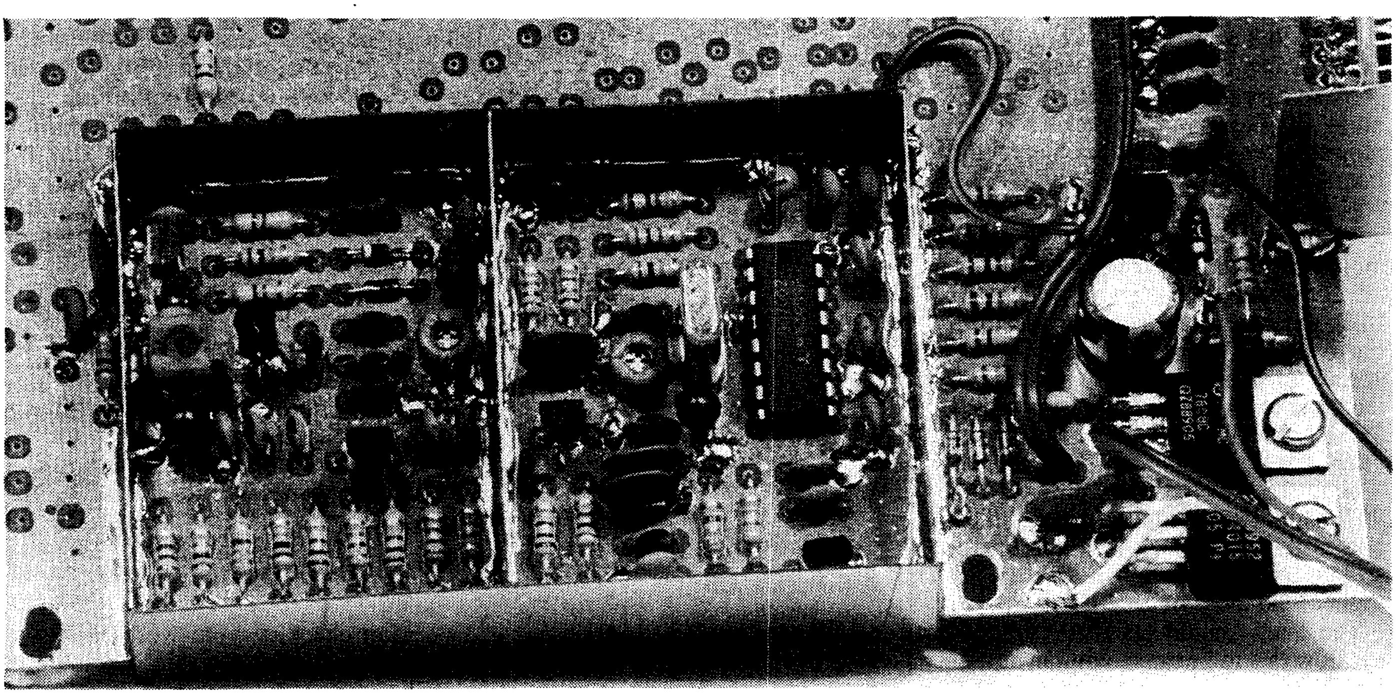
Transceiver Control Functions

MR:	Toggles between memory and 'dial' modes: In memory mode, the rotary tuning control and microphone Up/Down buttons select memory channels; in 'dial' mode, these controls select operating frequency directly in steps of either 5 or 25kHz.
WR	Writes a frequency setting to either the dial or the current memory channel. In 'dial' mode, it writes the displayed frequency to the memory channel; in memory mode, it writes the memory channel contents to the display.
LOW	Toggles between low (5W) and high (25W) output modes for transmit. The 'Low Pwr' LED lights in low power mode.
STEP	Toggles between 5 and 25kHz tuning steps, in 'dial' mode (as selected by MR switch).
REV	Toggles between 'normal' and 'reversed' repeater offset. Reverse offset mode is indicated by illumination of the 'Rev' LED. In reverse offset mode, the receiver frequency is offset from the displayed frequency, rather than the transmitter.
RPT	Selects repeater frequency offset mode on-off, and polarity. Repeated presses cycle through -600kHz, +600kHz and 0kHz (no offset) modes. Current offset is indicated by the '-600' and '+600' LEDs.
ON AIR	This LED illuminates during transmission.
BUSY	This LED illuminates when the CPU is busy servicing a control command.

Scanning operation

1. Before scanning, the Squelch must be closed (i.e., the 'BUSY' LED must be off, and the speaker quiet).
2. Use the MR button to select either the 'dial' mode, for frequency scanning, or the memory mode for memory scanning. In dial mode, the STEP button can be used to select either 5kHz or 25kHz scanning steps.
3. To begin scanning, press the microphone Up or Down button as desired, for about two seconds.
4. Scanning will stop automatically when an input signal opens the squelch. To stop scanning manually, turn down the Squelch control to open it or press the microphone Up, Down or PTT buttons.

3. Turn off the main power supply, and connect one end of a 100k resistor to the METER input of the CPU section (between C711 and C712). Connect the other end of this resistor to a positive variable voltage, with the negative of



Here is a close-up of the VCO/PLL circuitry inside its shield box, on the author's board. Many of the power supply parts are also visible, on the right. Note that many capacitors in the project have one lead soldered to the top 'ground plane' copper.

this source connected to the tranceiver's ground. Initially this voltage source should be adjusted for 0 volts.
4. Turn on the main power supply again. All of LEDs D701-710 should still be off, but as you start increasing the voltagefrom the variable supply, they should come on progressively. The input voltage for 'full scale' (all 10 LEDs on) should be about 7 volts (1.25-1.30V on pin 5 of U704).
5. Turn off the power, disconnect the variable supply and remove the 100k resistor.

PARTS LIST 3: VCO & PLL circuitry

Qty	Description	Location
3	10 ohm 1/4W	R412, R414, R415
5	100 ohm 1/4W	R411, R413, R419, R421, R424
2	220 ohm 1/4W	R410, R416
2	330 ohm 1/4W	R407, R418
4	1k 1/4W	R422, R425, R426, R427
1	2.2k 1/4W	R423
3	4.7k 1/4W	R401, R404, R406
5	10k 1/4W	R402, R405, R408, R409, R420
1	47k 1/4W	R417
1	2.2pF NPO	C415
2	3.3pF NPO	C406, C409
1	4.7pF NPO	C410
1	5.6pF NPO	C411
1	10pF NPO	C417
1	12pF NPO	C408
1	15pF NPO	C407
1	47pF NPO	C425
1	56pF NPO	C424
15	1nF ceramic	C401, C402, C404, C412, C414, C416, C418, C419, C427, C428 C429, C430, C431, C432, C420
4	0.1uF ceramic	C403, C421, C422, C435
1	1uF/16V tant.	C433
1	10uF/16V tant.	C434
2	33uF/10V tant.	C413, C423
2	20pF trimcap	C405, C426
1	Red coil, 2.5T	L401
1	RF choke, 10uH	L402
1	BB405 varicap	D401
1	MC301 diode	D402
1	2SK125 FET	Q401
1	BC548 transistor	Q402
2	2SC1923 trans.	Q403, Q404
1	M54959P PLL chip	U401
1	78L05 regulator	U402
1	10.240MHz	XT401

5. VCO-PLL CIRCUIT

Now you can turn your attention to the VCO-PLL circuitry, which was shown in the schematic of Fig.4 in the first article.

The components for this section are all identified with '4XX' numbers, as listed in parts list 3. Most of them mount inside the larger of the two shield boxes, with only five resistors and two capacitors 'outside'.

Many of the capacitors, and some of the transistors and diodes of this section have one lead connected to the ground plane copper on the top of the board.

As the space inside the shield box is rather confined, I suggest that you fit these components before the rest. This allows you to make the ground-plane joints a little easier than otherwise, and with less risk of damaging either the components concerned, or others nearby.

Then you can follow the usual order, with low profile components such as resistors, capacitors, diodes and ICs.

As the box walls underneath can make it hard to bend over some of the component leads to hold them in place for soldering, you might wish to use a small blob of 'Blu-tack' as a holding aid.

Pay particular attention to the orientation of polarised components such as electrolytic capacitors and diodes — removing and replacing them later would be very awkward.

When you're soldering in the plastic components such as the trimmer capacitors and the adjustable coil, be careful not to melt the plastic bodies.

Also take considerable care with the PLL controller chip U401, as it is an expensive part. I suggest that you fit this component second last, followed only by the crystal XT401.

Testing:

1. Adjust the core of L401 so that it is at the same level as the top of the plastic coil former.
2. After checking that the ends of the two On/Off switch wires are still joined together, apply a 13.8V supply.
3. Measure the voltage between either end of resistor R424 and ground. This should be close to 0 volts.
4. Now connect the PCB pin marked 'PTT' to ground, and turn the core of L401 clockwise into the former, with an alignment tool. After about 1-1/2 turns, the voltage on R424 should increase to 2-4 volts. At this stage, the voltage at pin 10 of U401 should be low. This means that the PLL is in lock.
5. Adjust the voltage on R424 to 3.0V by tuning L401.
6. Remove the ground from the PTT pin, and this time adjust trimcap C405 to bring the voltage at R424 back to 3.0V. Make sure that the front display shows '7000' (corresponding to 147.000MHz), and that the RPRT offset function is switched off.
7. Repeat steps 4, 5 and 6 until the PLL voltage remains at 3.0V in both the receiving and transmitting modes.
8. Try tuning to the bottom of the band (display reads '4000'), and then to the top end ('7999'). Confirm that the voltage at R424 is higher than 0.5 volts at the low end, and no higher than 4.5 volts at the high end.
9. Connect a frequency counter to the LO output (the end of R414 nearer to the edge of the board), then connect the PTT line to ground. Now adjust trimcap C426 to get the same reading on the transceiver's display as measured on the frequency counter.

Troubleshooting

In the event of trouble with any of the above steps, check the following DC voltages with a high-impedance multimeter:

U402	input	7.0V
	output	5.0V
U401	pin14	5.0V
Q404	collector	3.0V
	base	0.7V
Q403	collector	5.6V
	emitter	2.1V
	base	2.8V
Q401	drain	5.0V
	source	5.1V
Q402	collector	0.1V (RX), 5.0V (TX)
	base	0.7V (RX), 0.4V (TX)

(Note: The collector voltage might vary slightly, due to transistor gain tolerance, etc.)

If necessary, verification that Q401 is oscillating, and Q404 and Q405 are amplifying, can be done with a simple two-diode RF probe as described later in this article. The following DC levels were measured with such a probe, connected to a high input impedance multimeter. You should be able to read similar levels, although they might be little different due to the different V-A characteristics of the probe diodes. The levels shown in brackets were measured with more advanced test equipment with a 50-ohm input impedance:

Source of Q401	600mV
Collector of Q403	290mV (-4dBm)
Collector of Q404	400mV (-2dBm)
U401 pin 1	380mV (-2dBm)
LO output (R414)	200mV (-5dBm)

2m Transceiver

By connecting a frequency counter, capable of measuring up to 200MHz, to the LO output you can check the output frequency.

This frequency (whether the PLL is in or out of lock) must be able to be adjusted by tuning coil L401 over the range 144-148MHz in transmit mode (PTT pin grounded), and over the range 133.3- 137.3MHz in receive mode.

The reference oscillator within the PLL synthesiser chip U401 can be checked with an oscilloscope. Connect the CRO input to pin 14 of U401, using a 10:1 probe to minimise loading effects.

This level should be an AC signal of about 1V p-p, with a period of about 100ns (corresponding to 10.24MHz). This test point is at a very high impedance, and therefore will not drive many standard frequency counters as these often have high input capacitance or low input impedance.

If you try connecting one of these the oscillator will either change frequency or stop oscillating altogether.

As the test pin of U401 (pin 13) is connected to ground, the DC output level on pins 6 and 7 of this IC are controlled by serial data from the CPU.

The DC output from these pins is used for high and low RF power switching.

With pin 13 connected to logic 1 (+5V at pin 16), pin 6 of U401 becomes the output of the reference oscillator divided by the reference divider, and the pin 7 output is the input frequency divided by the programmable divider. So if it becomes necessary to check the operation of the built-in dividers of the PLL chip, you will have to de-solder pins 6, 7 and 13 from the PCB, or cut the tracks leading to them.

Next, connect pin 13 to pin 16, and check the signal on pin 6. It should be 5.00kHz. Also check the signal on pin 7 — this should again be close to 5kHz, as defined by the formulas:

f(pin7)=f(input)/(f(display)/5kHz), in transmit

=f(input)/((f(display) 10700kHz)/5kHz), in receive

After you have checked these, you'll have to disconnect pin 13 from +5V and reconnect pins 6, 7 and 13 as they were before.

The serial data, clock and reset signals from the CPU should look like Fig.11, with a clock period of about 100us. Check with a CRO that the inputs on pins 3, 4, and 5 of U401 are less than 0.6 volts for a logic low, and more than 2 volts for a logic high.

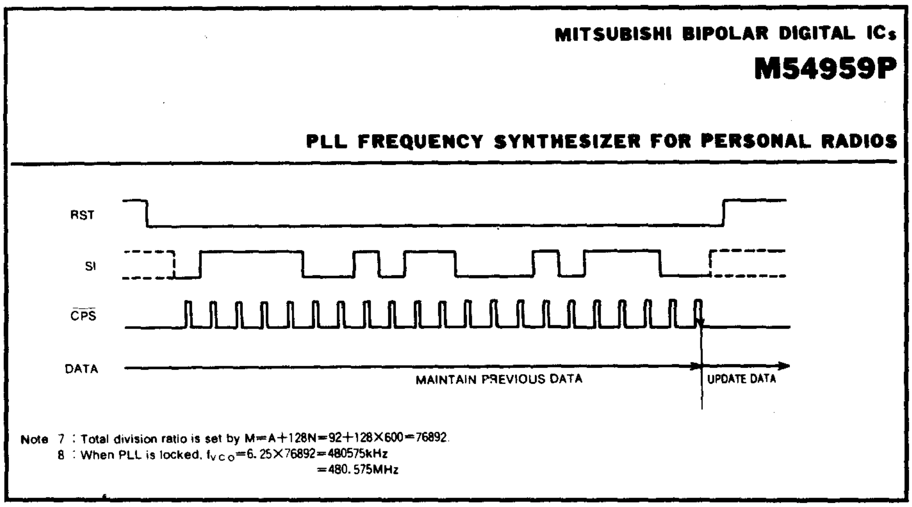


Fig.11: The serial data (SI), clock (CPS-bar) and reset (RST) signals fed from the CPU to the PLL chip (U401) should look like this, should you need to check them. But signals are only sent when a 'frequency change' control is operated.

Transmission of data from the CPU is only activated by changing a frequency control, such as turning the rotary encoder, grounding or ungrounding the PTT pin and so on.

When the PLL is locked, the signal on pin 9 of U401 should look like Fig.12.

If the PLL is unlocked, and the divided input frequency is higher than the reference frequency in the phase detector of U401, then the voltage on pin 9 of this chip should be close to 0 volts.

If the input frequency is lower, this voltage should be close to 5 volts. By slowly tuning the core of L401 and monitoring the voltage on pin 9 with a CRO or multimeter, you should be able to see the PLL trying to lock.

This indicates a problem around the lowpass filter R421-424 and C433-436, or tuning varicap D401 (perhaps the diode is connected in back to front).

If the PLL locks only in transmit mode, or only in receive mode, check the voltage on the collector of Q402.

In receive mode this should be less then 1 volt, while it should rise to about 6V in transmit mode.

Tune the VCO so that the PLL is out of lock, by adjusting the core of L401 deep into the coil, and then verify if the frequency of the local oscillator can be adjusted by trimcap C405 for about 8% frequency change between receive and transmit.

If the PLL doesn't remain in lock across the whole band, due to component spread, then the value of C407

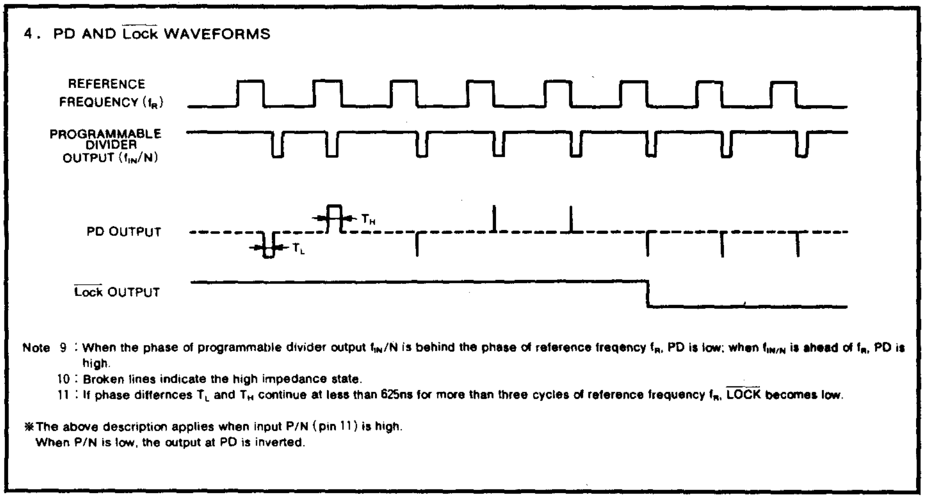


Fig.12: Waveforms associated with PLL chip U401, for both locked and unlocked conditions. Pin 9 is the PD output; pin 10 is the Lock-bar output (L= locked).

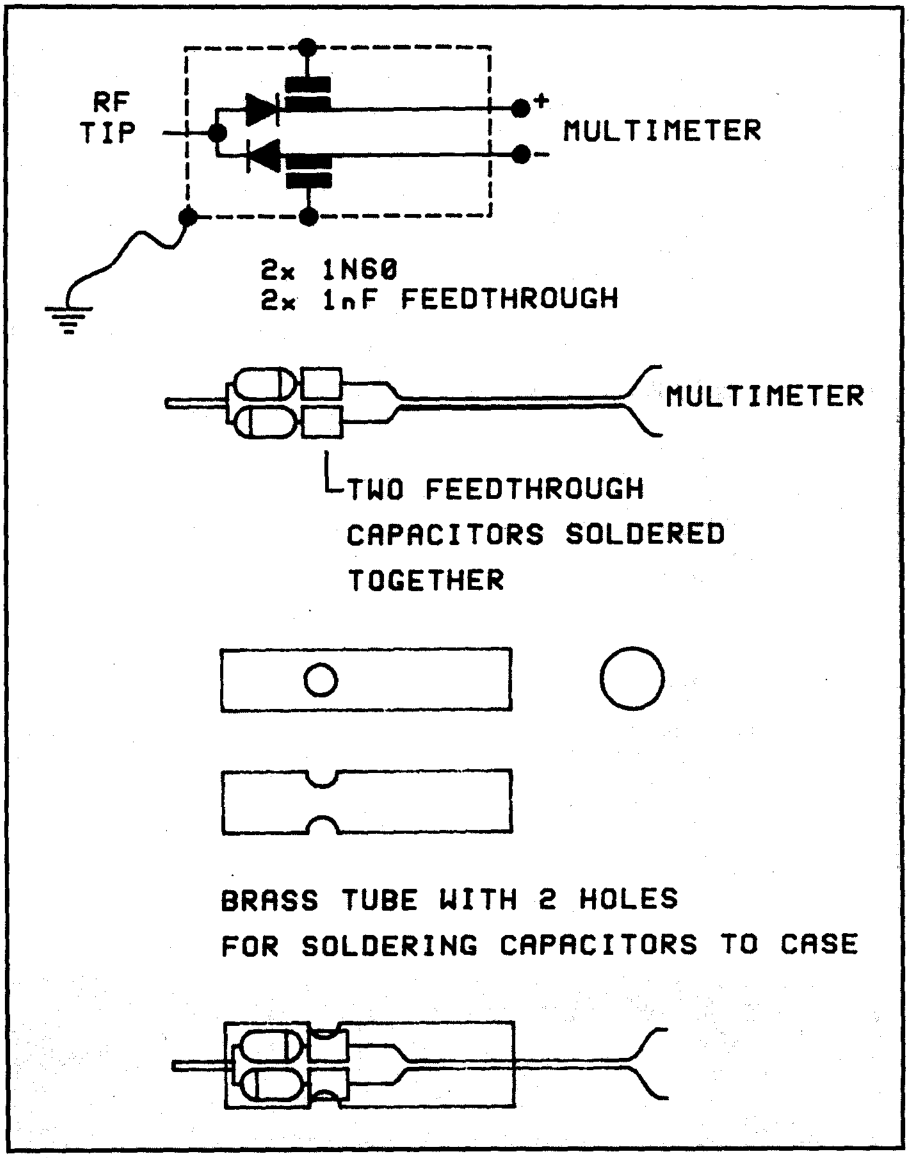


Fig.13: The circuit and construction details for a simple RF probe which can be used for checking oscillator and buffer stage operation in the transceiver, if this proves to be necessary. It must be used with a 'floating' multimeter or DMM.

should be slightly increased for receive, and C408 slightly increased for transmit.

Finally, the so-called PLL noise can be checked using a VHF communications receiver. By listening to the LO frequency with the receiver set to SSB, you will be able to check the noise output and PLL locking time.

With the receiver set to FM you may be able to check the level of FM noise. A high frequency 5kHz tone means there is insufficient filtering in the PLL low pass filter (R421-424, C433-435). All noise components should correspond to less than 0.1kHz deviation (more than 50dB below the signal).

With the receiver set to AM, you can listen for any AM noise. If present this will be most likely caused by lack of bypassing and filtering of the supply and inputs to the PLL and LO. If you have a modulation meter, the level of modulation should be less than 1%.

Simple RF probe

A lot of simple RF probes have been described over the years, but many are unable to measure a wide range of signal levels over a wide frequency range without significantly loading the circuit under test.

Expensive commercial RF voltmeters usually measure RF by comparing the unknown RF signal with a known low frequency signal, in two identicial rectifiers.

The older RF millivoltmeters usually employ a thermionic diode with good results.

So-called 'ZBD' or zero-bias diodes are suitable for measuring too, but in addition to their high price, they generally have low reverse breakdown voltage ratings.

Consequently ordinary germanium, silicon or Schottky diodes seem to offer the best characteristics for a simple, practical probe.

The disadvantages of these diodes are that they are very non- linear for low levels and their transfer characteristic is very temperature dependent. Germanium diodes offer good sensitivity, but are very non-linear; silicon diodes have poor sensitivity, but can have the highest break down voltages.

Schottky diodes give good linearity, being more sensitive than silicon diodes, but have reverse breakdown voltages only in the tens of volts.

They are suitable for probes operating into the GHz range.

Although the sensitivity and linearity can be improved by forward biasing the diodes by a few microamps, this significantly decreases the probe's input impedance.

For our purposes the main requirement is the ability to measure low levels of RF. The RF probe described here therefore uses two germanium diodes (e.g., 1N60), in a symmetrical voltage doubler configuration.

To minimise the effects of the probe tip, there is no series capacitor at the tip. Instead, the configuration allows the two DC storage capacitors to also provide DC isolation — assuming that the multimeter with which it is used, is not grounded.

The upper cutoff frequency of an RF probe is usually determined by the tip inductance and the diode capacitance, which together form a low-pass filter. The cutoff frequency of the diodes themselves is usually higher than the roll-off of this low-pass filter.

To maximise probe response it is therefore preferable to use a short, thick tip, as this will minimise tip inductance.

Details of the probe's construction are shown in Fig.13. The prototype probe was constructed inside a piece of 1/4" internal diameter brass tubing, as available in many hobby shops.

The centre conductor of the feedthrough capacitors can be removed using a soldering iron.

The diode leads are then passed through the remaining hollow ceramic tubes, which are pushed up so as to be as close to the case of the diodes as possible.

Solder the diode leads to the inner conductive plating on the feedthrough capacitors, and solder the outer plates of the two capactors together. Then twist together the leads at the other end of the diodes and cut and solder them to form a short, thick tip.

Solder some flying leads onto the the two diode leads where they emerge from the feedthrough capacitors.

The whole assembly can now be slid into the brass tube. Solder the outside of the capacitors to the inside of the tube.

The probe tip can be fixed into position using epoxy resin, or with suitable heatshrink material.

Note that, as stated previously, the meter used with the probe must have both terminals isolated from ground (i.e., as is the case with common battery-powered multimeters in plastic cases).

Probe calibration

If you want to be able to deduce the true RF voltage at the probe tip from the DC reading on your multimeter (not essential for this project), you'll need to calibrate the probe.

The easiest way to derive a calibration chart is to use an RF signal generator with calibrated output level, terminated into a 50-ohm load.

If an RF generator is not available, an audio generator can be used instead, although with somewhat lower accuracy.

The true AF voltage can be measured with a CRO, or a multimeter if it has adequate AF bandwidth.

If you do not have any of above equipment, you might use a low power transmitter (e.g., a 2m hand-held), with a step attenuator (e.g., DSE's kit K-6323).

From the specified or measured output power of the transmitter, the RF voltage can be easily calculated for the full output and for each of the attenuated outputs.

Amateur radio publications such as the ARRL or RSGB handbooks publish equations and tables for calculating voltage from the power into 50 ohms, the voltage ratio from decibels, and so on.

As mentioned above, germanium-diodes are very temperature sensitive. A temperature change of 10° can cause significant error when reading voltages below about 0.5 volts.

For voltages above 1 volt the error is insignificant.

Therefore when reading low level signals, care should be taken to ensure that the diodes are at approximately the same temperature as when the probe was calibrated.

That's it for the present. In the next of these articles we'll continue with the transceiver assembly.

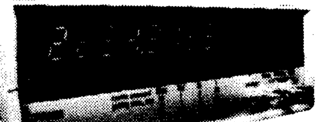
(To be continued) ■

MAIN ITEM PARTS LIST

1 Main PCB, code ZA-1413
1 CPU PCB, code ZA-1414
1 Display PCB, code ZA-1415
1 RF Power PCB, code ZA-1416
1 75mm speaker
1 Plastic case (two halves)
1 Front panel
1 Rear panel
1 8-pin mic socket, with plug
2 Small control knobs
1 Large control knob
1 Pack of tinplate shields (16)
2m length of 'rainbow' ribbon cable for interconnections; 1 x in-line fuseholder with 10A 3AG fuse; small tube of silicone grease for PA module heatsinking.

PHONEORDER TOLL FREE ALTRONICS 008 999 007

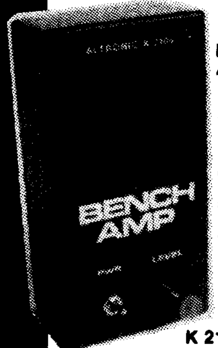
1 GHz Digital Frequency Meter



K 2515 WAS $299
NOW $249 SAVE $50

(See Silicon Chip Nov '87, Jan '88)
This superb 1GHz Frequency Meter will out perform many other instruments twice its price.

Features include: • Professionally machined and screen-printed red perspex front panel • Easy to assemble • Bright Hewlett Packard 8 digit display • Electronic switch latching • High performance IC's • High Quality components. **Specifications:** Operational Modes: Period frequency to 100MHz freq. to 1GHz freq. **Range:** 100Hz to 1GHz (1.7GHz typical) in frequency mode; 10Hz to 2.5MHz (5MHz typical) in period mode. Gating times: 0.01, 0.1, 1.0 and 10 seconds (10MHz and 100MHz ranges); 0.128, 1.28, 12.8 and 128 seconds (1GHz range).



BENCH AMPLIFIER

(See ETI April '80)
Invaluable for testing all your audio projects.
• 250 milli watts output into 4 Ohms • Runs off single 9V supply • Can give 0.5 watts when run on 12V + heatsink • Complete kit housed in "ABS" jiffy box.

K 2105 ~~$22.70~~ $20

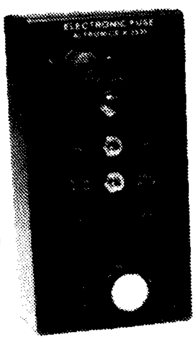
TWIN RANGE LED TACHO

(See ETI Aug '80)
O-1000 RPM/O/10,000 RPM
This unit is suitable for 1, 2, 3, 4, 6 and 8 cylinder vehicles, both 2 stroke and 4 stroke. Fully compatible with conventional CDI and transistorized ignition systems. Includes protection circuitry to prevent noise and high voltage spikes over-revving occurs. Only requires 3 connections to the electrical system.
K 4324 Normally $32.

This month even more fantastic value at only $20. SAVE $12.

DC ELECTRONIC FUSE

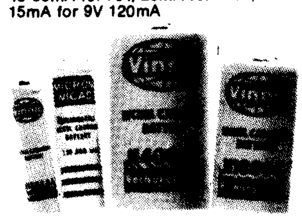
(See EA Nov '87)
Calling all servicemen and bench technicians This unit simply clips across the DC Fuse holder. Offers protection adjustable from 0-10A in two ranges. In essence it's an adjustable DC circuit breaker.



Features: Fast blow - slow blow setting. Manual reset button. LED fuse tripped indicator. Operates off 1 single 9V battery (not supplied). Two current settings easily adjustable via a pot and calibrated scale.
K 2535 Normal Price is $39.50
This Month $34.50

BONANZA NI-CAD SALE!

Premium Grade — Good for up to 1000 recharges!
Charge rates:
45-50mA for AA, 20mA for AAA, 10-15mA for 9V 120mA

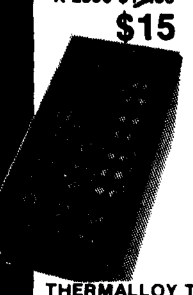


Cat No.		THIS MONTH 1-9	10+
S 5020	**AA** 1.2V 500mAh	$2.50	$2.00
S 5021	**AAA** 1.2V 180mAh	$3.50	$2.90
S 5022	**C** 1.2V 1.8Ah	$8.00	$7.00
S 5023	**D** 1.2V Massive 4Ah	$12.00	$10.00

TRANSISTOR TESTER

(See EA Aug '83)
Checks transistor in circuit "NO NEED TO UNSOLDER SUSPECT TRANSISTORS"

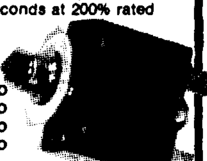
K 2530 ~~$17.50~~ $15



Features:
• Tests both NPN and PNP transistors in circuit at the touch of a switch. • Tests Diodes and SCRs as well. • No need to switch between NPN and PNP - its automatic. • LED indication to show condition of device.

LOW COST RESETTABLE CIRCUIT BREAKER

• Will hold 100% of rated current indefinitely at 25°C. • Will trip within 1 hour at 125% of load at 25°C. • Will trip within 4-40 seconds at 200% rated load.

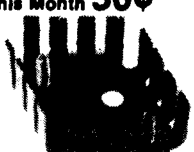


S 5503 3 Amp
S 5505 5 Amp
S 5510 10 Amp
S 5515 15 Amp
S 5520 20 Amp
S 5525 25 Amp

ALL $3 each.

THERMALLOY TO3

Heat Sink Bargain
H 0503 Value at $1.50
This Month 50¢



TRANSISTOR FET ZENER TESTER

(See EA Feb/Mar '88)

New updated circuit incorporates facilities for testing transistors FET's and Zeners etc.
FEATURES:
• Gain • Leakage • Breakdown voltages • Zener voltage • Polarity - NPN/PNP

K 2527 ~~$55~~ $45.

"Viatel" (now "Discovery") Sensation!

UNBELIEVABLE VALUE! (AROUND $250) FROM $30

Altronics has recently purchased this quality stock auctioned by the liquidator of DTX Australia LTD.

You can use this equipment to gain limited access to the "Viatel" information system. Each unit contains a Telecom approved modem and information decoding circuits.

The single PCB is a goldmine of quality components for the enthusiast, including the fantastic valuable SAA 5020 and SAA 5050 chips.

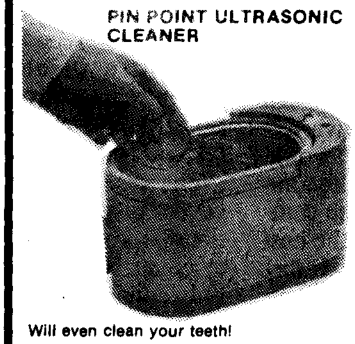
ALL STOCK BRAND NEW Sorry no warranty at this price.
Look at this list of component parts!
• Mains Transformer - 240-9/15/24V 300ma • Line isolation Transformer - Telecom approved 600/600 Ohm or 600/150 Ohm impedance • Video/RF Modulator (Channel 0) • Low profile 12V 5A SPDT Relay • Capacitor - 2.0uF 440V AC • Crystals - 6MHz and 4.43MHz • TTL, CMOS, Liniar and LSI ICs - SAA 5020, SAA 5050, 2516 and many more • Voltage regulators • Bridge rectifiers • Trimpots and capacitors • Filter capacitors • Flatpack heatsink 1 Plus much, much more!

VIATEL VIDEOTEX MODEM DECODER

Three models to choose from; Each with a numeric keypad.

X 1000 with RF output ~~$29.95~~ $25
X 1002 with RF o/p & telephone handset ~~$34.95~~ $29
X 1004 with RF and RGB video o/p ~~$34.95~~ $29

PIN POINT ULTRASONIC CLEANER

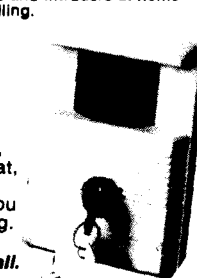


Will even clean your teeth!
Earns its cost hundreds of times over in cleaning connectors, PCB's, switches, jewellery, glasses, watches, drafting pens, etc. Awarded the Good Product Design Award for CETDC in 1987.
A 0100 Top Value Normally $199
ONLY $149 this month

BATTERY OPERATED PORTABLE P.I.R. INTRUSION ALARM

Ward off thieves and intruders at home and when travelling.

This super handy, go anywhere P.I.R. alarm system is great for shop, office, caravan, boat, garage and whenever you are travelling. ***Extremely easy to install.***



FEATURES:
• Exit delay • Entry delay • Large coverage - up to 100 square metres • Low battery LED indicator • 9V Alkaline battery (not supplied) lasts many months.

S 5305 ~~$60~~ $49

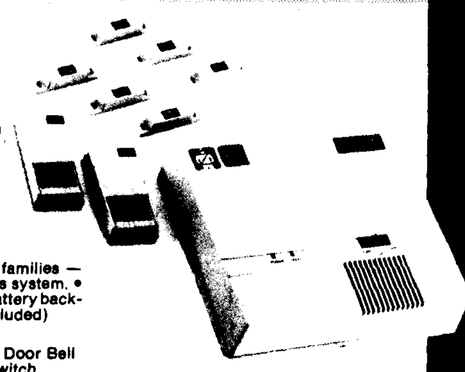
THE PROTECTOR ALARM KIT

(See SC Feb '88)
This refined car burglar alarm has about every feature you could possibly want to keep would-be thieves away.
Features: Internal and External Sirens. Dash Lamp Flasher. Battery back-up. Delayed and Non-delayed inputs. Easy to build and install.
K 4370 Was $129
Now a Great Special at $119

BONUS OFFER
We will include a set of 4 Car Alarm WARNING stickers ($3.95 value) ABSOLUTELY FREE with every Car Alarm Kit ordered this month.

SUPER GUARD HOUSEHOLD ALARM SYSTEM

• Easy to operate Simplicity itself — just select the switch to Home, Off or Away as desired. A 45 second exit/entry delay allows you to vacate and/or re-renter your premises and disarm the system. • No key switches or code buttons to push.
Thus the system is ideal for families — even the kids can operate this system. • Facility for external siren. • Battery back-up (battery 8 'C' cells not included)



System Contents:
• Master Control unit • Front Door Bell Switch • Panic/Emergency Switch
• Three Window/Door Reed Switches
• Mounting Hardware • 20 Metres Wire
• Instruction Manual.

Complete System S 5465 only
~~$125~~ now $85

PHONEORDER TOLL FREE ALTRONICS 008 999 007

Construction Project:

INTELLIGENT BLINKER UNIT

Eliminate the possibility of driving with your blinkers still flashing, with this intelligent blinker unit. It will turn them off for you when you forget, making driving safer for both you and others. As an extra feature, a buzzer sounds when the blinkers are operating, and remains on to tell you to cancel the blinker switch if automatic cancelling has occurred. It's clever, simple and easy to install.

by JEFF MONEGAL

The problem of the forgotten turn indicator is all too common. We don't need to describe the danger that can result, as most drivers will have experienced the situation. Some would argue that a unit such as the one described in this project should be compulsory on all vehicles, as even the best drivers fall foul of a blinker switch that fails to cancel. In fact, the idea came about as result of my own failure to cancel the blinkers after a lane change, while driving to work some months ago. Not only embarrassing, but a reminder of one's fallibility!

There have been various attempts to create the 'perfect' blinker system, usually based on a time delay. However, this method is not really useful in traffic, as very often sitting at a set of lights is sufficient time for the blinkers to cancel before you have even turned the corner.

Another problem is the low level of audible feedback provided by some types of flasher units. Under noisy conditions, or for the hard of hearing, the metallic clicking provided by thermally operated flasher units is often too soft to hear.

This project solves all of these problems. It will turn off the blinkers automatically after a preset distance has been travelled and it has a buzzer that pulses with the blinkers. The buzzer will remain on, rather than pulse if the unit has turned off the blinkers for you. This is the signal that the blinker switch is still on, and the buzzer stops when the blinker switch is cancelled.

To measure the distance travelled by the vehicle when the blinkers are first turned on, a sensor consisting of a coil and two magnets is fitted to the tail shaft. This type of sensor was fully described in our Digital Speedo, presented recently in *EA*. In fact, it is possible to use the same sensor to operate both the speedo and this project.

The distance before automatic reset occurs is selectable, to allow for variations between vehicles. A counter is used to count pulses from the sensor, and a link connects the counter output that provides the most suitable distance. In the prototype, a distance of 250 metres was selected, although this is a matter of choice for individual constructors.

The audible warning occurs approximately two or three seconds after the unit has switched off the blinkers, giving time to cancel the blinker switch before the warning occurs.

The project has been designed for easy installation. All that should be necessary is to remove the existing blinker unit and to put this one in its place. Admittedly fitting the sensor will require diving under the car, but even this part of the installation is relatively simple. The unit is assembled on one printed circuit board, which fits inside a jiffy case that can be mounted under the dashboard.

It's simple to build and install and takes one more worry out of driving. Now to the description of the circuit.

How it works

The circuit contains two timers (IC1 and IC2) that determine the flash rate of the blinker lights, and a distance counter (IC3) to stop the blinkers after a preset distance has been travelled. The blinker lights are operated by a relay (RLA), in turn driven by Q4, and the input sensor (coil and magnet assembly on the drive shaft) clocks the distance counter via transistor Q2. A flipflop is formed by IC4a and IC4b, and the buzzer, driven by Q1 is operated by the outputs of IC2 and the flipflop.

The 555 timers of IC1 and IC2 are both connected as monostables with IC1 controlling the 'on' time of the blinker lights and IC2 controlling their 'off' time.

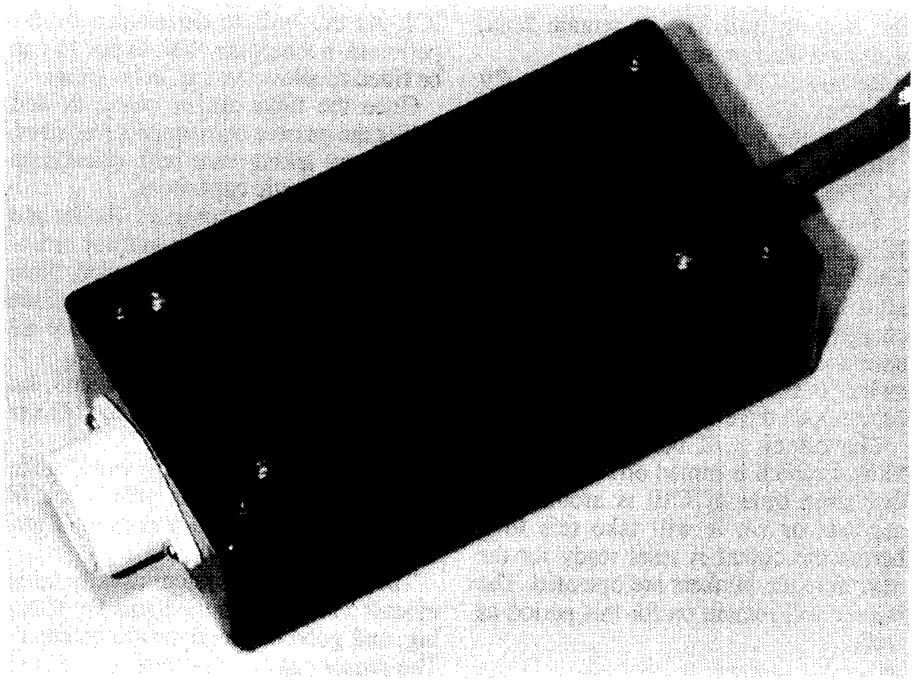
When the indicator switch is in its neutral position, R2 pulls the trigger input of IC1 high via diode D2, setting the output of IC1 (pin 3) to a low. IC2 is triggered by the output of IC1, and under quiescent conditions, its trigger input will be pulled high by R5, setting the output of IC2 to a low.

Resistor R2 will also set the input of IC4c to a high, giving a high at the output of IC4d. This will reset the output (pin 3) of the flipflop created with IC4a and IC4b, and also hold the counter IC3 in the reset condition. The low at the output of the flipflop will hold transistor Q3 off and, via IC5b and IC5c, Q1 (and the buzzer) will be held off.

If the blinker switch is operated the blinker lights will pull the cathode of D1 low, as at this stage, the relay contacts are still open. Under these conditions, D2 will be reverse biased and R3 will pull the trigger input of IC1 low, causing its output to go high.

The high at the output of IC1 will turn on transistor Q4, which in turn operates the relay, connecting the blinker lights to +12V via the relay contacts.

When the contacts operate, D1 will be reverse biased, allowing R2 to pull the trigger input of IC1 back to a high. The time the output of IC1 remains high is determined by R4 and C2, which for the values shown is around a quarter of a



Add intelligence to your vehicle's blinker system. If you forget, it will automatically turn the blinker lights off and warn you to reset the turn indicator.

second. When IC1 has timed out, its output will go low, triggering IC2 via C3.

This will set the output of IC2 high, which turns on Q1 via R17, sounding the buzzer. Because the output of IC1 is now low, the relay and therefore the blinker lights will be turned off. The output of IC2 is also connected to the trigger input of IC1 via diode D3.

The delay time of IC2 is determined by R6 and C5, and the values chosen give a delay of 250ms as for IC1. Once the delay period has expired, the output of IC2 returns to a low, reverse biasing D3. This allows the low present at the cathode of D1 to retrigger IC1, as already described.

In summary, when the blinker switch is operated, IC1 is triggered thereby operating the relay via Q4, causing the blinker lights to turn on.

When IC1 completes its timing cycle, IC2 is triggered. The buzzer now sounds, and the lights are turned off. Once IC2 has timed out, IC1 is retriggered, the buzzer stops and the cycle continues, at least until IC3 takes over. As already described, when the blinkers are turned off, a high is present at the anodes of D1 and D2, which via R7 gives a high at the inputs of IC4c. This sets the output of IC4c to a low, and C10 will be held in the discharged state. The resulting high at the output of IC4d holds the counter in the reset condition, preventing it from counting. When the blinkers are turned on, the low at the anodes of D1 and D2 causes the output of IC4c to become high. Capacitor C10 is now charged rapidly via D5 and R11 and the output of IC4d will be low. This now allows the counter to respond to the pulses supplied from the sensor.

The sensor consists of a coil placed close to two magnets attached to the drive shaft (or drive axle for front wheel drive cars) and the voltage pulses from the sensor are fed to D6.

When a positive pulse occurs from the sensor, D6 will be reverse biased — allowing Q2 to turn on via R13. The collector of Q2 will therefore be pulled low and the inverting buffer of IC5a will supply a high to the counter. When the sensor output falls below 0.6V, the clock input will be low. The counter increments at each negative transition at its clock input, but only if the reset terminal (pin 11) is low.

When the blinkers are operating, a square wave signal will be present at the anodes of D1 and D2, due to the relay being operated by the timers. The output of IC4c will also be a square wave, but the long discharge time for C10 provided by R10 prevents the output of IC4d from following this signal. Thus the output of IC4d will remain low during the cycling of the blinkers, keep-

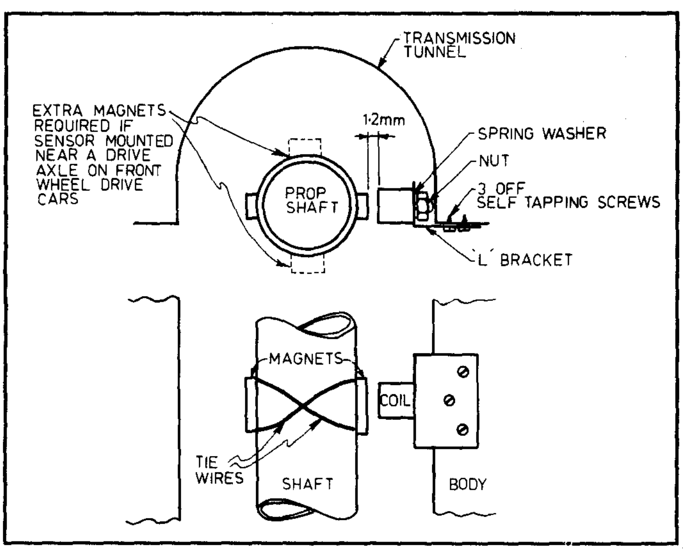
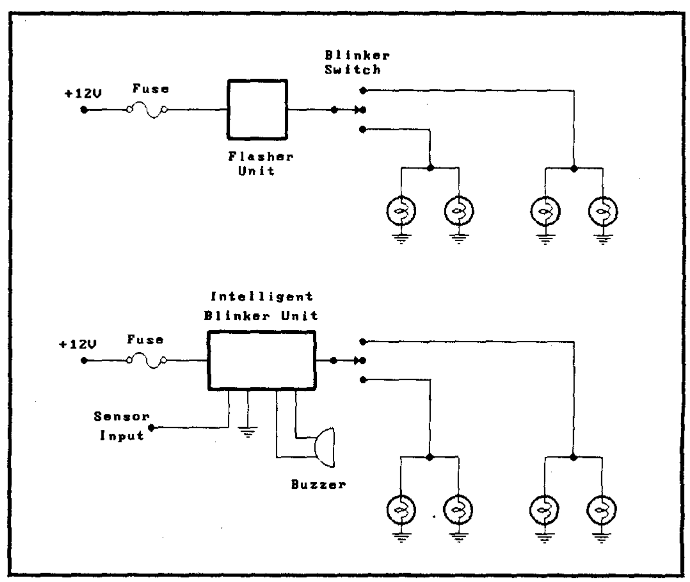


Fig.1: This diagram shows how the sensor is fitted. The magnets are held by double sided tape and strong wire wound over the magnets. Space the coil 1-1.5mm from the magnets..



Most vehicles have their blinker lights connected as in (1). Installation requires the existing flasher unit to be replaced with this project as shown in (b).

ing the counter enabled. If the blinkers are turned off, C10 will discharge after approximately two seconds, and the counter will be reset by the low at the output of IC4d.

In other words, while the blinker lights are flashing, C10 is charged to a level high enough to stop the counter from being reset, thereby allowing counting of the pulses from the distance sensor to occur.

After a preset number of pulses have been counted by IC3, the output from IC3 that connects to pin 6 of IC4b will become high. This sets the output of IC4a high, turning on transistor Q3. As the collector of Q3 is connected to the base of Q4, the base current being supplied by R16 is diverted to ground through Q3, turning Q4, the relay and hence the blinker lights off.

The counter output used to operate IC4b is selectable, and in the prototype, pin 15 was used as it gave a distance of around 250 metres.

The correct output will need to be found by experiment and will vary between vehicles. Output Q12 gives the longest distance, and output Q9 the shortest.

If the counter has stopped the blinker lights from flashing, the blinker switch will therefore still be turned on and D1 will be forward biased. The two timers will stop cycling, with the output of IC1 high and that of IC2 low. The counter will still be counting, but the output of the flipflop (pin 3) will remain high, waiting a reset pulse from IC4d.

Because D4 is reverse biased, C9 charges through R9. After a few seconds, the voltage across C9 will rise sufficiently to give a logic 1 to the input of IC5b.

This will cause a high at the output of IC5c, turning on transistor Q1 via R12. The buzzer will now sound continually, after having remained silent during the charging period of C9. The continual sound will indicate that the blinker switch is still on, even though the relay has stopped the blinker lights.

The circuit will be reset when the blinker switch is turned off. Because the discharge time of C10 is around two seconds or so, it will take this long before the circuit is reset ready for the next time the blinkers are operated. The buzzer will remain on for this period as well.

Construction

Construction of the unit is quite straightforward. As usual, check the PCB for manufacturing faults and drill the mounting holes for the board before starting.

It may also be necessary to chamfer the corners of the board to allow it fit inside the recommended case.

There are five links fitted to the component side of the board, and one insulated link on the copper side. The link that sets the distance travelled before automatic cancelling occurs is connected from pin 6 of IC4 to one of four possible pins (15, 14, 12 and 1) from IC3. As this will be determined by experiment, a temporary link to pin 15 can be fitted to allow the unit to be tested.

Once the links are in place, fit and solder the passive components (resistors, capacitors) taking care with orientation of the electrolytic capacitors.

Next mount the transistors, diodes and the IC sockets. Sockets are not essential, but are highly recommended. Note that diode D7 is a 1N4001 power diode and that the remaining diodes are all small signal types.

Finally, connect the buzzer and the leads that connect the unit to the blinker system.

Use heavy gauge (7 amp) wire for the leads that connect to the vehicle's 12V system, blinker switch and ground terminals.

The blinker light system usually takes at least 5 amps when the lights are flashing, and good connections are essential. The sensor can be connected either with a single wire if one terminal of the sensor is grounded at the mounting point. Otherwise, run two wires to the sensor, with one wire connected to the ground point of the PCB.

Testing the unit

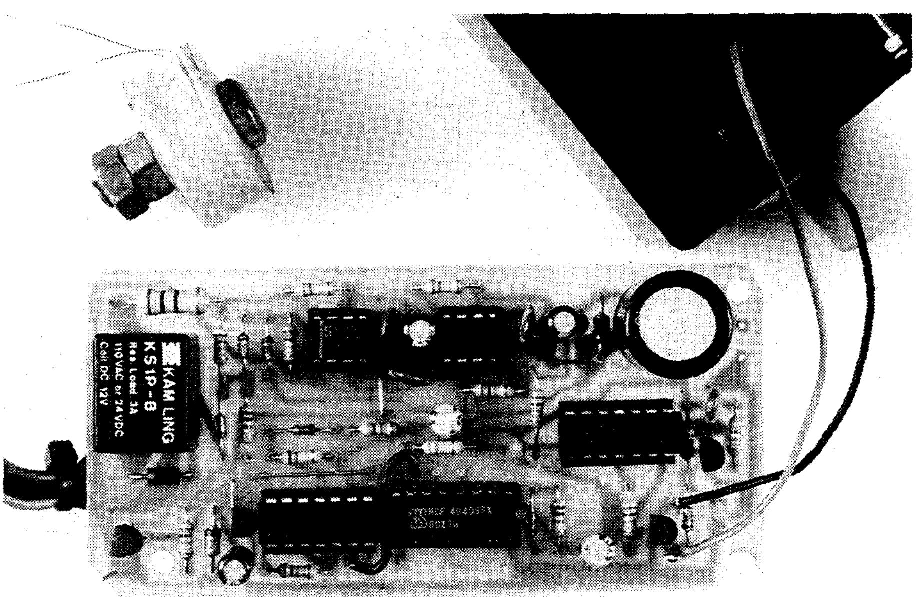
Once the unit has been assembled and examined for construction faults, it can be tested. Rig up a 12V lamp by connecting two leads to the lamp, then connect the board to a suitable 12V supply.

When power is first applied, the relay should pull in after a small delay (one second or so) and the buzzer will probably give one short burst of sound. Then connect the test lamp between ground (0V) and the wire that goes to the blinker switch. If all is well, the lamp should flash at a rate typical of an automotive blinker system (two or three pulses per second) and the buzzer should sound during the lamp off time.

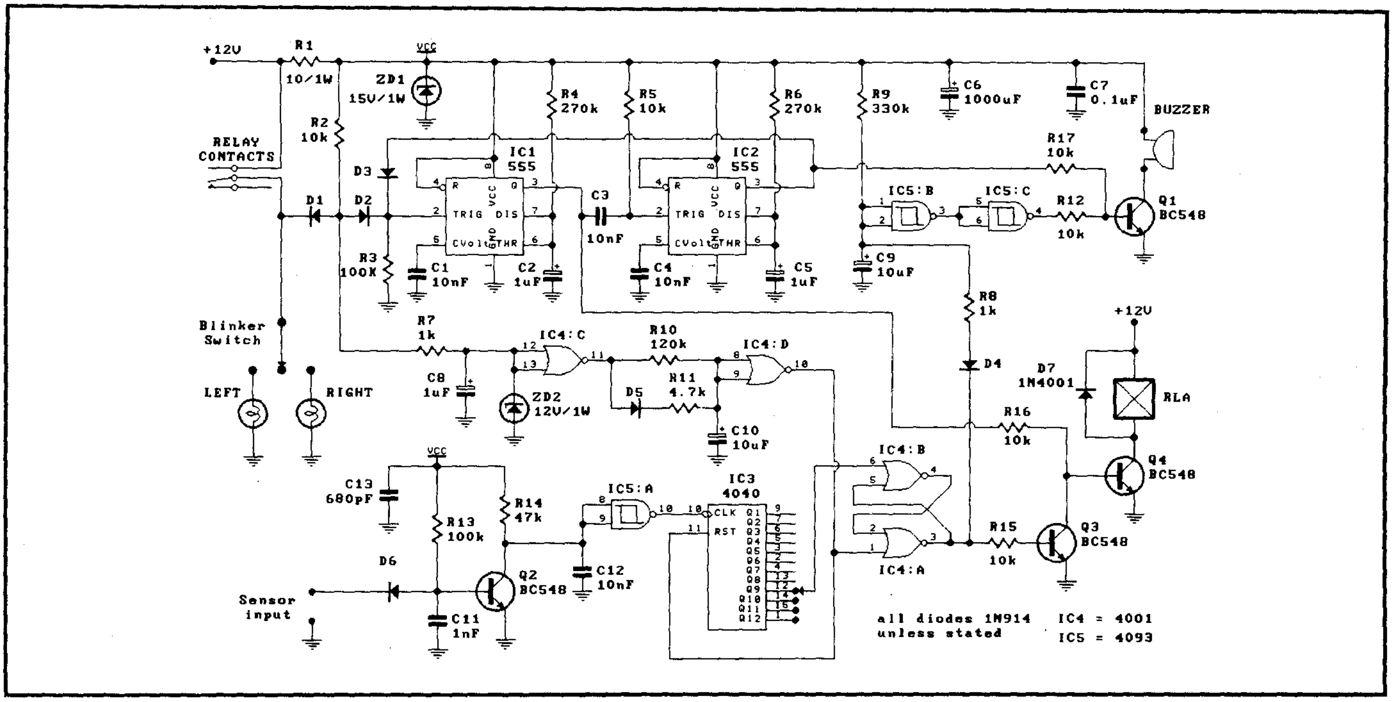
If not, refer to the circuit description to obtain a clearer understanding of the unit's operation. A voltmeter will usually suffice as a faultfinding instrument, as the circuit is fairly simple. For example, confirm that the timers are cycling when the lamp is connected and work from there through the gates to the transistors. Note that apart from IC4a and IC4b, all the gates are connected as inverters.

The distance sensing circuit can be tested by connecting a signal generator to the sensor input leads.

If you have connected the 'distance select' link to pin 15 of IC3, an input frequency of 500Hz will allow approximately four or five flashes of the lamp. A peak to peak input voltage of around 0.15V, either sine or square will



This shot shows the fully assembled PCB. The board is fairly crowded and the small components should be mounted first. The sensor coil is also shown above the board.



The circuit diagram of the blinker unit consists of timers IC1 and IC2 that flash the lights, a counter (IC3) to measure the distance travelled after the blinkers have been activated and drivers for the buzzer and the relay. NOR gates IC4a and IC4b form a flipflop to reset the counter and control the relay and the buzzer.

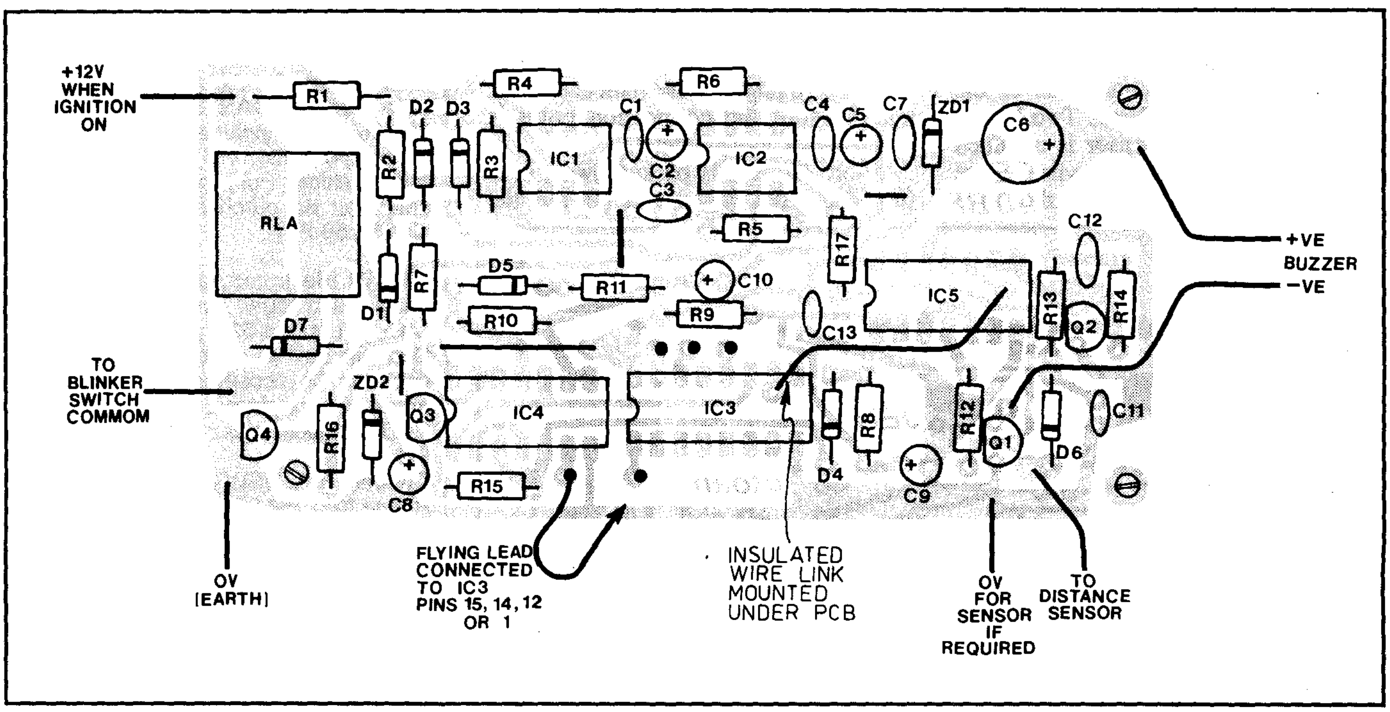
be needed to produce reliable clock pulses to the counter. If you don't have a signal generator, try connecting a 50Hz input, of around 100mV RMS as the input signal. It will take approximately 20 seconds for automatic cancelling to occur.

Some three seconds after the lamp has stopped flashing, the buzzer should turn on and remain on continually. To stop the buzzer, disconnect the lamp. It will take a further second or so before the buzzer stops sounding, after which the unit is armed ready for the next time the lamp is connected.

Once the operation of the unit has been fully tested, the sensor coil can be constructed.

Sensor construction

The sensor is identical to that used with the Digital Speedo presented in the January 1991 issue, and requires a coil of some 600 turns (or more) of 0.2mm



The layout for the PCB is shown here. One link is fitted on the copper side of the PCB and should be run with insulated wire. The link to IC3 determines the distance before the blinkers are automatically cancelled. The sensor can be earthed at the car chassis or connected as shown.

Blinker Unit

(32 B&S) enamelled winding wire using a 3mm (or 1/4 inch) steel bolt as the core. Make a bobbin by fitting two nylon or plastic washers of around 30mm diameter over the bolt, spaced apart by approximately 10mm.

Wrap insulating tape over the section of the bolt between the washers before winding the coil. The bolt should be at least 25mm long as it is also used to attach the coil to a suitable metal bracket fitted under the car.

Drill an exit hole in one washer for the wire, then with the wire passed through this hole, wind the necessary 600 turns. Keep the layers as neat as possible to ensure the full complement of turns will fit in the available space. Cover the complete winding with tape then terminate the windings with insulated wire leads soldered to the winding wire.

Fit a nut onto the bolt to hold the bobbin together, then pot the coil with a suitable epoxy glue to make it waterproof and to protect it from flying stones.

Final assembly

Before the unit is installed in the vehicle, the electronics should be fitted into a case. We used a jiffy box measuring 41 x 68 x 130mm, with the PCB attached to the lid of the box using three mounting bolts. Attach the buzzer to the case and drill an exit hole in the case for the leads.

The sensor coil should be secured to a bracket bolted to the underside of the vehicle, as shown in Fig.1. Two button magnets (four if the sensor is mounted near a drive axle on front-wheel drive cars) need to be attached to the drive shaft. We used magnets from a reed switch employed in a house alarm, although any type of small magnet will do. The magnets should be stuck to the drive shaft with double-sided tape, then securely held with non-magnetic wire wound over the magnets.

To prevent vibration due to imbalance of the shaft, fit the magnets close to the transmission end of the shaft near the front universal joint and ensure they are directly opposite each other. The sensor should be about 1 to 1.5mm from the top of the magnets.

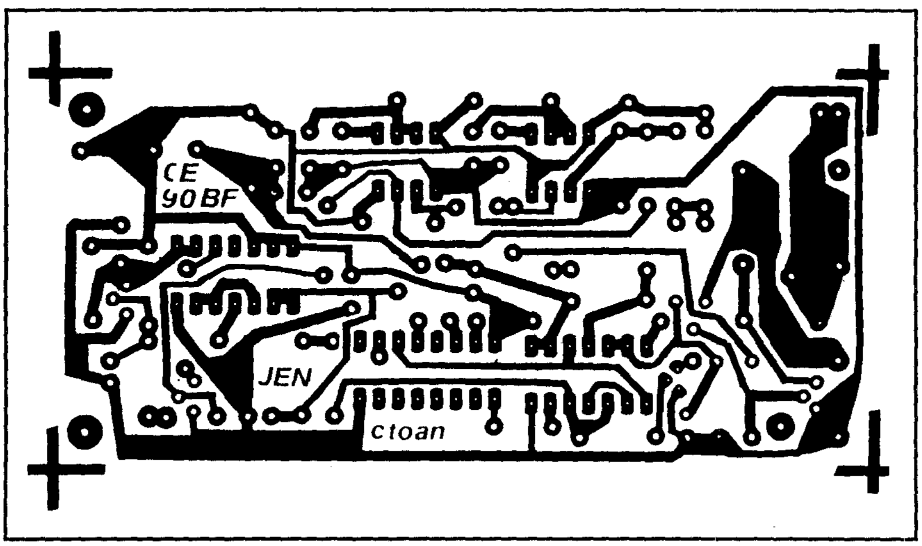
Position the wires connecting the coil to the blinker unit so that they are protected from flying stones. One wire from the coil can be connected to the vehicle chassis, and the remaining wire run inside the car to the electronics unit. It may be possible to strap this wire to the speedo cable which will also give an entry path to the cabin. Alternately, both wires can be run to the unit, with one earthed on the PCB as shown on the layout diagram.

Connecting the remaining wires should prove quite easy. As shown in Fig.2, the unit simply replaces the existing flasher unit; the configuration shown in Fig.2(a) is typical of most cars.

Identify the +12V supply lead, then disconnect it from the existing flasher unit and reconnect it to the unit being installed. The other wire should be the wire connected to the blinker switch and it should be reconnected to the lead from the unit referred to as 'blinker switch common'.

Finally, connect the earth wire from the unit to a point on the vehicle chassis, making sure the connection point is cleaned back to bare metal.

Before the unit is packed away, confirm that it not only works but that the distance before automatic cancelling occurs is suitable. As described, the link to set the distance can be to one of four outputs from IC3. Pin 1 gives the greatest distance and pin 12 the least. Once the link setting has been established, mount the box out of sight, and enjoy the extra safety you have now installed. ■



The PCB pattern for the board is reproduced full size.

PARTS LIST

Resistors

All 1/4W, 5% unless otherwise stated:

R1	10 ohm, 1W
R2,5,12,15,16,17	10k
R3,13	100k
R4,6	270k
R7,8	1k
R9	330k
R10	120k
R11	4.7k
R14	47k

Capacitors

C1,11	1nF ceramic
C2,5,8	1uF 25V low leakage electrolytic
C3,4,12	10nF ceramic
C6	1000uF 25V electrolytic
C7	0.1uF ceramic
C9,10	10uF 25V electrolytic
C13	680pF ceramic

Semiconductors

D1-6	1N4148 signal diode
D7	1N4001 1A diode
ZD1	15V 1W zener diode
ZD2	12V 1W zener diode
Q1-4	BC548 NPN transistor
IC1,2	555 timer
IC3	4040 CMOS 12 stage counter
IC4	4001 quad NOR gate
IC5	4093 quad Schmitt NAND

Miscellaneous

PCB 50mm x 110mm coded CE 90 BF; 12V buzzer; plastic case 41 x 68 x 130mm; speed sensor coil (see text) and two button magnets; 12V/10A miniature relay; hook up wire, solder, nuts, bolts, etc.

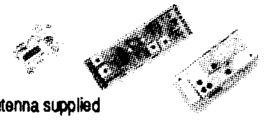
A kit of parts for this project is available from CTOAN Electronics for $32.95, which includes the PCB and all components. Add $2.50 for post and packing. Fully built and tested units can be purchased for $64.95, plus $3.50 P&P.

CTOAN Electronics also offers a full backup and repair service for the kit. Cost for repair is $20, plus $2.50 P&P. Only kits built as described in this article can be accepted for repair. To order, write or phone:
CTOAN Electronics
PO Box 33,
Condell Park, NSW 2200
Phone (02) 708 3763

SEND POSTAGE STAMP FOR LIST OF HUNDREDS OF RADIAL VALVES

L.E CHAPMAN

SUPER SPECIALS
FM Stereo Kits with circuit diagram.
All three modules supplied are fully assembled and aligned only **$22** pp$2.40



Antenna supplied

Tuning Capacitor
2 gang covers all Aust.AM bands
$4.75 pp $1.50 for one or two.

Tape deck or radio power leads, plug and sockets $1.50
Test prods and leads $1.50

Speaker Cabinet Cloth
$10 per metre width 5ft. Sendpostage stamp for samples

Car Radio Suppressors 4 for $2 Valve Sockets 9 Pin 4 for $2
Octal 4 for $2
Stick Rectifiers TV20SC $2
Transistors AD 161-162 pair $3 AD149 $2 each

TV CRYSTALS
4433/619 $2.00
88/238 $2.00
Microswitches SA 250V AC 50c

Chrome 1/4 push on knobs RRP $1.20 ea 10 for $1
Mixed Capacitors fresh stock 100 for $2
Mixed Resistors all handy values 100 for $2
Slide Knobs 10 for $1
IFS 455K for Valve radio $2 ea
Oscillator Coils $1 ea
Dynamic Microphone Ceramic $4 pp $1
Telsco Microphone Ceramic $2 pp $1

2 way speaker networks $2

Rotary Switches	TV Tuners
2 POS $1	46 300.5
4 POS $1.50	11 Volts $10

Touch micro switches as used on colour TV sets 4 for $1
Transistor ear pieces plug and lead 4 for $2
Push button switches 4 pos 50 ¢

Speaker Transformers
7000 to 15/OHM 5W **$7**
7000 to 3.5 OHM 15W **$10**
Speakers
5 x 7 $5, 6 x 4 $4
6 x 9 3.5 Ohm $7

Electros 20 uF 450 V, 10 uF 450V $1.50 each.

Inline fuse holders **4 for $1**
Shielded leads 7ft 3.5 to 3.5 **$1**
3.5 to 6.5 **$1**
6.5 to 7 ft **75c**
Incline Bay not Plugs & Sockets **4 for $1**

Shielded Cable 20 cents a metre

Tag Strips 10 for $1.00

Capacitors	
6N8 1500V	50¢
1000UF 16V	50¢
1000UF 50V	$1 ea
0.0039 Uf 1500V	50¢
0.0068 250V	10 for $1
47 UF 63V	$1 ea
47 UF 160V	3 for $1
470 UF 200V	$1 ea
0.1 UF 250V	5 for $1
680 UF 40V	3 for $1
0.027 250V	4 for $1
10 UF 25V	10 for $1
22 UF 160V	5 for $1

Resistors Heavy Duty

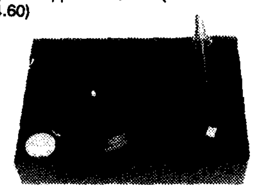
8 Ohm	10W	4 for $1
2.5K	3W	4 for $1
3300 Ohm 10W	4 for $1	
12 Ohm	3W	4 for $1
220 Ohm 10W	4 for $1	
220 Ohm 5W	4 for $1	
1500 Ohmdual	$1 each	
1200 Ohm3W	4 for $1	
115 Ohm 5W	4 for $1	
27 Ohm	5W	4 for $1
12 Ohm	10W	4 for $1
6.8K		4 for $1
6800Ohm 10W	4 for $1	
330 Ohm 5W	4 for $1	
4000Ohm 10W	4 for $1	
1K	5W	4 for $1
33 Ohm	3W	4 for $1
950 Ohm 3W	4 for $1	
820 Ohm 5W	4 for $1	
56 Ohm	5W	4 for $1
5000 Ohm5W	4 for $1	
15K	5W	4 for $1
120 Ohm 5W	4 for $1	
3.3K	7W	4 for $1
150 Ohm 5W	4 for $1	
43 Ohm	10W	4 for $1
1500 Ohm7W	4 for $1	
1200 Ohm3W	4 for $1	
820 Ohm 5W	4 for $1	
4700 Ohm5W	4 for $1	
75 Ohm	3W	4 for $1
4700 Ohm10W	4 for $1	
470 Ohm 7W	4 for $1	
22 Ohm	3W	4 for $1
47 Ohm	3W	4 for $1

5 Mixed Rotary Switches
5 for $2.50 Special

special
12 Mixed Switches $4.50

200 mixed screws self-tappers bolts, nuts, etc. 200 for $2

SUPER SPECIALS
Gramo Motor and Pickup 4 speed includes catridge and stylus mono or stereo. Ideal for recording 78 records to tape $18 pp NSW $3.80 (interstate $4.60)



SPECIAL
Dual VU Meters
$3 pp $1
For 1 or 2

POTS	
1/2 MEG $1.50	Dual 2 MEG Ganged Lin $2
1/2 MEG Switch $2	Dual 1 MEG Ganged Lin $2
1 MEG $1.50	Dual 1 MEG Ganged Log $2
1 MEG Switch $2 Dual OK Ganged Log $1	
25K Dual Ganged $2	50 OHM Single 50¢

Slide Pots	
1/2 MEG Dual $1	25K Dual $2
1 MEG Dual $2	50K Single 50¢
2 MEG Dual $2	250K single 50¢
1K Dual $1 10K Single 50¢	

Valves	
EF 50 $5	6 BZM8 $7
GK 7 $7	6 BL8 $5
EF 86 $8	5 AS4 $7
6K8 $10	12 AU7 $7
6V4 $5	6 U7 $10
1S5 $7	1T4 $7
6AL3 $6	6SA7 $10

1 C Sockets 28 pin 4 for $1, 18 pin 4 for $1, 24 pin 4 for $1
Jack Plug Sockets 2.5MM 4 for $1, 3.5MM 4 for $1, 6.5MM 4 for $1

122 PITT ROAD, NORTH CURL CURL, NSW 2099. PHONE (02) 905 1848

SEND POSTAGE STAMP FOR LIST OF HUNDREDS RADIAL VALVES

SEND POSTAGE STAMP FOR LIST OF HUNDREDS RADIAL VALVES SEND POSTAGE STAMP FOR LIST OF HUNDREDS RADIAL VALVES

SEND POSTAGE STAMP FOR LIST OF HUNDREDS RADIAL VALVES SEND POSTAGE STAMP FOR LIST OF HUNDREDS RADIAL VALVES

READER INFO No. 18

Fun With Your PC
Games
Educational Software
Joysticks
Sound Cards + Midi
Over 650 Games In Stock
Computer Systems

CALL FOR THE BEST PRICES IN TOWN

Send Large SAE for Full List

HYPEC

Electronics Pty. Ltd.
34 Herbert Street
West Ryde 2114
Phone (02) 808 3666 (5½ Days — 6 Lines)
Fax (02) 808 3596

READER INFO No. 19

For the servicing of Electronic Equipment with *SPECIALISED SCREWS.*

Insert Bits available for:-

Torx ®
Torx Tamperproof ®
Spanner
Phillips Security
(Pin in head)
Socket Security
(Pin in head)
Tri-Wing

Write for catalogue to:-

ENDEAVOUR

ENDEAVOUR TOOLS PTY. LTD.
31 Cleeland Rd.,
South Oakleigh, Vic 3167
Ph: (03) 562 8266 Fax: (03) 562 8363

READER INFO No. 20

Electronics Australia BOOK SHOP

DATA & REFERENCE

DIGITAL IC EQUIVALENTS AND PIN CONNECTIONS
BP140 **$18.00**
Shows equivalents and pin connections of a popular user-orientated selection of European, American and Japanese digital ICs. Also includes details of packaging, families, functions, manufacturer and country of origin.

LINEAR IC EQUIVALENTS AND PIN CONNECTIONS
BP141 **$18.00**
Shows equivalents and pin connection of a popular user-orientated selection of European, American and Japanese linear ICs. Also includes details of function, manufacturer, and country of origin.

POWER SELECTOR GUIDE
BP235 **$16.00**
Covers Power devices including Diodes, Thyristors, Triacs, FETs and Power transistors etc.

ELECTRONIC HOBBYISTS HANDBOOK
BP233 **$16.00**
Mr R.A. Penfold has used his vast knowledge of hobby electronics to provide a useful collection of data for the amateur electronics enthusiast, in a single source where it can be quickly and easily located.

RADIO AND ELECTRONIC COLOUR CODES AND DATA CHART
BP7 **$4.00**
Covers many colour codes in use throughout the world, for most radio and electronic components. includes resistors, capacitors, transformers, field coils, fuses and battery leads, speakers etc.

CHART OF RADIO, ELECTRONIC, SEMICONDUCTOR AND LOGIC SYMBOLS
BP27 **$4.00**
Illustrates the common, and many of the not so common, radio and electronic, semiconductor and logic symbols that are used in books, magazines and instruction manuals etc., in most countries throughout the world.

CIRCUITS & CONSTRUCTIONAL PROJECTS

IC PROJECTS FOR BEGINNERS
BP97 **$8.50**
Offers a range of simple projects based around a number of popular and inexpensive linear and digital integrated circuits. With most projects, complete layout and/or point to point wiring diagrams are included to help simplify construction.

30 SOLDERLESS BREADBOARD PROJECTS - BOOK 1
BP107 **$11.00**
Each project, which is designed to be built on a "Verobloc" breadboard, is presented in similar fashion with a brief circuit description, circuit diagram, component layout diagram, components list and notes on construction and use where necessary. Wherever possible the components used are common to several projects.

30 SOLDERLESS BREADBOARD PROJECTS - BOOK 2
BP113 **$6.50**
This book describes a variety of projects that can be built on plug -in breadboards using CMOS logic IC's. Each project contains a schematic, parts list and operational notes.

POPULAR ELECTRONIC PROJECTS
BP49 **$9.50**
Provides a collection of the most popular types of circuits and projects covering a very wide range of interests, including Radio, Audio, Household and Test Equipment projects.

HOW TO USE OP-AMPS
BP88 **$11.00**
This book has been written as a designer's guide covering many operational amplifiers, serving both as a source book of circuits and a reference book for design calculations. The approach has been made as non-mathematical as possible and it is hoped, easily understandable by most readers, be they engineers or hobbyists.

IC 555 PROJECTS
BP44 **$9.50**
Every so often a device appears that is so useful that one wonders how life went on without it. The 555 timer is such a device. Included in this book are basic and general circuits, motorcar and model railway circuits, alarms and noise-makers as well as a section on the 556, 558 and 559 timers.

50 SIMPLE LED CIRCUITS
BP42 **$6.00**
Contains 50 interesting and useful circuits and applications, covering many different branches of electronics, using one of the most inexpensive and freely available components - the light-emitting diode (LED). Also includes circuits for the 707 common anode display.

50 SIMPLE LED CIRCUITS - BOOK 2
BP87 **$6.00**
A further range of uses for the simple LED which complements those shown in book number BP42.

50 PROJECTS USING RELAYS, SCRs AND TRIACs
BP37 **$8.50**
Relays, silicon controlled rectifiers (SCR's) and bi-directional triodes (TRIAC's) have a wide range of applications in electronics. This book gives tried and practical working circuits which should present the minimum of difficulty for the enthusiast to construct.

MINI-MATRIX BOARD PROJECTS
BP99 **$6.50**
This book provides a selection of 20 useful and interesting circuits, all of which can be built on a mini-matrix board just 24 holes by 10 copper strips in size.

REMOTE CONTROL HANDBOOK
BP240 **$13.00**
Replaces our original book DP73 and is aimed at the electronics enthusiast who wishes to experiment with remote control in its many aspects and forms.

MODEL RAILWAY PROJECTS
BP95 **$8.50**
Provides a number of useful but reasonably simple projects for the model railway enthusiast to build. The projects covered include such things as controllers, signal and sound effects units, and to help simplify construction, stripboard layouts are provided for each project.

ELECTRONIC PROJECTS FOR CARS AND BOATS
BP94 **$9.50**
Describes fifteen fairly simple projects for use with a car and/or boat. Each project has an explanation of how the circuit works as well as constructional details including a stripboard layout.

POWER SUPPLY PROJECTS
BP92 **$6.00**
Mains power supplies are an essential part of many electronic projects. This book gives a number of power supply designs, including simple unstabilised types, fixed voltage regulated types, and variable-voltage stabilised designs, the latter being primarily intended for use as bench supplies for the electronics workshop. The designs provided are all low-voltage types for semiconductor circuits.

ELECTRONIC SECURITY DEVICES
BP56 **$9.50**
This book, besides including both simple and more sophisticated burglar alarm circuits using light, infra-red and ultra-sonics, also includes many other types of circuit as well, such as gas and smoke detectors, flood alarms, doorphone and baby alarms, etc.

PRACTICAL ELECTRONIC BUILDING BLOCKS-Book 1
BP117 **$8.50**

PRACTICAL ELECTRONIC BUILDING BLOCKS-Book 2
BP118 **$8.50**
These books are designed to aid electronic enthusiasts who like to experiment with circuits and produce their own projects. The circuits for a number of building blocks are included in each book, and component values and type numbers are provided in each case. Where relevant, details of how to change the parameters of each circuit (voltage gain of amplifiers, cut-off frequencies of filters, etc.) are given so that they can be easily modified to suit individual requirements. No difficult mathematics is involved.

HOW TO DESIGN ELECTRONIC PROJECTS
BP127 **$9.00**
The aim of this book is to help the reader to put together projects from standard building blocks with a minimum of trial and error, but without resorting to any advanced mathematics. Hints on designing circuit blocks to meet your special requirements where no "stock" design is available are also provided.

HOW TO DESIGN AND MAKE YOUR OWN PCBs
BP121 **$6.50**
Chapter 1 deals with the simple methods of copying printed circuit board designs from magazines and books and covers all aspects of simple PCB construction as comprehensively as possible.
Chapter 2 covers photographic methods of producing PCB's and Chapter 3 deals with most aspects of designing your own printed circuit board layouts.

S.W., AMATEUR RADIO & COMMUNICATIONS

COMMUNICATION (Elements of Electronics-Book 5)
BP89 **$11.00**
A look at the electronic fundamentals over the whole of the communication scene. This book aims to teach the important elements of each branch of the subject in a style as interesting and practical as possible.

AN INTRODUCTION TO AMATEUR RADIO
BP257 **$11.00**
Gets you started with the fascinating hobby that enthrals so many people the world over.

INTERNATIONAL RADIO STATIONS GUIDE
BP255 **$16.00**
Totally revised and rewritten to replace the previous edition (BP155), this book contains considerably more information which is now divided into thirteen sections including: Listening to SW Radio, ITU Country Codes, Worldwide SW Stations, European, Middle East & N. African LW Stations, European, Near East & N. African MW Stations, Canadian MW Stations, USA MW Stations, Broadcasts in English, Programmes for DXer's & SW Listener, UK FM Station, Time Differences from GMT, Abbreviations, Wavelength/Frequency Conversion

AERIALS

AERIAL PROJECTS

BP105 **$8.50**

The subject of aerials is vast but in this book the author has considered practical aerial designs, including active, loop and ferrite aerials which give good performance and are relatively simple and inexpensive to build.

25 SIMPLE SHORTWAVE BROADCAST BAND AERIALS

BP132 **$6.50**

Fortunately good aerials can be erected at low cost, and for a small fractional part of the cost of your receiving equipment.

This book tells the story. A series of 25 aerials of many different types are covered, ranging from a simple dipole through helical designs to the multi-band umbrella.

25 SIMPLE INDOOR AND WINDOW AERIALS

BP136 **$6.00**

Written for those people who live in flats or have no gardens or other space-limiting restrictions which prevent them from constructing a conventional aerial system.

The 25 aerials included in this book have been especially designed, built and tested by Mr. Noll to be sure performers and give surprisingly good results considering their limited dimensions.

25 SIMPLE TROPICAL AND MW BAND AERIALS

BP145 **$6.00**

Shows you how to build 25 simple and inexpensive aerials for operation on the medium wave broadcast band and on the 60, 75, 90 and 120 metre tropical bands. Designs for the 49 metre band are included as well.

AUDIO & HI-FI

DIGITAL AUDIO PROJECTS

BP245 **$11.00**

Contains practical details of how to construct a number of projects which fall into the "Digital Audio" category. They should be of interest to most audio and electronic music enthusiasts.

AN INTRODUCTION TO LOUDSPEAKERS AND ENCLOSURE DESIGN

BP256 **$11.00**

All you need to know about the theory and operation of loudspeakers and the various types of boxes they may be fitted into.

Also includes the complete design and constructional details of how to make an inexpensive but high quality enclosure called the "Kapellmeister".

AUDIO PROJECTS

BP90 **$8.50**

This book covers in detail the construction of a wide range of audio projects. The text has been divided into the following main sections: Pre-amplifiers and Mixers, Power Amplifiers, Tone Controls and Matching, Miscellaneous Projects.

All the projects are fairly simple to build and designed to assist the newcomer to the hobby.

AUDIO (Elements of Electronics-Book 6)

BP111 **$13.00**

Analysis of the sound wave and an explanation of acoustical quantities prepare the way. These are followed by a study of the mechanism of hearing and examination of the various sounds we hear. A look at room acoustics with a subsequent chapter on microphones and loudspeakers then sets the scene for the main chapter on audio systems, amplifiers, oscillators, disc and magnetic recording and electronic music.

AUDIO AMPLIFIER CONSTRUCTION

BP122 **$9.00**

The following practical designs are featured and include circuit diagram and description, Veroboard or PCB layout and any necessary constructional or setting-up notes.

Chapter 1 - Preamplifiers: versatile microphone type based on the NE5534; tape type using the LM3802; RIAA pre amp; simple guitar pre amp; ceramic or crystal pick-up type; active tone controls using a LF351; general purpose pre amp.

Chapter 2 - Power amplifiers: simple low power battery type using a 2283 IC; 2 watt using the TBA820; 8 watt using the TDA2030; 16 watt 12 volt P.A. amplifiers; 20 watt using a MOSFET output stage; 100 watt DC coupled amplifier using four MOSFETs in the output stage.

CHOOSING AND USING YOUR HI-FI

BP68 **$6.00**

Provides the fundamental information necessary to make a satisfactory choice from the extensive range of hi-fi equipment now on the market.

Help is given to the reader in understanding the technical specifications of the equipment he is interested in buying.

THEORY & CALCULATIONS

FROM ATOMS TO AMPERES

BP254 **$12.00**

Explains in crystal clear terms the absolute fundamentals behind the whole of Electricity and Electronics. Really helps you to understand the basis of the subject, perhaps for the first time.

FURTHER PRACTICAL ELECTRONICS CALCULATIONS AND FORMULAE

BP144 **$16.00**

Written in the same style as the first book (BP53) and with the same objectives in mind, this book is divided into the following fourteen sections: Electricity, Electrostatics, Electromagnetism, Complex numbers, Amplifiers, Signal Generation and Processing, Communication, Statistics, Reliability, Audio, Radio, Transmission Lines, Digital Logic and Power Supplies.

THE SIMPLE ELECTRONIC CIRCUIT AND COMPONENTS

BP62 **$12.00**

ALTERNATING CURRENT THEORY

BP63 **$12.00**

SEMICONDUCTOR TECHNOLOGY

BP64 **$12.00**

The aim of this series of books is to provide an inexpensive introduction to modern electronics so that the reader will start on the right road by thoroughly understanding the fundamental principles involved.

BOOK 1: This book contains all the fundamental theory necessary to lead to a full understanding of the simple electronic circuit and its main components.

BOOK 2: This book continues with alternating current theory without which there can be no comprehension of speech, music, radio, television or even the electricity mains.

BOOK 3: Follows on semiconductor technology, leading up to transistors and integrated circuits.

ELECT. & COMPUTER MUSIC

ELECTRONIC MUSIC PROJECTS

BP74 **$9.50**

Provides the constructor with a number of practical circuits for the less complex items of electronic music equipment, including such things as fuzz box, waa-waa pedal, sustain unit, reverberation and phaser units, tremelo generator, etc.

MUSICAL APPLICATIONS OF THE ATARI ST's

BP246 **$12.95**

The Atari ST's are fast becoming the first choice in computers for the electronic music enthusiast due to their relatively low cost and MIDI interface. The Penfolds show you how to make the most of these machines musically, with simple add-on circuits and program routines.

COMPUTER MUSIC PROJECTS

BP173 **$11.00**

Shows some of the ways a home computer can be used to good effect in the production of electronic music. Topics covered include sequencing and control via analogue and MIDI interfaces, computers as digital delay lines and sound generators for computer control.

MORE ADVANCED MIDI PROJECTS

BP247 **$11.00**

Carries on where book BP182 left off by providing constructional details of some more advanced and sophisticated projects such as a mixer, merge unit and harmoniser etc.

ELECTRONIC SYTHESISER CONSTRUCTION

BP185 **$11.00**

This book will enable a relative beginner to build, with the minimum of difficulty and at reasonably low cost a worthwhile mono-phonic synthesiser, and also learn a great deal about electronic music synthesis in the process.

TV, VIDEO & SATELLITES

AN INTRODUCTION TO SATELLITE TV.

BP195 **$12.95**

As a definitive introduction to the subject this book is presented on two levels. For the absolute beginner with no previous knowledge, the story is told as simply as it can be in the main text.

For the professional engineer, electronics enthusiast, student or others with technical backgrounds, there are numerous appendices backing up the main text with additional technical and scientific details, formulae, calculations and tables etc.

FAULT-FINDING

HOW TO GET YOUR ELECTRONIC PROJECTS WORKING

BP110 **$8.50**

We have all built circuits from magazines and books only to find that they did not work correctly, or at all, when first switched on. The aim of this book is to help the reader overcome just these problems by indicating how and where to start looking for many of the common faults that can occur when building up projects.

AUDIO AMPLIFIER FAULT-FINDING CHART

BP120 **$4.00**

This chart will help the reader to trace most common faults that might occur in audio amplifiers. Across the top of the chart are two "starting" rectangles, vis Low/Distorted Sound Reproduction and No Sound Reproduction; after selecting the most appropriate one of these, the reader simply follows the arrows and carries out the suggested checks until the fault in located and rectified.

GETTING THE MOST FROM YOUR MULTIMETER

BP239 **$11.00**

It is amazing just what you can check and test with a simple multimeter if you know what you are doing. This book tells the story, covering the basics and relative merits of analogue and digital instruments,component checking and dealing with circuit testing.

MORE ADV. USES OF THE MULTIMETER

BP265 **$12.00**

A sequel to book BP239 showing the reader some more advanced and unusual applications of that humble test instrument - the simple multimeter.

HOW TO USE OSCILLOSCOPES AND OTHER TEST EQUIPMENT

BP267 **$12.00**

Just as the title says, this book shows the hobbyist how to effectively use a number of pieces of electronic test equipment including the oscilloscope.

To order, simply fill in the coupon, remembering to included the code numbers and $5.00 postage and handling. If the coupon is missing, write down the names, code numbers and prices of the books you require. Include your name, address, ph number, plus cheque, money order or credit card details (card type, card number, expiry date and signature) and send it all to Federal Publishing, Freepost No.3, P.O.Box 199 Alexandria, NSW 2015. Don't forget to sign all orders.

Mini Construction Project:

Low cost meter for electrolytic caps

Here's the design for an easy to use, very low cost capacitance meter especially suited for checking electrolytics with values up to 1500uF. It also incorporates a simple 'reforming' circuit, to allow repolarisation of capacitors which have been stored for long periods.

by J. EMERY

The design and construction of this meter was prompted by the fact that the capacitance range of many lower priced and older DMMs does not extend above 20uF — and in some cases, only 2uF.

Obviously many electrolytic capacitors used in electronic equipment have values rather higher than this, and in servicing it is often desirable to check their value.

The meter uses only one dual-timer IC, a transistor and a LED, but is a fully self contained measuring circuit which can indicate capacitance from 0.47uF to 1500uF in three ranges.

No great claims are made for its accuracy, but because it is intended for use mainly with electrolytics, this is not likely to be a real disadvantage. Provision is also made for reforming capacitors which have been stored for long periods.

The voltage applied to the capacitor under test is about 5 volts DC. When used to measure capacitance the tester uses an NE556 dual timer, which is the equivalent of two NE555 timers in a single package.

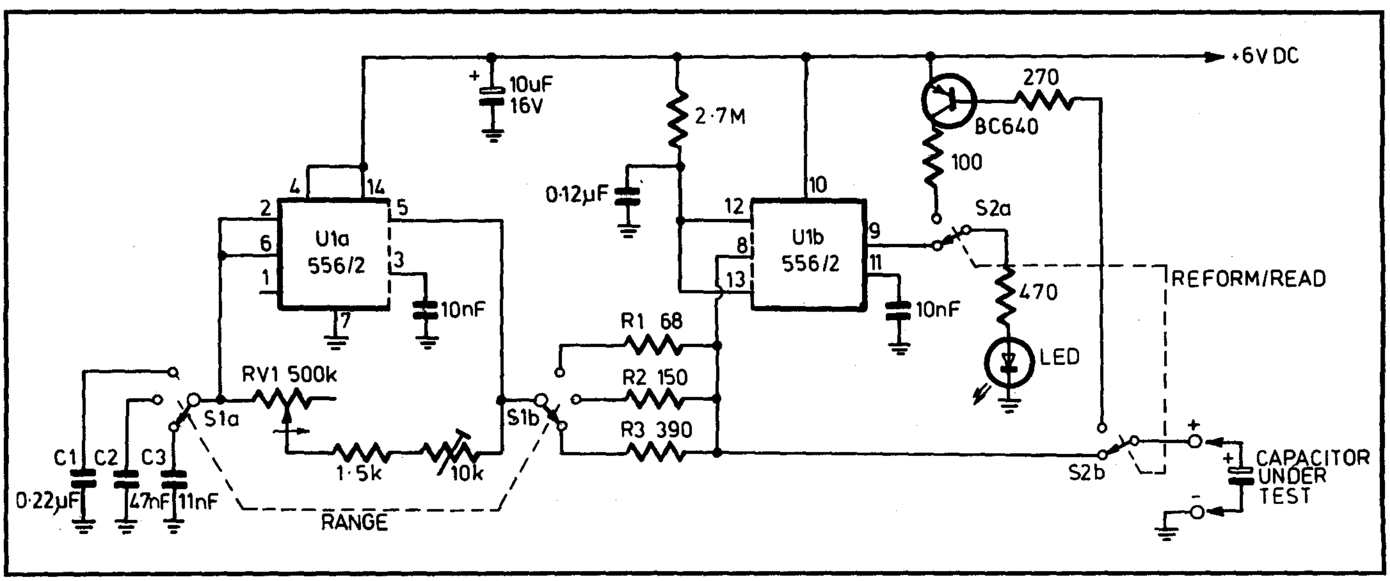
One of the timers (U1a), is used to generate a square wave, whose frequency is controlled by the potentiometer RV1 and one of the timing capacitors, C1, C2 or C3).

The square wave output of this timer is used to alternately charge and discharge the capacitor under test, via one of the charging resistors R1, R2 or R3. (The double-pole three position switch S1/A — S1/B selects the appropriate values for C and R. This will result in a saw-tooth wave across the capacitor under test.

The peak voltage of this wave will depend mainly on the output frequency of the timer, the value of the charging resistor (R1, R2 or R3) and the value of the capacitor under test.

The second 'NE555' timer U1b is used as a monostable, with its trigger terminal connected to the capacitor under test and a LED connected to its output.

If the output frequency of the first timer is high compared with the value of the capacitor under test, then the amplitude of the saw-tooth voltage across it will be small and will be insufficient to trigger the second timer. Hence the LED will remain 'OFF'.



The schematic for the meter, which as you can see uses only a handful of parts. It can reform depolarised electros, too.

But if its frequency is decreased by increasing the resistance setting of RV1, a point will be reached where the amplitude of the saw-tooth voltage across the capacitor under test will be just large enough to trigger the second timer and light the LED.

RV1 can therefore be calibrated to read the value of the capacitor under test, using the LED as an indicator.

Using the three values of timing capacitor shown, I was able to obtain three ranges — 0.47 to 15uF, 4.7 to 150uF and 47 to 1500uF. The potentiometer used for RV1 was a standard size (approx 25mm diameter) 'A' curve (log) 500k unit from Altronics.

The connections to this potentiometer were such that its resistance was zero when its shaft was rotated fully anticlockwise.

The 10k trimpot and 1.5k ohm fixed resistor in series with RV1 were used to set the range of capacitance which could be measured with one sweep of RV1.

I started by setting the trimpot in about the mid position.

The three scales for RV1 can be calibrated by using a selection of capacitors whose values have been checked on a reliable capacitance meter.

I found that by selecting capacitors with suitable tolerances for C1, C2 and C3, it was possible to use a single scale — 4.7 to 150uF — and to multiply or divide by 10 for the other ranges. (C3 consisted of a 10nF and a 1nF capacitor in parallel). Perhaps I was lucky!

Because the impedance of the circuit used to charge and discharge the capacitor under test is low, this capacitance meter is reasonably tolerant to the normal leakage found in electrolytic capacitors.

However, because some of the capacitors tested may have been unused for some time, I decided to include provision for 're-forming' these before testing.

This facility is selected by a DPDT switch S2/A and S2/B, which should be a 'break before make' type.

With this switch in the re-forming position, the capacitor under test is charged via the emitter-to-base junction of the BC640 transistor and the 270 ohm resistor in its base circuit. The switch also connects the LED as the collector load of the BC640.

When the capacitor to be tested has been reformed, it will 'charge up' and reduce the base current to the BC640 — whose collector current will then fall and the LED will dim.

If the insulation resistance of the capacitor is good enough, the LED will extinguish completely.

The reason for including the 100-ohm resistor in the collector lead of the BC640 is to limit the current, should the constructor be unable to use a 'break before make' type of switch for S2A/B.

It is possible for a virtual short circuit to occur between the six volt positive supply and earth via the BC640 and pin 9 of the NE556 during the operation of this switch.

The 100 ohm resistor limits the current to less than 60mA.

In my prototype, the NE556 and most of the other components were mounted on Vero-type utility board and housed in an aluminium box.

The current drawn varied with the value of the capacitor under test, but did not normally rise above 20mA (except when the capacitor being tested short circuited).

Reducing the supply to five volts did not seem to make any appreciable difference in the capacitance readings, with the prototype unit. However 6V operation is recommended. ■

New product review:

Stover's 150W HF-UHF dummy load

Queensland marine electronics specialist Stover Electronics has produced a compact new dummy load suitable for use by both technicians servicing mobile and marine two-way radio gear (or cellular radio phones), and radio amateurs. It's designed to present an accurate 50-ohm load well into the UHF region, and has an intermittent power rating of 150W.

by JIM ROWE

When you're testing or adjusting a transmitter or the transmit section of a transceiver, it's unwise to have the output connected to an antenna because you could easily radiate spurious signals. The accepted approach is to use instead a 'dummy' load — so called not because it isn't a real load, but because it's designed to *substitute* for the normal antenna load.

There are three basic requirements of such a dummy load:

- It should present a load impedance that remains as close as possible to the designed antenna load impedance of the transmitter (usually 50 ohms), and hence provide a correct termination for the feeder cable.
- It should be capable of absorbing and dissipating all of the RF power fed into it, without damage.
- Preferably, it should prevent any of the energy being radiated, except as heat.

Simple enough requirements to meet, you might think — just stick a 50-ohm resistor in a metal shield box! But as in so many other areas of electronics, particularly where radio frequencies are involved, in practice it isn't that easy.

Probably the first requirement is the toughest, particularly at UHF and higher frequencies. When you get up into these frequencies, most nominal '50-ohm resistors' become anything but resistive, and present a value that can end up well away from 50 ohms. This is because of the stray capacitance and 'parasitic' inductance associated with the resistor element itself and its connection electrodes. The nett impedance can not only veer away from the 50-ohm value in a 'steady' fashion, but may also pass through a series of sharp peaks and dips, due to assorted resonances.

Achieving a resistor (or array of resistors) that *stays* essentially a pure 50-ohm resistor up to your highest working frequency can be quite a challenge, in fact. Generally it involves going to considerable trouble to minimise inductance and stray capacitance, and/or to balance them so that the nett result is effectively a transmission line with the same characteristic impedance as the load itself.

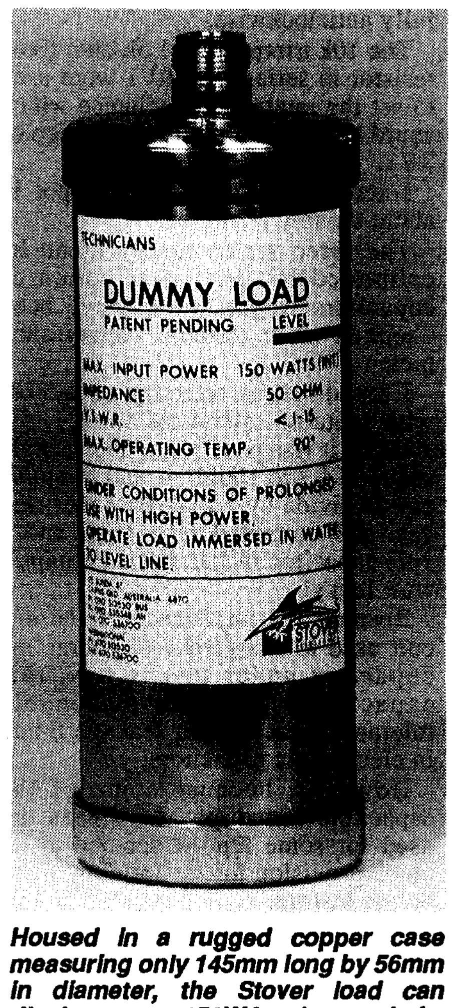
What makes this all even harder is the need to meet the other two requirements, at the same time. And to a certain extent these also conflict with each other: the load has to be fully enclosed, for shielding, but also has to be able to dissipate all of the incoming RF energy without damage as heat.

In short, there's a lot more to making a good dummy load than you'd think, and it gets harder the higher up in frequency you go and the more power you want it to dissipate. No doubt that's why many of the better VHF and UHF dummy loads are surprisingly expensive, for 'a resistor in a tin'. Especially as up until now, they haven't been manufactured in Australia...

Novel design

But that's now changed, thanks to Mr Joe Stover of Stover Electronics in Queensland's sunny Cairns. Mr Stover specialises in manufacturing, selling and servicing marine electronics gear, and is involved in servicing quite a bit of VHF and UHF radio equipment. Seeing how expensive the imported dummy loads were, especially those with a reasonable power rating, he apparently decided to have a go at designing and making one himself.

The end result of his efforts is the compact new load you see in the photo, in a cylindrical copper case measuring only 145mm long by 56mm in diameter and weighing a modest 750g (a little over 1.5lb). Yet this compact little unit can dissipate up to 150W on an 'intermittent' basis, as it stands, or for quite prolonged periods if operated with the lower 2/3 of the body immersed in water. And it boasts a commendably low rated VSWR, of less than 1.15 up to 520MHz.



Housed in a rugged copper case measuring only 145mm long by 56mm in diameter, the Stover load can dissipate up to 150W for short periods.

How has he done it? Well, the details are a little sketchy as Mr Stover has applied for patents. However it would seem that inside the case is a specially designed non-inductive 50-ohm resistor, with a free-air rating of about 60 watts. This is surrounded by a thermally conducting wax, which is very efficient in conducting heat from the resistor to the copper case.

In fact at 65°C the wax actually liquifies, and acts as a kind of 'heat pipe' to assist in the heat conduction process. It is the additional heat conduction provided by the wax that provides the ability to dissipate up to 180W intermittently, while the sturdy copper case allows this order of power to be dissipated for longer, when it is immersed in water.

One complication of having the case filled with wax is that when the wax melts, it expands. However Mr Stover has avoided any potential problems by fitting a special piston device inside, to allow for expansion and contraction while still containing the wax — and the RF energy.

In short, it's a novel design, and one that has resulted in a surprisingly compact unit for this power rating.

By the way, the load is available fitted with either an SO-239 'UHF' socket, or an N-series socket as desired.

Test results

We were able to test a sample dummy load fitted with an N-series connector at frequencies up to and including 1296MHz, with the kind assistance of our old friend Dick Norman, VK2BDN (thanks, Dick!). And it gave a very good account of itself, as measured using a Bird model 40 directional wattmeter.

At frequencies below 400MHz it was near enough to an ideal 50-ohm load, with virtually no measurable reflected power. At 432MHz the reflected power was just below 0.8%, corresponding to the quoted VSWR of 1.15. Although this rose at higher frequencies, it did so quite slowly, giving a VSWR of 1.4 at 1296MHz. Bearing in mind that this corresponds to a reflected power of only 3% of the forward power, it shows that Mr Stover's load is still very useable even up at 1296MHz — which compares very well with many imported loads.

The power dissipation performance was equally impressive. It happily dissipated the rated continuous level of 60W for long periods, and seemed unperturbed by a burst of 150W for a couple of minutes, even in free air.

We then tried immersing it in about 3L of water in an old ice- cream container, up to the level indicated on the side, and gave it 180W of input for a full five minutes. The temperature of the load's copper case became a little too hot to touch, as you'd expect, but still well below the rated maximum of 90°C; the water became warm. Our impression is that if you used a larger amount of water, you'd probably be able to dissipate at least 150W almost indefinitely.

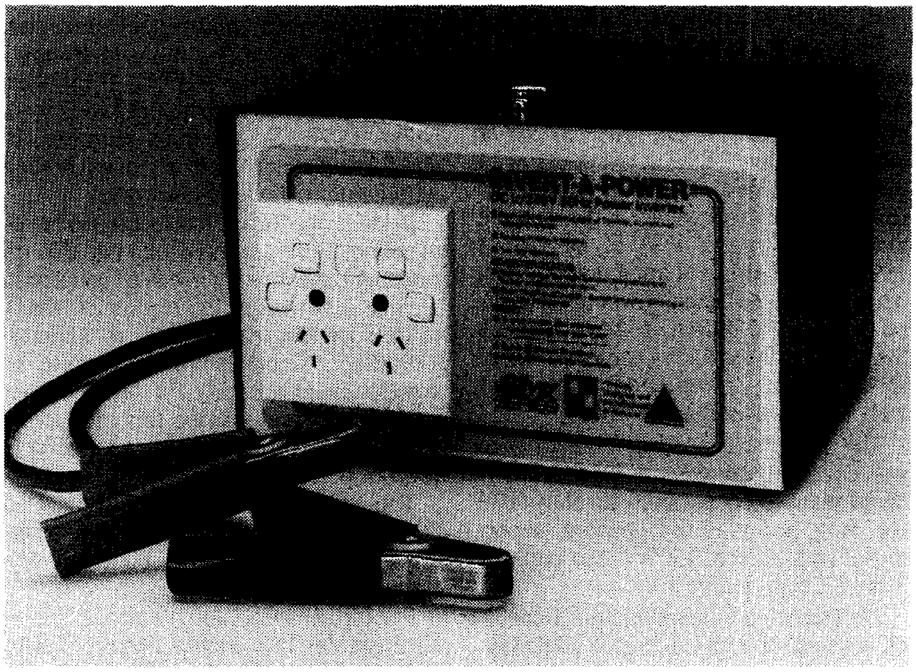
Of course most transmitter/transceiver tests tend to last a few minutes at most, and the majority of VHF/UHF mobiles and base stations have output levels well below 180W. So for most purposes, it shouldn't be necessary to even bother with dunking the load into water.

In short, the Stover load seems to be an excellent little unit, and one capable of meeting the everyday needs of just about anyone involved in the testing of transmitters or transceivers, up to at least 1296MHz. We believe Mr Stover is to be congratulated not only for his initiative in designing and making this product in Australia, but for achieving such a high level of performance.

The Stover dummy load is priced at $235 plus $7.50 for packing and postage anywhere in Australia. Quoted delivery time is four days.

For further information contact Stover Electronics, 175 Bunda Street, Cairns 4870 or phone (070) 51 3530. ■

NEW PRODUCTS



Higher power inverter models

Selectronics of Bayswater, Victoria, hs just released two new additions to the long standing and reliable Invert-A-Power range — the Silver Series.

After two years in development and field testing, the Silver Series versatility and reliability have been proven. Features include current and thermal overloads, short circuit and high/low battery volts protection, failsafe reverse polarity protection, demand start, the ability to start and run fluorescent and high efficiency compact lighting and electric motors, and modular construction for parallel operation.

The confidence Selectronics have in their new product is reflected in the generous two year warranty provided.

There are three models in the Invert-A-Power Silver Series:

- SPI-1200-12SS with an output of 1200W continuous (24 hours) — 1450W (30 min) and 4600W (20 secs);
- SPI-1500-24SS — 1500W continuous, 2000W (30 min) and 5600W (40 secs);
- SPI-1500-48SS — 1500W continuous, 2000W (30 min) and 6500W (40 secs).

All lend themselves to a wide range of remote, field and bench applications.

For further information circle 241 on the reader service coupon or contact Selectronic Components, 25 Holloway Drive, Bayswater 3153; phone (03) 762 4822.

High voltage electrolytics

Based on the highly successful PEH169 series, Rifa has now introduced a 450V DC can electrolytic offering very low ESR, very long life and high reliability. The capacitance range covers 68uF to 2200uF.

An example of the performance that can be expected from the new range is the 2200uF capacitor. This offers a maximum of 48 milliohms ESR at 20°C and 100kHz.

As with all Rifa electrolytics, the 450V DC range offers a 10 year shelf life, and an operational life of 10 years at 50°C, making it suitable for the most demanding applications.

Further information is available by circling 244 on the reader service coupon or by contacting Ericsson Components, 202 Bell Street, Preston 3027; phone (03) 480 1211.

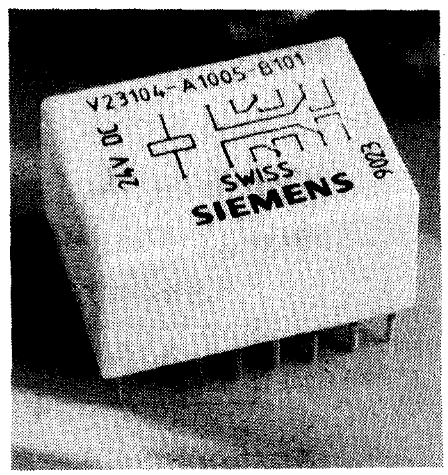
D4 miniature relay

With four switching functions and extremely small dimensions, the new D4 miniature relay from Siemens offers the user clear advantages with regard to space requirements and cost.

This neutral, monostable, dual-in-line light-current relay is particularly suitable for modern telecommunication systems.

With its four changeover contacts and low power consumption of 300mW, it is equally suitable as an inexpensive, high-sensitivity switching device for many tasks in measurement, control and process control systems.

As a result of fully automatic production and final testing, as well as its hermetically sealed plastic case, the new D4 offers very high reliability. The D4 miniature relay is available from Siemens with rates

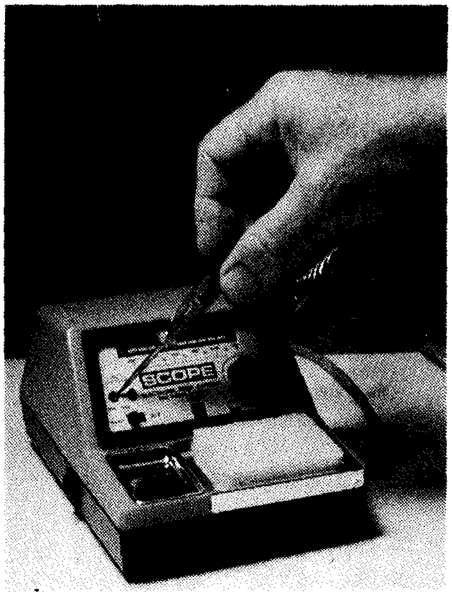


voltages of 5, 12, 24 and 48V.

For further information circle 242 on the reader service coupon or contact Siemens, 544 Church Street, Richmond 3121; phone (03) 420 7308.

Solder station extends tip life

A new version of its 60W 'zero cross' solder station with an 'auto switch off' or time-out feature, has



been released by Scope Laboratories of Melbourne. Its code number is ETC60L-1-AO.

If the iron is undisturbed for any selected time from 5-30 minutes, the station shuts down.

When the iron is touched the clock circuit is reactivated and tip temperature restored in about 40 seconds.

Principal benefits claimed include:

- extended tip life through reduced corrosion at high temperatures;
- less power consumption; and
- reduced risk of tip seizure due to oxidation.

The manufacturer claims the additional cost of this feature is soon offset by the saving of two or three tips.

For further information circle 245 on the reader service coupon or contact Scope Laboratories, PO Box 63, Niddrie 3042; phone (03) 338 1566.

150-watt DC/DC converter

Powercube's 28DC515-150 'Triplecube' is the first of a new family of high-density multiple-output DC-DC switching regulator modules featuring advanced integrated magnetics and control circuit technology.

The unit accepts a 28V DC input per MIL-STD-704D and produces 150 watts output power with 80% efficiency.

Other features include input/output isolation, auto-recover from a short circuit and overvoltage protection on all outputs.

Input voltage can vary from 22-34V DC and it can withstand input transients from 18-20V DC for two seconds.

Output voltage (+/-1%) is +5, +15 and -15V DC with output current at 15, 2.5, and 2.5 amps. Operating frequency is 250kHz, and all components are derated to NAVSO P-3641 guidelines.

For the three outputs load regulation is 1.5%, 3% and 3%, and line regulation is 0.5%, 1.0% and 1.0%, with transient response settling times of 1.0ms, 100us and 100us.

Dimensions are 4.6 x 3.0 x 0.57 inches, and weight is 11.5oz.

For further information circle 247 on the reader service coupon of contact Priority Electronics, 23-25 Melrose Street, Sandringham 3191; phone (03) 521-0266.

Headset two-way radio

In-com is a multi-purpose communications device designed for a wide variety of industrial applications.

Its dual Bilsom Viking earcup/speakers combine effective ear protection and communication in one lightweight, low cost package.

The two-way radio incorporates a patented noise reduction/voice-activated system for communication at even the highest workplace noise levels; there are no buttons to push.

Each In-com unit comes with headstrap for any safety headgear, hardhat adaptors, battery pack and a storage/carrying case.

Made in Canada, the unit is manufactured with military grade parts to ensure optimum performance.

The circuitry is coated with a waterproof sealant to protect it against both rain and cold weather condensation.

For further information circle 248 on the reader service coupon or contact Down Under Communications, PO Box 146, Fawkner 3060; phone (03) 359 9720.

Pocket-size humidity meter

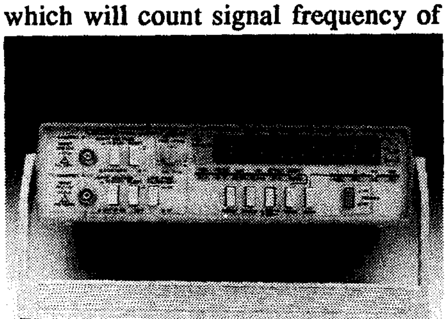
For people who require a fast convenient way of accurately measuring humidity and temperature, Vaisala has introduced the innovative HM34 pocket-size humidity/temperature meter. This stylish but rugged little meter incorporates the latest version of the Humicap humidity sensor, the H-sensor, to achieve levels of performance unattainable from more elaborate devices only a few years ago. HM34 is very easy to use. Four function keys on the unit serve as on/off switch, and selection of the humidity or temperature displays. A hold function allows the user to retain a measured value until it has been recorded. Measurement normally take only a few seconds.

An automatic Power-Off function prevents accidental discharge of the batteries. In the absence of any measurement activity of approximate three minutes, the HM34 will automatically shut off. It is available with either Celsius or Fahrenheit temperature scales.

For more information circle 246 on the reader service coupon.

175MHz universal counter from Tek

Tekronix' new CDC250 Universal Counter is a dual channel instrument which will count signal frequency of



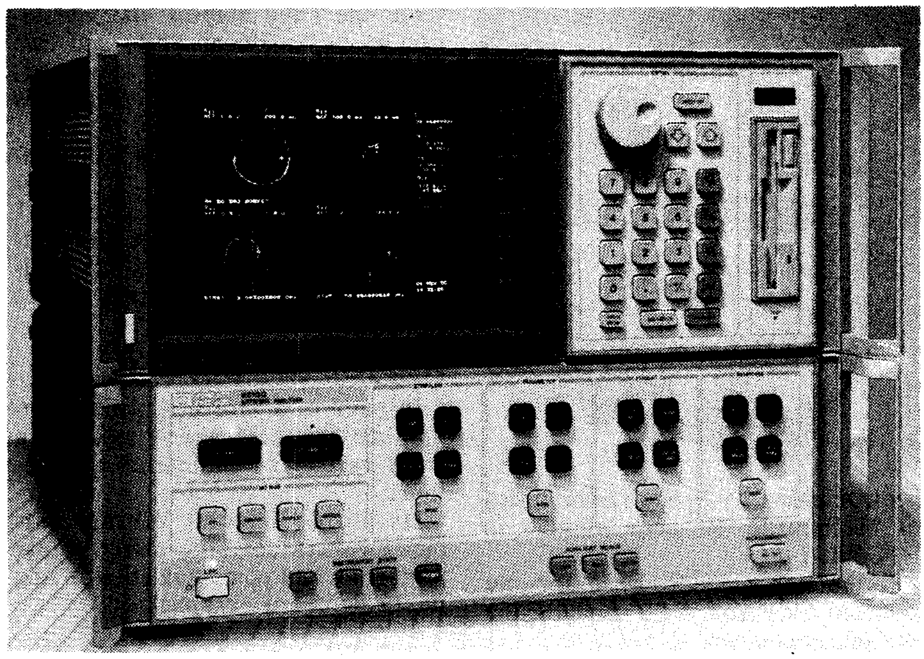
sine, square and triangle waves from 5Hz to 175MHz, at input levels from 20mV to 24V peak. The CDC250 also provides period measurement. It has a temperature compensated timebase to ensure reliable performance in changing ambient temperature.

The CDC250 can function as a standalone calibration tool or as a rack-and-stack component of a complete test bench set-up. Like its TM250 family counterparts, the CDC250 is UL listed and CSA certified.

For further information circle 250 on the reader service coupon or contact Tektronix Australia, 80 Waterloo Road, North Ryde 2113; phone (02) 888 7066.

NEW PRODUCTS

Microwave network analyser



Hewlett-Packard has introduced a third-generation microwave network analyser, the HP 8510C, that, together with a new 50GHz S-parameter test set (HP 8517A) and a 50GHz synthesised sweeper (HP 83651A), makes up a network-analyser system.

The new system provides better performance at 50GHz than was previously available in coaxial-based instruments above 26.5GHz, HP says.

Performance improvements provided by the new system include:

- 20dB of uncorrected directivity and 16dB of uncorrect source match at 50GHz, which significantly improves calibration stability and increases the time between necessary calibrations from hours to days;
- 60dB dynamic range at 50GHz, which HP says is 10dB better than currently available on any other network analyser above 40GHz;
- Ramp-sweep frequency accuracy improved by a factor of 10 — which HP believes is the fastest sweep-mode available — with an error-corrected 201 point measurement requiring less than 500msec; and
- Synthesised step-sweep speed improved by a factor of six. (A 201 point data trace now takes 1.6 seconds).

Sales information may be obtained by circling 243 on the reader service coupon or calling Hewlett-Packard's Customer Information Centre on 088 033 821.

'Matchbox' for antenna testing

Vicom Australia says it has the ultimate in 'fool-proof' testing of cellular antennas, with the new Helper Matchbox. This new instrument allows the reading of SWR and match efficiency directly from an analog meter with no calculations required.

The MB450 and MB800 are from the Helper Instrument Co range of products. The MB450 has a frequency range of 400-525MHz, while the MB800 range is 775-1025MHz.

The normal method of testing an installed antenna is to measure the SWR. With the Matchbox you simply determine the percentage of signal power being returned and wasted. The SWR reading is also available from the same meter if required.

The units are fully self-contained for rapid testing of mobile cellular phone installations.

Simply connect the antenna to the front panel, set the frequency and the Match will calculate the Match efficiency and SWR.

For further information circle 251 on the reader service coupon or contact Vicom Australia, 4 Meaden Street, South Melbourne 3205; phone (03) 690 9399. ■

EA with ETI marketplace

ADVERTISING RATES FOR THIS PAGE

SMALL ADS: The minimum acceptable size of 2 centimetres x one column costs only $50. Other sizes up to a maximum of 10 centimetres are rated at $25 a centimetre. CLASSIFIEDS: $4 for 40 letters. Just count the letters divide by 40 and multiply by $4, ROUND UP TO NEAREST WHOLE NUMBER. CLOSING DATE: Ads may be accepted up to the 15th of the month two months prior to issue date. PAYMENT: Please enclose payment with your advertisement . Address your letter to THE ADVERTISING PRODUCTION MANAGER, ELECTRONICS AUSTRALIA, PO BOX 199, ALEXANDRIA, NSW 2015.

FOR SALE

MY AUSTRALIAN DESIGNED: low cost super fast Z80 micro-controller development system has gained acceptance already with educational institutions. Pop it on the end of any PC MSDOS or Z80 machine and away you go. Boards, EPROM, and 360K disk $76 including postage for a short form kit. Gee, I wish I had this when I was a kid. For more info . send a 41c stamp to Don McKenzie 29 Ellesmere Cres Tullamarine 3043

WEATHER FAX PROGRAMS: For IBM XT/AT's*** "RADFAX2" is a high resolution, shortwave weather fax, morse & RTTY receiving program. Needs CGA, SSBhf radio & RADFAX decoder. Also "RF2HERC", "RF2EGA" & "RF2VGA" same as RADFAX2 but suitable for Hercules, EGA, & VGA cards respectively. $35 *** "SATFAX" is a NOAA, Meteor & GMS weather satellite picture receiving program. Uses EGA or VGA modes. Needs EGA or VGA color monitor and card, + "WEATHER FAX" PC card. $45 *** All programs are on 5.25" OR 3.5" disks (state which) + documentation, add $3 postage . ONLY from M.Delahunty, 42 Villiers St, New Farm 4005, Qld. Ph (07) 358 2785.

AMIDON FERROMAGNETIC CORES: For all transmitter and receiver applications. Send DL size SASE for data/price to: RJ & US Imports, PO Box 157, Mortdale, NSW 2223. Agencies at Geoff Wood Electronics, Sydney; Webb Electronics, Albury; Electronics Components ACT; Truscott's Electronics, Melbourne; S.Willis, Perth; Assoc TV Service.

PUBLIC DOMAIN SOFTWARE: Over 30,000 programs, $3.50 per disk . Send SAE for price list
COMPANION COMPUTERS (03) 562 9900
26 Fulton St. Sth Oakleigh 3167

AT MOTHERBOARD: 16MHz $190
SER/PAR Card $35. VGA Card 256K $95. Other Boards Available. Send SAE for price list.COMPANION COMPUTERS
(03) 562 9900 26 Fulton St.
Sth Oakleigh 3167

SELL HITACHI CRO SERVICE MANUALS: Originals with full circuit diag. Callibration procedure and parts list.$25.00each. Steve (02) 808 3663

1179 MIXED RADIO AND T.V. VALVES: Most are new still in wrappers. Available as a job lot or seperately. Write with S.S.A.E for list of types and prices. Macathur Radio and T.V., 84 Katoomba St., Katoomba 2780

LEARN WITH UCANDO TRAINING COMPUTER ANIMATED VIDEOS:
VT201 53mins DC circuit $75.42
VT202 71 mins AC circuits $79.54
VT203 54 mins VCR maint. $75.42
VT204 110 mins VCR repairs $114.97
VT205 47 mins semi conductors $75.42
VT206 55 mins PWR Supplies $75.42
VT207 54 mi ns amplifiers $75.42
Mastercard/Visa/NZ cheque to Electronics Assembly Company P.O.Box 21191 Christchurch New Zealand
Phone (03) 795570. Price includes Post and Packing
All prices in Australian dollars.

For Sale: Medtron Progressive Treatments Unit, with manual; Mullard valvew tester with spare parts; BAC221-AC Frequency Set with AC supply in mint condition; offers please.
Phone Hycal Instruments (02) 633 5897.
Capacitors: 2,00 mfd 25 volt, chassis mounting $1.00 each, 0.47 Farad and 0.1 Farads only $5 each, Slider pots 50k lineaar 45mm travel $1.50, MC14514BPC $2.00, LM7812 & LM7912 $0.70 each, LM324 $0.75, 9 volt battery connectors $0.20, battery holder 2 x AA $0.28, 1N5404 $0.30, 1N5819RL $1.00, 1N4742 (12V Zener) $0.24, 1N752 (5.6V Zener) $0.18. Minimum order $5.00. All stock is new.Phone Hycal Instruments (02) 633 5897.

KIT REPAIRS!!
Repairers of kits from all magazines.
Computer equipment sales/repairs.
Got a problem? Or queries?
Ring anytime 9am-9pm Mon-Sun.
EEM ELECTRONICS
10 Bouverie Place,Epping,Vic.
(03)401-1393

MIDI software for IBM PC's
Advanced music sequencer with notation display, and excellent features.
(see reviews: EA 3/90 & 3/89).
Jel Maestro Release 5-only $125.
Australian author- John Loftus
10 Lorient Crt. PETRIE 4502
Tel: (07) 285 5142

FIX-A KIT
$20 PER HOUR LABOUR
3 months warranty on repairs.
12 months warranty on construction.
Technical help.
HYCAL INSTRUMENTS
Design, manufacture, repair of electronic equipment
(02) 633 5897

RCS RADIO PTY LTD
Established 1933
IS THE ONLY COMPANY WHICH MANUFACTURES & SELLS EVERY PCB & FRONT PANEL published in EA & Silicon Chip.
651 Forest Road, Bexley 2207
AUSTRALIA
RING (02) 587 3491 FOR INSTANT PRICES.

1 GHz Digital Frequency Meter: AEM July 1986, fully built, calibrated with 12 month warranty $300.

VALVES: 6v6g, 3s4, 2x2/879, DF64, IC7G, VR118, 3C45, 12E1, G50 /1G, GC10/48, 7583, 2T4C, 1421A. All NOS.
Hycal Instruments (02) 633 5897.

Capacitors: 2,00 mfd 25 volt, chassis mounting $1.00 each, 0.47 Farad and 0.1 Farads only $5 each, Slider pots 50k lineaar 45mm travel $1.50, MC14514BPC $2.00, LM7812 & LM7912 $0.70 each, LM324 $0.75, 9 volt battery connectors $0.20, battery holder 2 x AA $0.28,

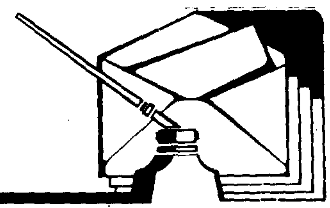
WANTED

WANTED TO BUY: Microphones. Obsolete microphones made before 1960. From broadcast and P.A. 09 279 1234 or 85 Parker st Bassendean 6054 W.A.

TRANSFORMER REWINDS
ALL TYPES OF TRANSFORMER REWINDS
- REWOUND TO YOUR SPEC
- EXACT REPLACEMENT WINDING
- VINTAGE RADIO A SPECIALITY
- ALL ONE OF TYPES
- ALL QUOTES BY RETURN MAIL
- RAPID SERVICE

For price quote send details showing physical size & number of tappings (or send unit, same will be returned to sender if quote not satisfactory)
TRANSFORMER REWINDS
FREEPOST NO 7, PO Box 438,Singleton, NSW 2330.Ph: (065) 761291 Fax: (065) 761003

Information centre



Conducted by Peter Phillips

Some handy tips and ideas

This month we have letters describing how to fix remote controls, flag waving in a Kreisler and more. In particular there's some mail on my Nicad Charger and Discharger designs, and I pose the usual What?? question.

There's an old saying which says 'any fool can ask a question the wisest man cannot answer.' Most of us, at one time or another come up against questions where the ego of the questioner seems more important than the question. For example, at a job interview some time ago I was asked: 'using terminology your grandmother would understand, explain the principle of inductance.' My grandmother was dead at the time, so no simple answer came to mind. Someone else's grandmother might well hold a degree in Nuclear Physics. Guess I flunked that question!

Examinations are another source of tricky questions, like the paper which asked for an in-depth discussion on the merits of polypropylene as a dielectric for capacitors. Nothing so wrong with that, but how about the next one which asked 'What did you think of the previous question?' I learnt later that the answer was 'a good question if I got it right'.

And then there are the ambiguous questions, like 'name the above circuit.' I've often been tempted to answer 'John', or to make up a ridiculous name, but usually I wasn't game. My favourite ambiguous question is: Explain how you would faultfind the given circuit. Answers can be anything from 'ask the guy who designed it' to 'buy a new one' and so on. Pedantic! Maybe, but that's what a journalistic environment does to you...

Having been exposed to my share of tricky and ambiguous questions over the years, I vowed not to impose similar nasties on readers in the What?? section of these pages. But the problem is finding a question each month that fits these specifications. I have a plethora of questions that are stupidly tricky, or others that can only be solved with mesh analysis, superposition theorems and so on, but very few that only need Ohm's law. I'm sure there are literally thousands of mind-bending questions that have simple answers, it's just that I'm running out of ideas.

So how about it readers! Can you help me? If so, send your question and its solution and if it meets the specifications it will be published. It's evident from the number of letters I receive that the What?? question is very popular, and I'm anxious to keep it going.

Finally — the man's name is spelt 'Kirchhoff', for those who were still wondering after reading my intro in last month's issue.

And now to business, starting with some hints on how to repair a remote control...

Fixing remotes

I'm writing in response to your project for testing IR remote control units. Some years ago I purchased a Sony remote control TV set, only to find that the remote control unit started failing. After some months of putting up with lost functions, I decided to try and repair the unit.

Like many such units, this one uses moulded rubber keys with a carbonised layer that shorts between printed circuit tracks when the key is pressed. Obviously the carbon layer was failing, but the question was how to repair it.

It was several years later that I bought some pressure sensitive copper tape for another project, and the idea came to me to try this on the remote control unit by using it to replace the carbon layer on the faulty keys. All I had to do was roughen the surface of the keys, cut strips of copper tape and press a strip onto the surface, using a eraser on the end of a pencil to press it on with.

Needless to say the remote unit works like a new one, including the 'sound kill' button, which I have sorely missed. (G.P., Hurlstone Park NSW).

Thanks G.P., a great idea and one that I'm glad to know works. I thought of doing something similar some years ago, except I wondered if the carbon layer incorporated resistance that formed part of the circuit's operation. Obviously not!

The next letter offers another method which is equally as easy.

I am writing following the discussion in the November issue on repairing TV remote controls. To this end, I offer a repair method that requires a nail brush, warm water, cotton buds and *some switch cleaner. This assumes the remote control unit is one of those that use carbonised rubber keypads that press onto copper tracks, which seems to be a popular type of construction.*

The method is: clean the copper contacts on the PCB with the eraser, then use the switch cleaner and cotton buds to remove any trace of the eraser from the board. Next wash the top side of the rubber pad with the nail brush and warm water, to dispose of any dust and crumbs, then repeat this very gently on the carbonised side. After the carbon layer has been padded dry with a towel, clean the carbon layer again using a cotton bud wetted with switch cleaner to remove any contaminates. Use a gentle wiping action when doing this..

Then put it all back together and it should work as good as new. (A.B., Lindfield NSW).

So there's two methods to fix the 'unfixable'. And speaking of fixing remote control units, here's another letter, but on a rather different type of remote with a different problem:

IR-FM gateway monitor

I'm writing about the IR-FM project described in the September 1990 edition of EA. I wasn't interested in the whole project but I decided to build the transmitter section, depicted in the lower half of the bottom circuit on page 130. I constructed it on a piece of matrix board and made the coil (L1) exactly as described. (I didn't forget to remove the 4mm drill before installing the coil, even though the article didn't mention this important point!)

Unfortunately the transmitter didn't work. So I constructed three different coils, modified the layout, checked all components for accuracy but still no go. I then studied the circuit to see if I could find any errors, but none were apparent. Finally I decided to do some mathematics to establish the value of the coil, to see if the tuned circuit was operating at the wrong frequency. According to my calculations, the coil has an inductance of 16.24pH, requiring a capacitance of some 20nF to obtain resonance in the band of 88 to 108MHz, compared to the 20pF shown on the circuit.

I then fitted a 30nF ceramic capacitor in parallel with the existing trimmer, and finally I was rewarded with the LED level indicator on my FM radio showing a transmission around 90MHz. Perhaps the circuit works using the specified values if a PCB is used, but it certainly didn't when built on matrix board. Or maybe the original design incorporated an extra capacitor of the value I calculated, but was somehow omitted in the final presentation. (R.G., Wollongong NSW).

An interesting one, as it seems unlikely that a PCB design could add 20nF while a piece of matrix board doesn't. Still, whatever the reason, thanks R.G. for letting us know your findings, so we can share them with other constructors.

Changing the topic, here's an idea that strikes me as being rather sensible...

Universal LED

Every time I use a LED, I ask myself why do I have to put up with having to install a series resistor to limit the current or add a diode for polarity protection. After all, if they can fit an entire IC into the package to make the LED blink, the 'universal' LED must be equally as possible.

If a FET (connected as a constant current source) and a diode (or even a bridge) could be integrated into the package holding the LED element, we would end up with a LED able to work from 2.5V to 30V, with either AC or DC. A challenge to industry, perhaps?

I guess to ask for flexible leads as well would be too much to ask for! (K.W., Hawthorn Vic).

Wouldn't it be great if National or one of the major manufacturers happened to read this letter and produced such a LED. I'm not sure I agree with flexible leads, but I like K.W.'s idea of a universal LED.

The next letter discusses the working voltage of an electrolytic capacitor, following a letter on this topic in the November 1990 issue:

Capacitor dilemma

The suggestion that an electrolytic capacitor should be operated near its rated voltage struck a familiar chord with me as well, so I researched the issue in a text book, admittedly dated 1969. According to this reference, the dielectric of an electrolytic capacitor is maintained by a small leakage current. If the capacitor is operated at a voltage much lower than its rated voltage, the lower value of leakage current may cause the dielectric to 'thin out', giving an increase in capacitance.

I have been unable to find any reference to this effect in a current text, so perhaps electrolyte technology has cured the problem. (P.W., Subiaco WA).

As I said in November, I've never experienced the phenomenon of an electrolytic increasing in value with a reduction in the working voltage, but forewarned may be forearmed. It may still exist but to a lesser extent. Thanks for your letter, P.W. Turning now to a small request...

D31 CRO tube

I am trying to obtain a CRO tube for a Telequipment D31 CRO. The tube type number is 3AZ P31 and if anyone has such a tube I would be grateful if they could contact me on (02) 411 1395 or write to Phil Krix, 10 Edmund Street, Chatswood 2067.

Flag waving cure

I have received two letters describing how to cure flag waving in a Kreisler TV models 59-1-2-3, in response to a letter I included in the November edition. It seems the problem is caused by the time constant in the horizontal AFC network being too long to follow the inherent timebase errors from a video recorder.

The solution is quite simple and is as follows: Locate the line control module CU701, which is fitted to the bottom left-hand corner of the deflection board. This board is mounted on the left hand side of the cabinet, looking from the rear.

Then link pins 3 and 10 and short pin 11 to ground. (Note that pin 8 or 14 connects to ground, giving a suitable connection point.) For a 59-4, locate module CU451 and short pin 8 to ground. Many thanks to the two readers who independently supplied this information (P.M., Sydney, and R.P., Pambula Beach NSW).

INFORMATION CENTRE

NiCad charger/discharger

The July 1989 NiCad charger project crops up periodically with suggestions on how to cure the timing problem that seems to be plaguing the design. Fortunately all writers end up getting around the problem in various ways and I'm most anxious to present the solutions offered. After all I designed the thing, and although the various prototypes I constructed all worked, circuit design is an art form which knows no bounds.

The first letter offers two modifications although one of these has me wondering and I doubt if it is really necessary:

First some bouquets. I have built a fair number of EA projects over the years, starting with one from the sixties and my latest effort is the NiCad Charger from July '89. Your circuit diagrams are first rate as are the instructions and comments. Please don't change anything here.

The NiCad Charger was something I needed, so after watching for any errata I decided to go ahead and build it. Unfortunately it didn't work first up, which I traced to faulty CMOS ICs, perhaps caused by the higher volts my 15V AC plug pack was supplying or maybe the result of voltage spikes during soldering. Replacing these got the project going, but the time delays were about half what they should be.

To fix this, I cut the track from the bridge rectifier to R17, and connected a diode from the AC input to R17. To lower the DC voltage from the bridge (it was 18.5V from a 15V AC plug pack) I connected a 15V zener in series with a 150 ohm, 5W resistor from the cathode of D1 to ground. This lowered the voltage to 16.3V. The charger now gets lots of use. Thanks for a great project. (J.A., Auckland NZ).

Thanks for the nice comments J.A., and I'm glad you got the charger going. Using a 15V plug pack shouldn't be a problem as the CMOS ICs are protected by a zener diode, and IC3 can be powered by voltages up to 36V. Your method of loading the plugpack with a zener and a series resistor to reduce the output voltage is not really a good way of doing it, (like putting bags of bricks in the boot to slow the car down!). Still, if it's working and not getting too hot, leave well alone.

The next letter describes quite a few changes, although one of these adds an extra IC to give a 14-hour time delay. I've condensed the letter as space is limited:

I spent some time getting the NiCad Charger going properly, and have added an extra IC (4082) to give a 14-hour time delay. The mods that I've added to give reliable operation are:

add a 0.1uF capacitor across C1, add a 10uF electrolytic from the 12V supply for IC4 and 5 to ground, and connect a 10uF electrolytic from pin 6 of IC3b to ground. I also added a 22nF capacitor across R18, changed R24 and R25 from 1.5k to 2.2k and added a diode in series with LED 3.

To give an indication that the clock is working, I also connected a 2.2k resistor from pin 4 of IC4 in series with another LED, connected to ground. I used a dual colour LED for LED 3 to incorporate the extra indicator, thus making LED 3 serve two purposes.

I also built the Discharger, which works quite well. (A.G., Morphett Vale SA).

Thanks for your letter too, A.G. Some of these modifications are possibly unnecessary and I think the unit would probably have worked quite well by simply adding the 0.1uF capacitor across C1. This addition has been described before and should have been part of the original design. My error here, as I know the importance of

having ceramic bypass capacitors in a digital circuit.

Now to another project I had a hand in...

3.5-d voltmeter

After reading about the 3.5-digit voltmeter described in June 1990, my conclusion is an excellent project spoiled by a poor reference. I was surprised no mention was made of an improved reference, in the article presented in October describing a temperature probe and a negative rail generator for this project.

Based on Clive Chamberlain's figures (Sept, 1990, Letters to the Editor), a 3.3V zener diode will change by - 2.31mV/°C. Why not use an LM336-2.5 reference diode instead? When coupled with two silicon diodes and adjusted to 2.49V, the temperature stability will be around 1.8mV (max 6mV) for the temperature range of 0 to 70°C.

Basically the zener reference has a stability of 0.7% per °C and the LM336 a stability of 0.0034% per °C. In conclusion, an excellent project at a very reasonable price with the capacity for accurate readings providing a good reference is used. (M.N., Blackheath NSW).

Fair comment M.N., and undoubtedly true. However, the whole idea of this project was to produce a cost-effective panel meter with good (but not startling) accuracy. As a colleague often warns, 'perfect is the enemy of good', and knowing when to stop is often the secret to a successful project. We discussed all kinds of reference devices during the design process, including an LM336 device and decided on the zener for a number of reasons.

Firstly, it's cheaper and in a marketplace where panel meters are fairly common this was important. Secondly, a zener diode is consistent with the level of accuracy provided by the rest of the circuit.

Although the zener voltage will vary with temperature, a 20°C change is probably the greatest change most environments would offer. Based on the figures suggested, this gives a maximum change of 46.2mV for the reference or a percentage error of 2.31% for the 2V range. Given that the resistor values in the divider network are likely to change value as well, the overall effect is difficult to determine.

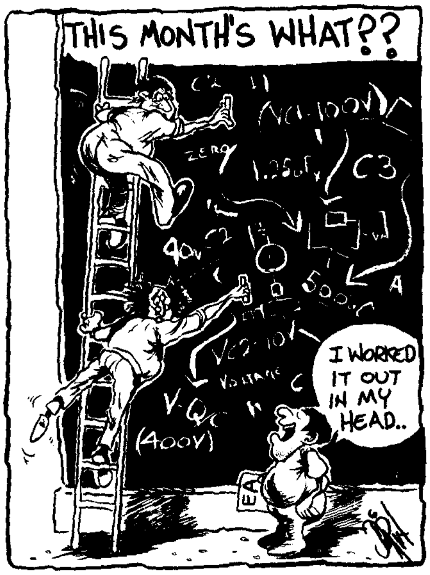
Using a better reference would reduce this source of error, but then we would really need a laser trimmed divider network, a quality integrating capacitor and all kinds of improvements to gain the benefit.

Constructors can include the better reference if they choose, but for most practical purposes the circuit as it stands will be more than adequate.

As we said in the article describing the meter, a higher accuracy will need quality calibrating equipment and regular checking to maintain it. Still, it's good to air opinions on the best type of reference device, and my thanks to M.N. for raising the issue.

What??

It's time for a digital question, for all those used to dealing with one's and zero's. The task: using two gates and *only* two gates, draw a circuit that implements the Boolean expression (AB).(C+D). There's a bit of a trick to it, but the answer is ridiculously simple. No diodes are allowed.



Answer to last month's What??

This was a tricky one, unless you know how! The answers are: VC1 = 100V, VC2 = -10V and VC3 = -90V. Note how C2 and C3 have reversed polarities and that the total voltage across the combination sums to zero, which it must be across a closed switch!

The solution is as follows:

(1) Find the total capacitance of the series combination of the capacitors, which comes to 1.25uF.

(2) Add the voltages to give a total voltage across the combination, which gives 400V.

(3) Calculate the total charge (Q), where charge equals CV, giving 1.25uF x 400V or 500uC. This is the total charge available within the series circuit, and the charge left on each capacitor will be its initial charge less the charge available when the switch is closed.

(4) Calculate the charge on each capacitor, subtract 500uC from this value and determine the new voltage across that capacitor using the equation V = Q/C. ■

NOTES AND ERRATA

Watertight Hi-Light Torch (November 1990): On page 90, the PCB shown in the photo is an earlier prototype version. The PCB overlay is correct. Transistor Q1 can be a BD238, or the more readily available BD140. On page 93, the turnon point for the low battery LED is stated as 5.80V; it can, in fact, be any value down to 5.60V. The turn-off point will vary with the turn-on setting, but is not critical. The parts list should show the resistors as 0.6W, not 0.25W. On page 92, the third paragraph should read 'Mount the five diodes and four capacitors'.

Frame Grabber (August 1989): Constructors who are still experiencing trouble with this project may care to send a formatted floppy disk to RCS Radio, of 651 Forest Road, Bexley 2207. Bob Barnes of RCS has assembled a file of all known notes and errata on this project (including those from Paul Turtle), and has generously offered to provide constructors with a copy of the file, gratis.

But please include a stamped self-addressed disk box for him to return your floppy disk safely. ■

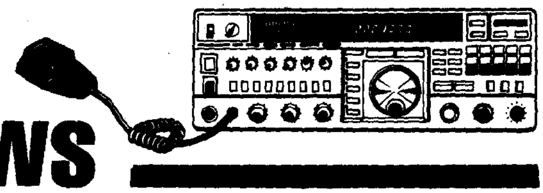
WARNING

Constructors of the 'Watertight Hi-Light' rechargeable torch project described in the November 1990 issue of *Electronics Australia* should be aware of a possible risk of explosion unless gas produced during battery charging is able to escape.

The Gates Battery people have advised of this risk, which arises because the firm's high-capacity cells, although nominally 'sealed', are in fact fitted with a safety vent. During charging a small amount of hydrogen can be emitted from the vent, and this can combine with oxygen from the air to form a potentially explosive mixture when the cells are confined in a relatively sealed case.

Constructors are therefore advised that they should either unscrew the front of the torch while charging, to allow venting of any gas, or alternatively provide the case of their torch with a small vent — perhaps a small hole which can be fitted with a rubber plug, except during charging.

Amateur Radio News



Townsville ATV station closes

A news fax from the Townsville Amateur Radio Club advises that the club has had to close down its low power experimental TV transmitter, which had operated on channel 35 from Mt Stuart for some time, and was in fact Townsville's first and longest-running UHF TV station. Apparently the closure was made necessary because of the Federal Government's Regional TV Aggregation Scheme, which does not allow ATV transmissions in the UHF TV band.

Although the TARC transmitter had an output of only 5 watts, it allowed club members to carry out investigations of signal and component behaviour at UHF. Apparently it also served as a tuning and antenna alignment source for domestic viewers in the Townsville area, when they installed UHF antennas in anticipation of the new professional stations.

TARC members had a shut-down ceremony and barbeque at the Mt Stuart transmitter site, to commemorate its passing.

Reminder: Gosford Field Day

As advised last month, this year's Gosford Field Day will be held on Sunday 17th February at the Gosford Showground.

There's to be an expanded programme of technical seminars, plus all the traditional features of this very popular field day: displays of the latest amateur gear by equipment distributors and retailers, plus sales of disposals, second-hand and surplus equipment — including a 'flea market'. Other attractions include a display of historical equipment, packet radio and amateur TV displays, and a QSL bureau.

The gates will open at 8am regardless of the weather conditions, as all displays will be under cover. There is plenty of off-street parking available, while a courtesy bus will operate between Gosford railway station and the showground. Food will be available.

Registration for the field day costs $6.00 for adults and $3.00 for pensioners. Children are admitted free.

Further information is available from the Field Day Committee, Central Coast Amateur Radio Club Inc., PO Box 252, Gosford 2250 or by ringing (after hours) on (043) 92 2244.

Canada's new regulations

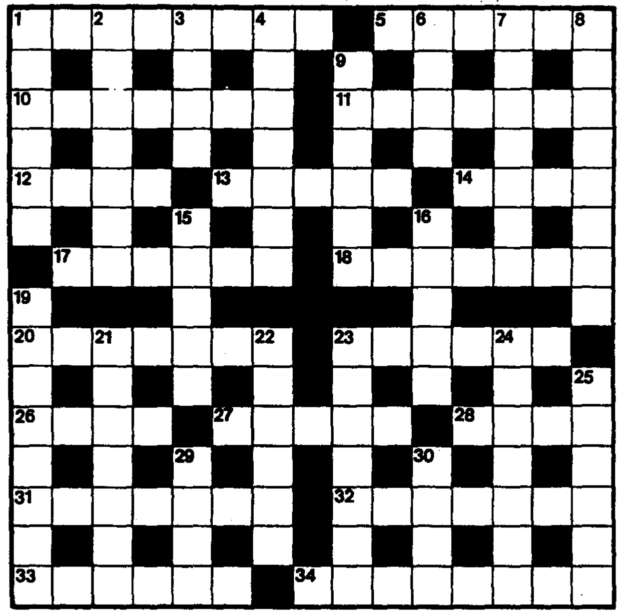
You may recall that we ran an item in the November 1990 column, regarding the new Canadian licensing scheme and its restriction of the use of 'home brewed' transmitters to the highest 'Advanced' level of licence holder. Reader Rick Beres, VK8KY/VE6CW has written from Anula in the Northern Territory, and enclosed a copy of the new Canadian regulations. His cover letter adds the comment that the regulations show the Canadian authorities are not 'just handing out amateur certificates on request', nor are they 'moving amateur radio into the ranks of CB'.

Fair enough — the regulations (Radiocommunication Information Circular RIC-24, dated July 1, 1990) certainly call for an examination on basic electronics theory, propagation, interference and suppression, station operation and operating procedures, even for the lowest-level 'Basic' licence. The two middle-level grades call for Morse tests of 5wpm and 12wpm, while the 'Advanced' examination calls for a detailed knowledge of circuit operation, transmission and modulation techniques, test equipment operation and so on.

Obviously this is a long way from simply issuing licences on request; but then, *we* didn't actually say they were doing this. What we *did* say was that apparently only the Advanced licensees are allowed to build and operate their own transmitting equipment, and this *does* appear to be true.

While one can understand the factors which have probably caused the Canadian authorities to make this decision, it does seem at odds with the original concept of amateur radio as an activity for technical experimentation. Since probably only a small proportion of total amateurs are likely to progress to the Advanced call, it means that by regulation most Canadian hams must now remain as 'appliance operators' — and therefore that much closer to the kind of operation which is common among less technical CB operators. Sad, don't you think? ■

EA CROSSWORD



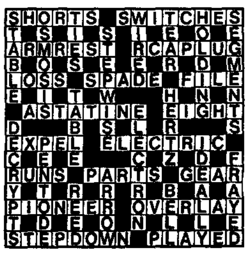
Across

1. Cause of priority signal.(8)
5. Special coils for inhibiting AC. (6)
10. Changes nature of waveform. (7)
11. Determine component frequencies. (7)
12. Communication link. (4)
13. Said of state of modern electronic equipment. (5)
14. Control on a VCR. (5)
17. Move in a rotating manner. (6)
18. Substance in skin resulting from UV stimulus. (7)
20. Nature of electromagnetic energy. (7)
23. Colour in the visible spectrum. (6)
26. Sound of pre-digital watch. (4)
27. Measure of phase lag. (5)
28. Prefix with similar meaning to semi. (4)
31. Calculate. (7)
32. Cause to operate. (7)
33. Substance in an electric cell, --- oxide. (6)
34. Type of car telephone network. (8)

Down

1. Tools with a twist. (6)
2. Atomic number of ytterbium. (7)
3. Yttrium and samarium are --- earth elements (4)
4. Beat that is detected by the electrocardiograph. (7)
6. Part of a tape recorder. (4)
7. Inert gas used in light bulbs. (7)
8. Moving like a CRO trace. (8)
9. Radioactive element number 88. (6)
15. Electromagnetic echoing system. (5)
16. Type of lamp. (5)
19. What copywright does for software. (8)
21. Said of number system of base ten. (7)
22. The ---- effect occurs when electrons cross a potential barrier. (6)
23. A potentiometer is a ---- divider. (7)
24. Stereo organ? (7)
25. Kind of accelerator. (6)
29. Power. (4)
30. Acronym for Harrier-type aircraft. (4)

SOLUTION TO JANUARY



Electronics Australia with ETI

Reader Information Card

On the reverse of this page you will find the Reader Information Card. This is a service EA with ETI provides free to readers who want more information about products advertised or otherwise mentioned in the magazine. At the bottom of the article or advert you find a RI number. Just circle that number on the card and send the card to us. We will pass on your address to our contacts, either the advertiser or our source for the story, who will then inundate you with literature on the product of your choice. Another feature: to the right, there is a blank space. Why not use it to drop us a line, and let us know what you think of the magazine. We are particularly interested in ideas from readers on how we can improve things.

Note to the Editor:

....

....

....

....

....

....

....

....

....

....

For publication! Yes/NO

Name:..

Address: ....

....

Postcode:..

50 and 25 years ago..

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

February 1941

Colour Television on the Way: During the month reports have been received that Mr J.L. Baird, pioneer television engineer, has given a demonstration of colour television in England.

Actually, Baird gave a colour television demonstration as far back as 1928, when television at its best was still very crude.

As Baird pointed out during his visit to Australia, there is no great problem in obtaining colour in television — the problem is to get good colour. His original transmitter presented an image scanned three times in the three primary colours, using suitably sensitive and filtered circuits, the persistence of the eye being relied upon to give the blending of the colours themselves.

Vital New Industry: Rola Company (Aust) Pty Ltd. manufacturers of Rola loudspeakers, have announced that they are now manufacturing high quality magnet wires — an industry new to Australia and vital to this country's economical self-sufficiency.

A modern and efficient plant, capable of producing all types of magnet wires, is now in operation.

February 1966

Europe's First Microcomputer: Europe's first computer range based entirely on integrated circuits has been developed by the Marconi Co Ltd of Chelmsford, Essex, England. These will be the first European machines based entirely on microelectronic techniques. They will demonstrate how normal electronic circuits, made up of separate and recognisable components can be replaced by minute chips of silicon, .02in sq., holding the equivalent of dozens of conventional components. Such 'integrated circuits' have now been used to build a complete, ultra-high-speed computer.

True 3D Photographs Using Laser Optics: By using the special characteristics of the laser, it is now possible to create a black-and-white, three-dimensional photographic transparency without the use of any special optical viewing devices.

With this new photographic system, the viewer sees a three-dimensional image suspended in mid-air. The image is, in fact, more than just three dimensional.

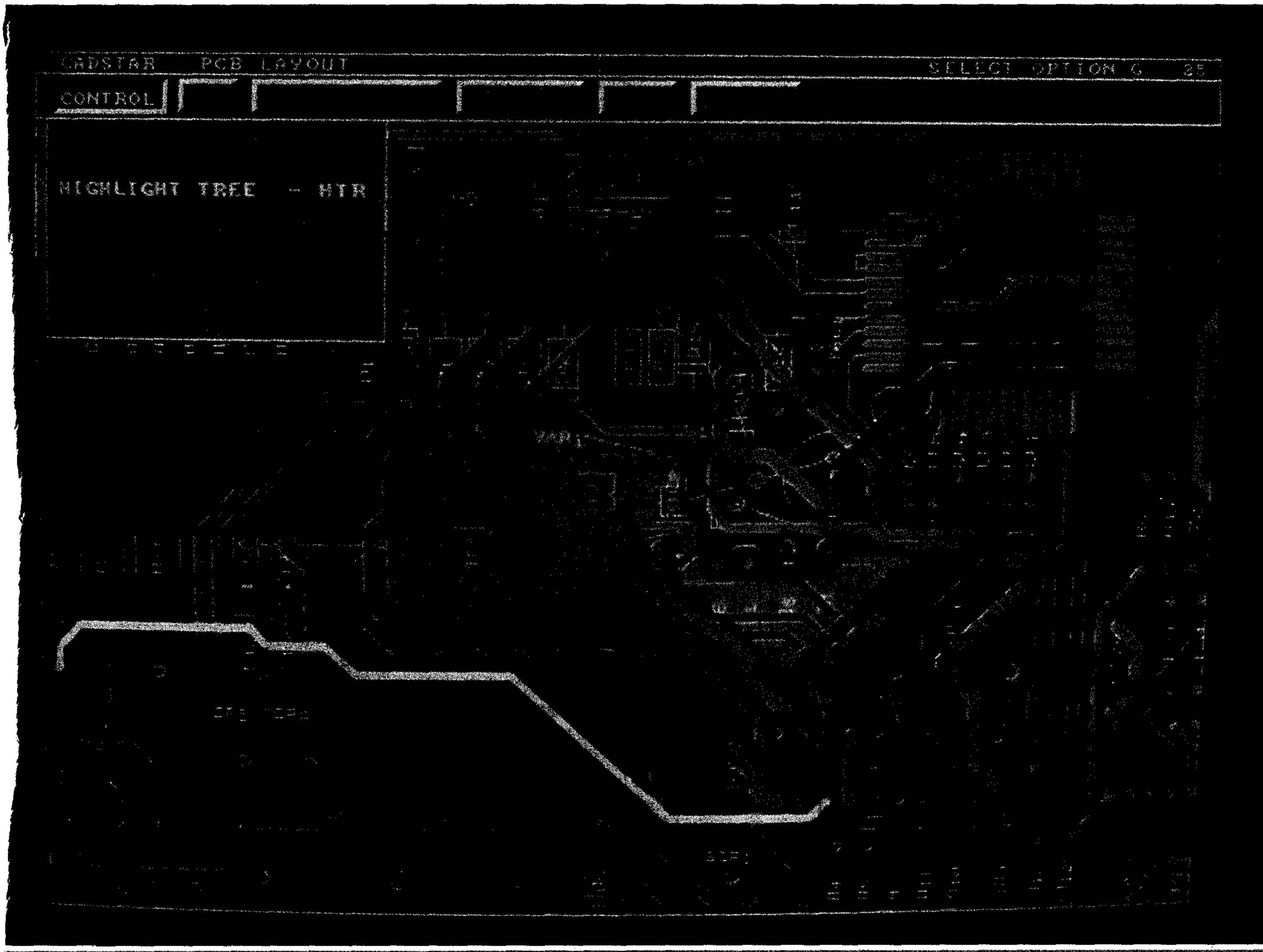
It has all the visual properties of the original object, including a change of perspective with a shift in the observer's viewing position and parallax between near and far objects in the image. When placed side by side, image and object are indistinguishable to the viewer.

Another amazing by-product is the fact that if the original transparency is divided into many small fragments, each fragment, in itself, is capable of reproducing the original object (with some degradation in resolution).

WORKSTATION

EA'S COMPUTING SUPPLEMENT

CAD PRODUCTS UPDATE



UV-LASER SYSTEM MAKES 3-D SOLID MODELS FROM CAD

SUCCESS FOR LOCALLY MADE PHOTOPLOTTER

Back in the July 1989 issue, we ran a story on the development of a new low-cost photoplotter for PCBs, by enterprising Australian firm Quest Electronic Developments (QED). Here's an update on the subsequent success of the QED400 photoplotter QED now boasts over 100 units in use, both within Australia and overseas.

Three of South Australia's four PCB manufacturers are operating photoplotters — which generate 1:1 PCB artwork on film — developed by Quest Electronic Developments, a company operating from Technology Park, Adelaide.

Imp Engineering, Entech Products and Nova-Crest Australia have all purchased and installed the QED400 Personal Photoplotter during the past year, a move principals of each company claim was because the photoplotter's excellent price and performance distinguished it from competing products.

Costing just $16,500 for hardware and software, the system is less than half the price of competing systems and about one quarter the $60,000 price tag of systems which were available when it was released.

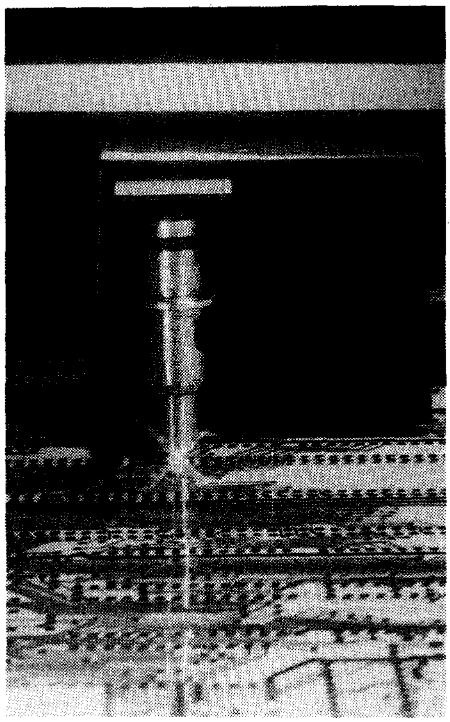
The QED Photoplotter has also won International acceptance with sales to Europe, the USA and South East Asia.

In Australia, notable users include the Dept of Defence, Dept of Foreign Affairs, Aust Broadcasting Corporation, IEI Australia, Monash University and service bureaux in Melbourne, Adelaide, Perth, Canberra and Brisbane.

The QED400 operates from a PC and can be used in an office as a penplotter as well as a photoplotter. It runs from an XT, AT or OS/2 personal computer.

The unit currently has different photopen sizes ranging from 0.004" to 0.100", plus over 5000 internally generated apertures covering: round, square, rectangular, oval and octagonal pads, together with thermal reliefs, annulus's and targets.

The software selects which photopens to use and in which order. A robot arm then collects the photopen and checks it is working before commencing the task of photoplotting.



A close up of one of the QED400 shadow-image photopens in operation.

The unit operates in red 'safelight' conditions for loading and unloading the film, and is fitted with a moulded light-proof cover whilst photoplotting for normal light operation.

Although the basic mechanical coordinate table originates from Japan, all of the photoplotter's specialist components are manuafctured in Adelaide. To ensure long term accuracy, an internal calibration procedure is included so that alignment is maintained if parts begin to wear after a year in constant use.

Growing demand

The expansion of electronics-based manufacturing in Australia has seen a strong growth in the demand for PCB production.

For South Australian PCB manufacturers, the need for increased production efficiency was the deciding factor for photoplotting to supersede traditional techniques.

Bob Hodgson, a founding father of the South Australian PCB industry in the 1960's and now technical manager of Imp Engineering, the State's second largest PCB manufacturer, said the photoplotter was necessary for efficiency. He said it had attracted a lot more customers for Imp.

The company, which has operated the QED personal photoplotter since the start of 1989, bought the unit because of the increasingly common practice of providing information on computer disk, he said.

The first Adelaide company to install the QED personal photoplotter was Entech Products, which went from ink-on-paper plotting to photoplotting, running the QED unit almost 24 hours a day. The demand proved so great that Entech has now installed a second QED unit.

"We were in first because the quality of plotting is extremely important to us," said Entech managing director Doug Brown.

"With customer-supplied artwork, different quality would produce different results. If we can do it all ourselves directly on film, then we can guarantee the results, so we now provide photoplotting as part of our service."

Brown said the QED photoplotter provided a cost-effective entry into productivity-improving new technology. "Certainly it has improved our productivity by 25% and it has proved a cost-effective way to do it."

"We learnt a long time ago that in order to control the quality of the product we make, we must control the incoming material, which in this case, is computer generated artwork."

The most recent arrival to Adelaide's PCB-manufacturing industry is Nova-Crest Australia. Dave Williamson, part-owner and marketing director, said the QED personal photoplotter had certainly improved productivity.

"If the customer insists on giving us old-fashioned types of artwork, then it does not increase productivity because it goes through the old-fashioned process," he said.

"In a sense one could say we had no choice but to buy one: If technology goes that way, then we must follow technology. But it (the Quest photoplotter) gets us into that technology without a lot of pain."

"It means we can take 5.25" disks from our customers and plot the artwork to produce their board from the disk. We chose Quest for various reasons, including price, and as far as we can tell the quality is very good."

Quest Electronic Developments, a subsidiary of Melbourne-based Quest International Computer Ltd, was established in late 1986 when owner David Brown employed an electrical engineer to commence development and make a photoplotter, an in-house designed product that could be sold in Australia and overseas.

QED started work on the photoplotter almost straight away by acquiring the rights to a basic photopen which had been developed in Victoria by the Royal Melbourne Institute of Technology, Department of Applied Physics.

In early 1987 the electric engineer, Greg Fidock, was joined by fellow University of Adelaide honours graduate Tim Sollznow and later by Adrian von Einem. They all worked fulltime on the project, together with specialist subcontractors and in March 1988, the first production prototypes were released.

After having bugs ironed out of the system and being tested in several beta sites, the QED personal photoplotter had its first export success with two units exported to the UK in May 1988.

Now there are over 40 installations in Europe, 10 in the USA, 20 in South East Asia and 40 in Australia, plus small numbers in the USSR, India, Brazil and Israel.

For more details on the QED400 photoplotter, circle 201 on the reader service coupon or contact Quest International Computer, 1 Hamilton Place, Mount Waverley 3149; phone (03) 807 7444. ■

CAD News & New Products

Autodesk launches AutoCAD Release II

AutoCAD Release 11, the latest upgrade to the world's most popular computer-aided design (CAD) software, is now available in Australia for 80386 and 80486 based computers.

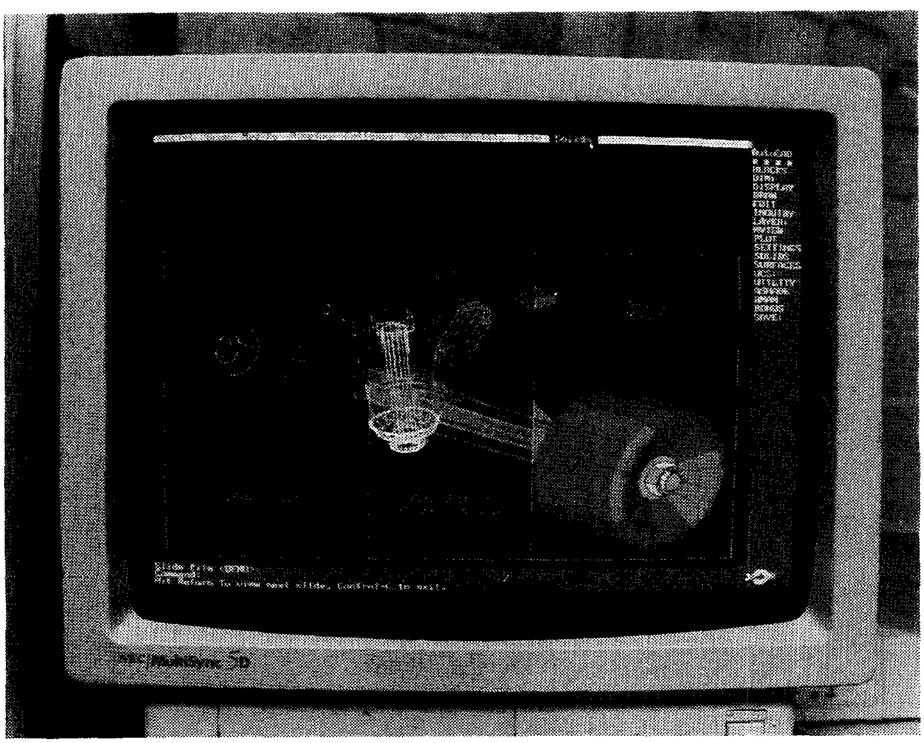
"Release II is the most significant and innovative upgrade since AutoCAD was first introduced in 1982," said managing director of Autodesk, Tony Zammit.

"Many of the improvements are as a direct result of customers' requests for more productivity and versatility and we've built in new features that extend AutoCAD's ability to penetrate new markets such as geographic information systems (GIS), mechanical design and other areas which benefit from integrated systems."

The new release features a host of technical innovations. Multiple-view plotting is a new productivity feature that provides designers with theflexibility to lay out, organise, annotate and plot multiple-view AutoCAD drawings quickly and accurately. Release II provides network support for up to 128 workstations and includes a file locking system to protect against accidental overwrites.

Building on its foundation of open architecture, AutoCAD Release II incorporates the new AutoCAD Development System (ADS) — a 'C' language programming environment — that helps developers create specialised application programs which work with AutoCAD in many different industry sectors. ADS can also be used to link AutoCAD to other software applications such as spreadsheets and database programs.

Other new features of AutoCAD Release II include:



Optional features of the new AutoCAD Release 11 include Advanced Solid Modelling (AME), with an integrated fast shading facility as illustrated here.

- a drawing recovery command to help safeguard customers' investment in their drawing files;
- a reference file feature, especially useful on large projects, that allows a reference drawing to be attached to an active drawing;
- a new, quick SHADE command to produce shaded images of a drawing or model;
- additions to AutoCAD's dimensioning capabilities;
- and advancements in the AutoCAD interface, such as improved dialogue boxes, that make AutoCAD easier to use.

For further information circle 207 on the reader service coupon or contact Autodesk Australia, 9 Clifton Street, Richmond 3121; phone (03) 429 9888.

8051 simulator runs on PCs

An integrated set of PC-based design tools for embedded system applications using the popular 8051 microcontroller has been developed by Avocet Systems.

The Avcase Development System package includes an 8051 simulator/debugger, 8051 family C compiler, 8051 assembler, linker and editor, all designed to run on an IBM PC or compatible with 640K of RAM or more, MSDOS 3.0 or later, and ideally a hard disk. The package integrates these tools in a windowing environment, whose operation is similar to Borland International's Turbo Debugger. Unlike other simulators, the Avcase 8051 simulator has been carefully hand-coded in assembler for optimum speed. It runs at up to 1/5 real time to move through the program, while full simulation (including peripherals management and maintenance of an 'undo' history) runs as up to 1/25 real time on a 16MHz/386 machine simulating an 8051 running at 12MHz.

Extensive break-pointing facilities are provided to control execution. Windows are easily set up to perform 'inspector' and 'watch' functions, to allow monitoring of program and system variables by type and scope. All on-chip registers can also be monitored, while conventional memory dumps are available if required.

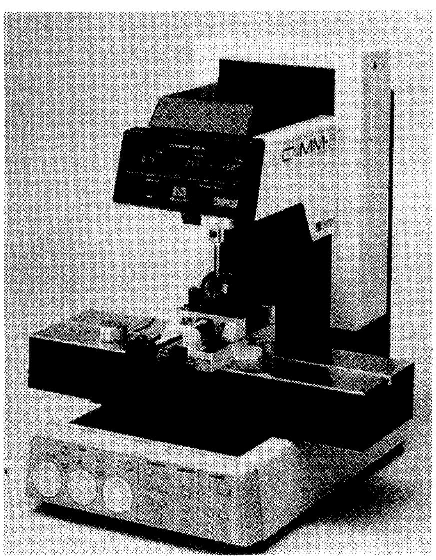
For further information circle 203 on the reader service coupon or contact Program Development Systems, Suite 1, 63 Murrumbeena Road, Murrumbeena 3163; phone (03) 563 3063.

Roland appoints RCS Cadcentres

Cadcentres has been appointed Victorian master dealer for the complete range of Roland Computer Aided Modelling Machine (CAMM) products. "We were looking for a specialist to represent our range of CAMM products in Victoria," says Bill Kaliviotis of Roland.

"RCS Cadcentres hs been involved in electronics, CAD systems, sales and support for over eight years. They have a strong background and have just the right balance for a Roland Master Dealer," said Kaliviotis.

The Roland products that will be



sold and supported by RCS Cadcentres include the well-known CAMM-1 cutter and pen plotter. The CAMM-1 uses the latest technology with its desktop design and the CAMM-2 is for engraving metals, plastic, wood and perspex. Both units use existing software drivers written for Roland or HP A-3 size plotters. Real three dimensional computer aided modelling is possible with the fascinating Roland CAMM-3, a micro-milling station which uses linear interpolation and enables designers and engineers to turn screen images on their PC into solid three dimensional models. Designers can use a range of software available from Roland including Modelart 3 and Smartcam, or CAMM-3 interfaces with many popular CAD software programs such as QikDraw. The CAMM-3 can mill almost any material ranging from wood and plastics to metals.

For further information circle 205 on the reader service coupon or contact RCS Cadcentres, 731 Heidelberg Road, Alphington 3078; phone (03) 499 6404.

Transputer autorouter

The CADSTAR Transputer Autorouter brings the power and flexibility of Racal Redac's Bloodhound Autorouter within the reaches of all users of the CADSTAR PCB design system. It provides a package which can be installed on any IBM AT, 386 or compatible machine, giving users exceptional price/performance in autorouting solutions. The Transputer Autorouter package consists of a T800 transputer running the Helios operating system and the Racal Redac Advanced Autorouter.

CAD Products

The transputer printed circuit board can be 'plugged in' to an existing PC-AT or compatible, bringing true 32-bit power to the PC/AT user. It provides autorouting performance that can only be matched by workstations and 386-based PC's without additional investment in hardware. When running CADSTAR's Transputer Autorouter, the user is kept in the familiar DOS environment, as the Helios operating system remains transparent. The Transputer Autorouter effectively complements the auto-interactive placement and layout optimisation facilities of CADSTAR PCB design. It is capable of providing 100% routing solutions to the majority of well-placed boards, including high technology designs with double sided component mounting and fine-line multilayer designs.

For further information circle 206 on the reader service coupon or contact RCS Cadcentres, 731 Heidelberg Road, Alphington 3078; phone (03) 499 6404.

Tennyson Graphics has 10th birthday

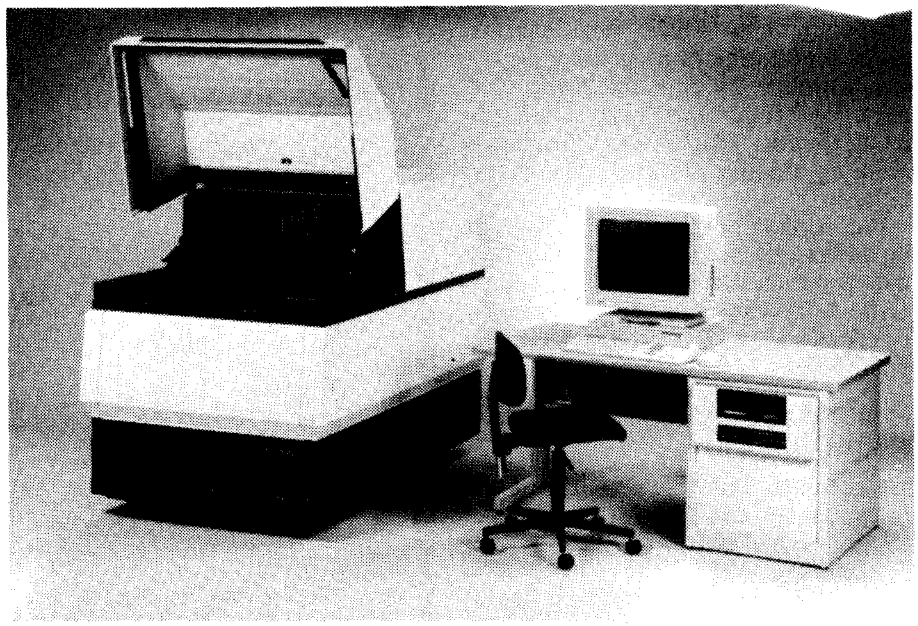
Melbourne-based CAD plotting bureau Tennyson Graphics is celebrating its 10th year in business. The firm is now one of the most experienced suppliers of PCB art masters in Australia.

"Right from the start we've never spared any expense in getting the world's most advanced equipment", said Tennyson's Nick Martinis.

The firm has pioneered in introducing laser photoplotters to Australia, with the Scitex Response 280 System. As a result, Tennyson can accept data on either tape or floppy disk, and in either AutoCad or industry standard Gerber file formats. It can also offer very fast turnaround, and a standardised pricing structure based purely on size of board. A combination of local and overseas orders now requires Tennyson to run its laser photoplotters 24 hours a day — a significant measure of its success.

The firm has also moved from a small converted office in Murrumbeena to modern purpose-built premises in Dingley.

For further information circle 204 on the reader service coupon, or contact Tennyson Graphics, 7 Plane-Tree Avenue, Dingley 3172; phone (03) 551 8600.



Enhanced photoplotting system

Gerber Scientific Instrument of the US has unveiled the model 9725 laser photoplotting system, which provides 20" x 26" plots at half-mil resolution in four minutes.

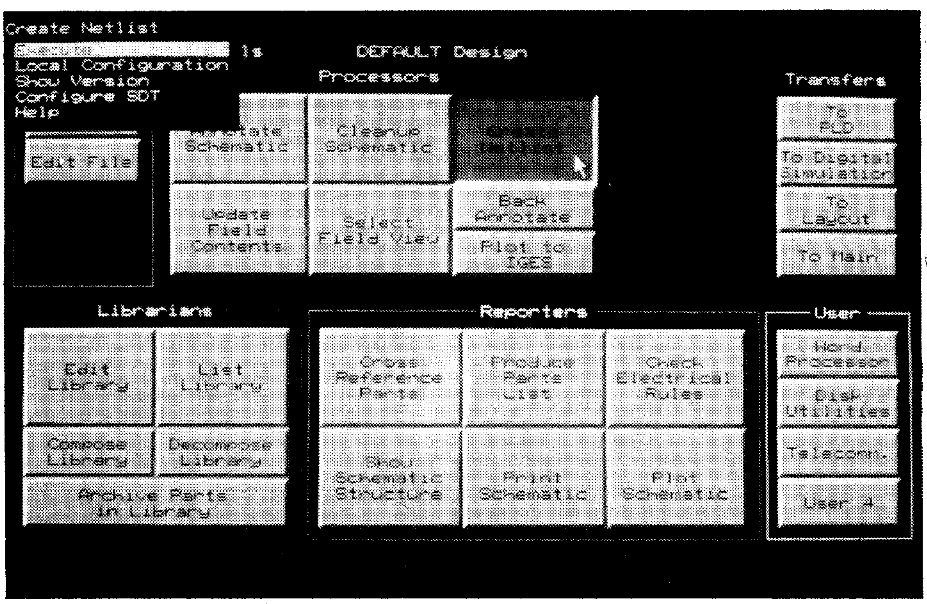
The 9725 is the latest release in a range of precision photoplotters.

The CPU which provides overall control can be expanded up to 64Mbytes of RAM. The 9725's multitasking environment permits simultaneous imaging of one job while processing one or more other jobs from a single workstation.

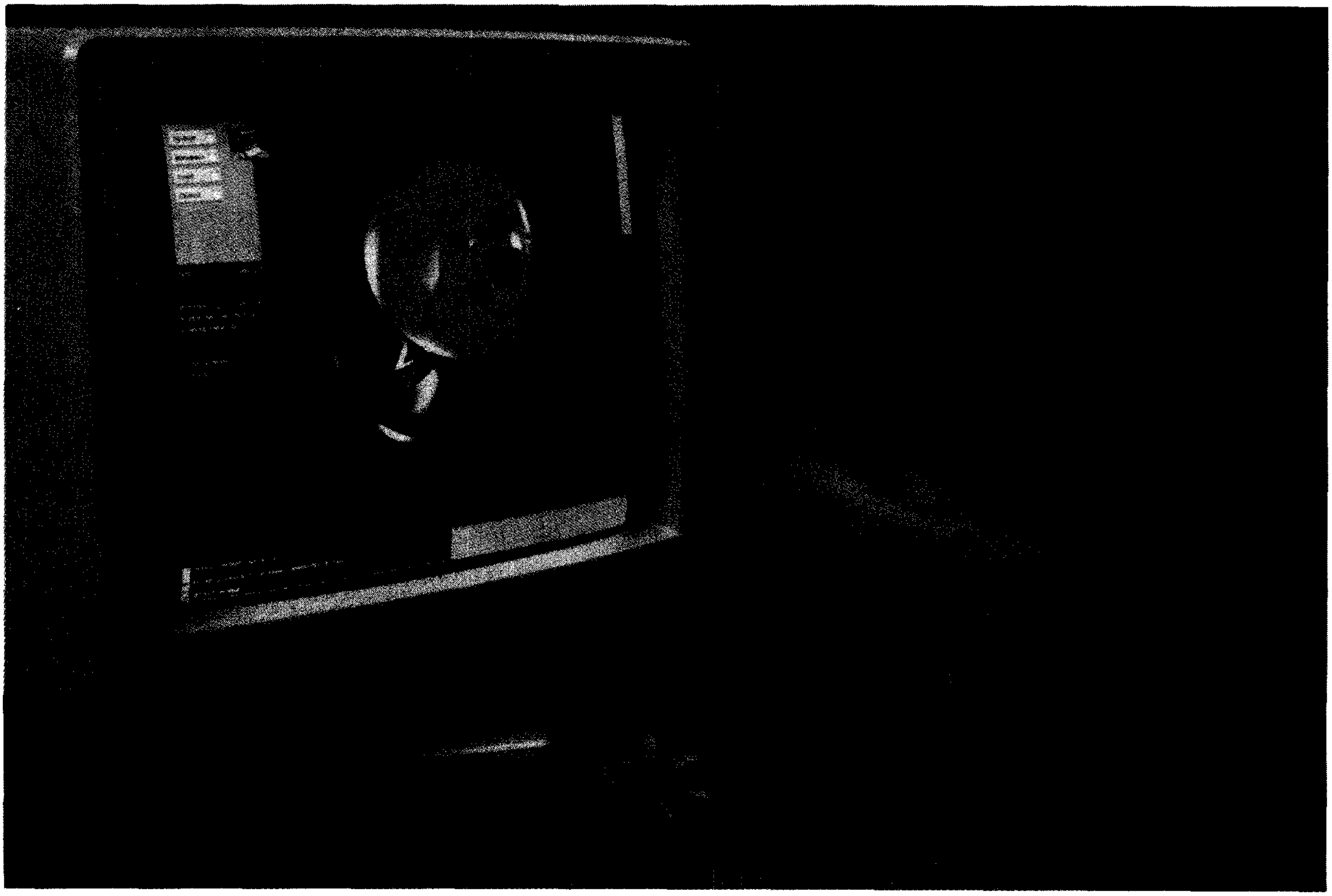
The model 9725 can be configured to fit any I/O requirement including Ethernet, RS-232 and magnetic tape (800, 1600 or 6250bpi). Hard disk configurations are available from 208 to 976MB and the high resolution graphics are available in both monochrome and colour versions.

For further information circle 202 on the reader service coupon or contact RCS Cadcentres, 731 Heidelberg Road, Alphington 3078: phone (03) 499 6404. ■

OrCAD's new 'ESP' user interface



As mentioned in last month's computer news section, OrCAD has upgraded its very popular family of design automation software products. Here's the appearance of their new 'ESP' graphically based user interface. The Australian distributor is Prometheus Software Developments — phone (02) 809 7255.



UV Laser process turns CAD designs into prototypes

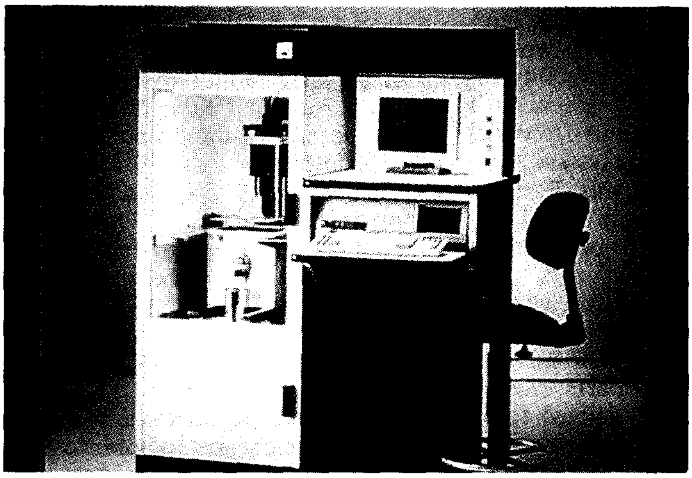
A new process known as stereolithography achieves a dramatic speedup in the design of new products, by allowing production of a solid model, prototype or casting master directly from a CAD system design file. The system uses a computer-controlled optical scanning system to create the 3D model 'slice by slice', by solidifying liquid polymer using intense UV light from a helium-cadmium UV laser.

Developed in the United States by Charles Hull of 3D Systems Inc, based in California, the stereolithography system is exclusively distributed in the South-West Pacific region by Vipac Engineers and Scientists Ltd, based in Melbourne.

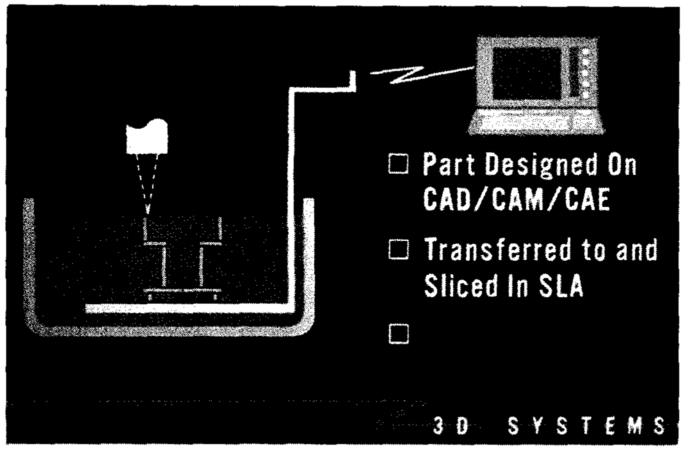
Stereolithography uniquely combines CAD/CAM/CAE software, photo chemistry and laser and optical scanning technologies. The patented process, which creates three dimensional plastic parts from CAD data in a matter of hours, is producing parts for the automotive, aerospace, computer, medical, consumer and electronic components industries. Applications for this technology include conceptual designs, prototypes testing models, and casting master patterns.

Using the StereoLithography Apparatus (SLA), solid or surface data from the CAD system is 'sliced' into very thin cross sections. A helium-cadmium laser then generates a small intense spot of ultra violet light, which is moved across the top surface of a vat of liquid photopolymer by a computer controlled optical scanning system. The laser changes the liquid photopolymer to a solid where it touches, as it precisely 'prints' each cross section.

A vertical elevator system lowers the newly formed layer, while a recoating and levelling system establishes the



A look at the SLA modelling system. The tank containing the photopolymer liquid is in the compartment on the left.



The basic SLA modelling system. The UV laser is scanned across the surface of the polymer, creating a 'slice' of model. The elevator is then lowered slightly for the next slice.

next layer's thickness. Successive cross sections, each of which adheres to the one below it, are built one on top of another to form the part from the bottom up.

After the last layer is made, the part is removed from the SLA and undergoes a high intensity flood of ultra violet light to complete the polymerisation process. The part can be finished by sanding, sand blasting, painting or dyeing.

Describing the technology Ian Jones, Vipac's Director for Stereolithography said, "It really is like magic. The SLA machine combines Computer Aided Design, photochemistry and lasers to produce a radical new technology that can produce prototypes and concept models in a matter of hours."

He said, "The concept is so novel that many Australian and Asean businesses are unfamiliar with it. Yet it has raised more than a few eyebrows in the board rooms of local industry who have seen a preview of the technology."

Vipac's Pamela Fyvie explained that the process takes a CAD design with all features capable of being designed on a CAD system and downloads it into the stereolithography system.

"Initially the CAD design is taken and 'sliced' by computer. The thickness and number of slices depends on the amount of curve (vs straight edge) and the complexity of the part to be produced. Slice thickness can range from 0.12mm to 0.5mm — the standard slice is 0.25mm," explained Ms Fyvie.

Each slice is transformed into a solid by a 12.5 milliwatt helium-cadmium laser, which generates a UV beam onto the surface of a 10" (25cm) cube containing 30 litres of liquid photocurable polymer.

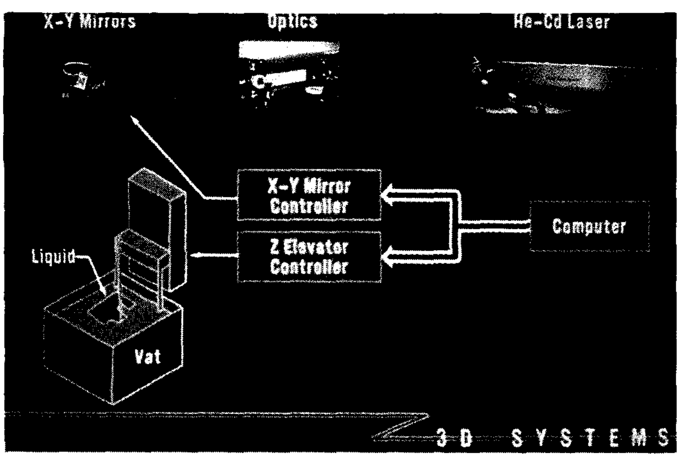
The result is a part which has been formed in a matter of hours. It can be used as a prototype — tolerances are fine — the smallest cross section is dependent on the diameter of the laser generated beam — 0.12mm.

Time savings using stereolithography can be staggering compared to producing parts using the conventional process of models, wooden patterns and tooling.

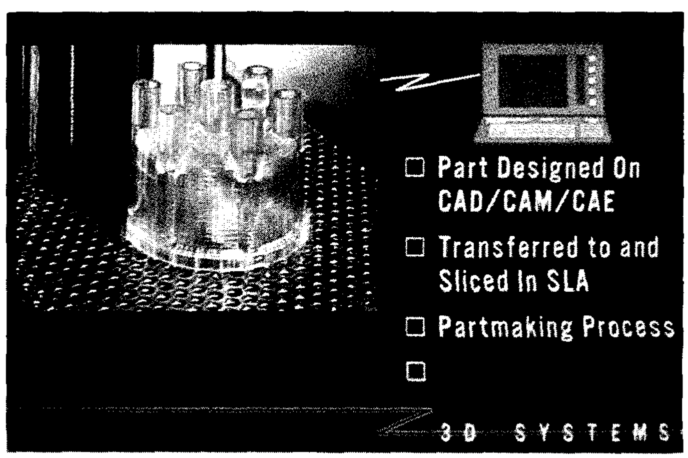
"You are looking at hours using stereolithography as opposed to anything from one to 20 weeks," said Ms Vyvie.

"The potential savings are huge — in time and dollar costs. Obviously, if you wished to produce a solid box the stereolithography process might be seen as an expensive option, but take the production of a part such as an impeller or a fan blade — you'd need a five-axis machine to produce a prototype, and lots of time."

"Such a part could be produced



A diagram showing the system in a little more detail. Computer controlled optics manipulate the UV laser beam to scan the surface of the polymer liquid.



When the model is finished, it is subjected to a high intensity flood of UV to complete the polymerisation. This produces a prototype, as shown here.

CAD Designs

using stereolithography in a matter of hours — ready for evaluation, testing and alteration by engineers and designers. And for longer jobs the process can run unattended overnight."

The size of the polymer vat (25cm cube) does not necessarily restrict the size of an item to be produced — larger parts can be built in sections; currently a larger 50cm cube is available to allow the production of larger single components.

Bureau facility

At a cost of around $300,000 for the unit, it is no wonder many US corporations have acquired their own machines.

Pamela Fyvie predicts a similar trend in Australia, but she maintains there will be a demand from smaller manufacturers and design houses for Vipac services and expertise — "We have only been running the machine here since July last year and we find that Max Fawahl, our operator who trained in the US, is continually developing his skill."

Ms Vyvie explained that Vipac was offering the process to clients with their own CAD systems, as well as providing a design bureau facility including a service which would allow a manufacturer to present drawings which can be fed into the system.

In the US, General Motors, Eastman Kodak, Apple Computers and Texas Instruments are but a few of the many users of stereolithography.

Prototypes ranging from plastic components for disk drives to complete mock ups of air-to-air missiles have been produced. Parts can be produced, finished and painted to be evaluated for consumer preferences or for a design group.

Depending on the size of the item a number of variations can be produced — as many as will fit on the elevator platform in the polymer-filled cube.

To market — quickly

Ms Fyvie sees advantages in product improvement as well as initial design. "The speed of the process allows numerous options to be considered and tested so that the best design can be used." General Motors in the US took a year to produce models for their 1990 Chevrolet Corsica's bumpers — estimates of the time for the production of such a job using stereolithography are in days.

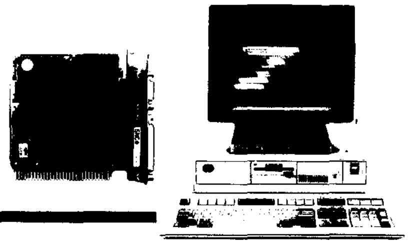
In its first month in operation at Vipac's Port Melbourne headquarters, the process of stereolithography attracted interested from 40 companies. "It's something all manufacturing companies could use. We've held seminars and ,workshops to demonstrate the process. We want people to come and see this process. Industry has to do things smarter and quicker — and this process enables industry to do both."

As Ms Fyvie pointed out, a squared shape may be cheaper to produce using an NC machine if you have the machine time. But the cost savings are significant for more complicated items — hollow shapes such as prototype perfume bottles for Avon can be produced in one piece.

Further information on the SLA system is available from Vipac Engineers and Scientists Ltd, Victorian Technology Centre, 275-283 Normanby Rd, Port Melbourne 3107; phone (03) 647 9700.

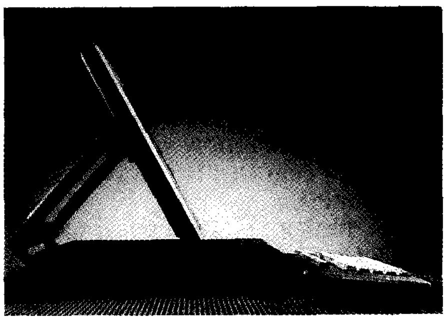
(Adapted from 'Link' which is published by the Department of Industry and Office of Economic Planning, Victoria). ■

Computer News and New Products



SX, CD-ROM portables

SMT Goupil which claims to be Europe's leading PC manufacturer, has released two new versions of its stylish Golf SX series of portables. The new 20MHz 386SX version of the Golf features hard disk capacities of either 100MB or 200MB, has 1MB to 9MB of RAM, and comes standard with Super VGA video.



Thanks to the use of high speed memory accessing technology, it even out performs many full 386 computers of the market. And with two built-in expansion slots and a separate 102-key keyboard, it can genuinely claim to be a true 'portable desktop' system.

The innovative CD-ROM edition of the Golf SX portable is ideal for anyone requiring instant access to massive amounts of data.

It includes a built-in 540MB CD-ROM player, 40MB to 200MB of hard disk storage, a 3.5" floppy disk drive, and is priced from $9450 incl tax.

Goupil is taking aim at its two major competitors — Compaq and Toshiba, by reducing its pricing in Australia over 25% on all models. The price of the 16MHz/40MB Golf SX has dropped to $5395 incl tax. Included in the Goupil price dive is a special package deal which consists of the Gold SX portable computer together with a Super VGA colour monitor; starting at only $5995 incl tax for the 16MHz/40MB version and extending to $8895 for the 20MHz/200MB system.

Further information can be obtained by circling 161 on the reader service coupon or contacting the Australia distributor, Quartz Australia, PO Box 371, Carlton South 3053; phone (03) 663 6509.

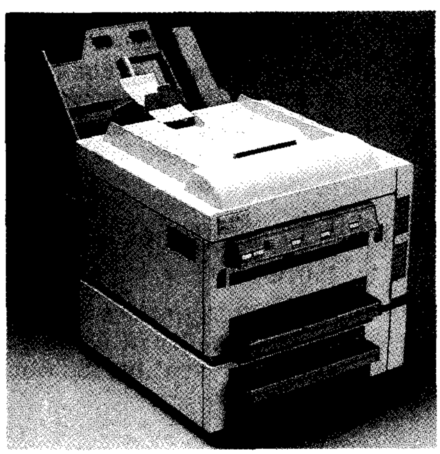
10ppm high capacity laser printer

The Facit Model P8100 laser printer has been designed for both the stand-alone workstation and network environments.

With a print speed of 10 pages per minute, and a duty cycle of 20,000 pages per month, the printer is suitable for applications ranging from basic word processing to graphics and desktop publishing.

The list of standard features includes dual Centronics parallel and RS-232-C serial interfaces, 512K byte memory, 200 sheet paper tray capacity, and 300 x 300dpi resolution.

Emulations provided in the base



unit are HP Laserjet Series II, IBM Personal Printer Data Stream (PPDS) and the IBM 7372/HP7475A (HPGL) Graphics Language.

Optional items cover memory expansions of 1,2 or 3.5M byte, a 500 sheet document feeder, 75 envelope feeder, a wide range of font cards and soft fonts for the HPLJII and PPDS emulations, and a special input paper tray for A5 size sheets.

The original Adobe Postscript language in either 17 or 39 font versions completes the list of hardware options.

For further information circle 162 on the reader service coupon or contact your local Elmeasco Instruments office on Sydney (02) 736 2888.

Low cost Z180 emulator

A new Z180 ICEBOX in-circuit emulator for Zilog's Z180 microprocessor has been released by Softaid Inc of the USA.

The Z180 ICEBOX provides the zero-wait-state emulation that is so essential to efficient hardware/-software development. It supports up to 65,536 simultaneously set full speed hardware breakpoints. Breakpoints can be set on fetch, read or write cycles. Commands are provided to set ranges or breakpoints so the user can easily find codes that access particular blocks of memory.

64K of overlay RAM is standard. The RAM can be mapped into the target system's address space, to replace the target's memory. The RAM can be located anywhere within the processor's 1MB address space.

An optional real-time Trace and Performance Analysis unit lets the user capture up to 1024 machine cycles at full processor speed. It also non-intrusively monitors the opera-

COMPUTER NEWS

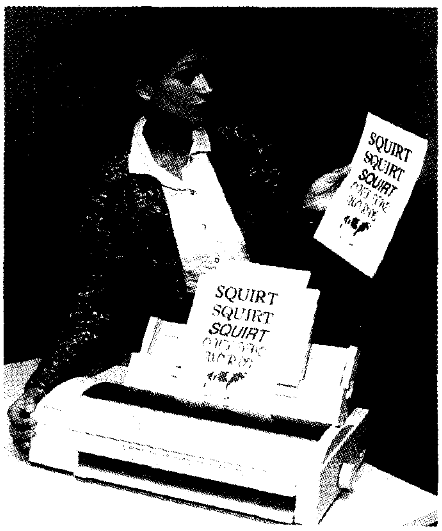
tion of the user's code to determine how much time is used by each subroutine.

For further information circle 163 on the reader service coupon or contact Emona Instruments, 86 Parramatta Road, Camperdown 2050: phone (02) 519 3933.

More Canon bubble jets

Canon's new BJ330 and BJ300 printers extend the Bubble Jet range and introduce even faster print-speed and more paper handling options.

They complement the popular BJ130 office model, released in 1989, and the 'Little Squirt' released in September 1990, and will be marketed as members of the Squirt family. Both have the same control panel and offer essentially the same features. The



only difference is that the BJ300 is an 80 column printer and the BJ330 is a 136 column printer. Software compatibility is assured with IBM Proprinter X24e/XL24e emulation as well as Epson LQ850/LQ1050 emulation.

The 64 nozzle print head outputs at 150cps in high quality mode and 300cps at 10cps in high speed mode. Graphics resolution is 360dpi, superior to laser quality. Both newcomers have more type options than most printers in their class.

In addition to resident fonts of Courier, Prestige and Gothic, the printers have two font card slots with three font card options and, with special software, the ability to scale fonts to any required size.

For further information circle 164 on the reader service coupon or contact Canon Australia, 1 Thomas Holt Drive, North Ryde 2113; phone (02) 887 0166.

4.5 digit DMM card for PCs

Priority Electronics has released the PCL-860, a 4-1/2 digit multimeter card for IBM PC/XT/AT or compatibles.

The features of the PCL-860 allows the user to use the card as a benchtop DMM, with display and control panel shown on the PC screen, or incorporate it as part of an auto test station for final pass/fail interrogation.

A combination of other supportive products can realise a variety of auto test functions using digital-to-analog, digital I/O, relay output and counter/timer cards.

Multi-channel measurements for up to 256 channels can be easily implemented by using the onboard 16 bit digital output port to control external relay multiplexer boards.

The PCL-860 is a fully isolated voltmeter that provides DCV, true RMS AC and DCR measurements. There are four programmable input ranges with an autorange setting that provides a basic accuracy of 0.03%. The four wire DCR function incorporates a 0.1, 1 and 10mA current source for accurate resistance measurements.

The utility disk provided supports benchtop DMM mode and programming mode. Custom software applications and installations can be provided for specific requirements.

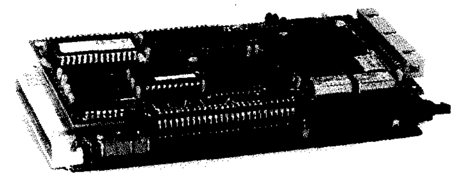
For further information circle 165 on the reader service coupon or contact Priority Electronics, 23-25 Melrose Street, Sandringham 3191; phone (03) 521 0266.

VGA/EGA graphics on STEbus

A high resolution graphics option is now available for the ECAT single Eurocard AT compatible STEbus processor card.

Consisting of a single add-on daughter board, the ECATX adds extra features to the already powerful 80286 single board computer.

VGA graphics withresolution of 640 x 480 or 800 x 600 pixels with red, green and blue analog signals, EGA graphics with resolution of 640 x 350 pixels, a second serial comms port, 80287 maths co-processor socket and up to 1M byte or ROM disk



complement the feature packed ECAT.

The ECAT itself has onboard serial and printer ports, floppy, keyboard, speaker, calendar-clock, timers, interrupt controllers and DMA circuits which perform the same as the IBM PS/2 model 30; clock speeds of 12.5 or 16MHz; DRAM from 512K to 4Mbytes; CGA/Hercules mono graphics plus the option for LCD controller. The onboard ROM disk allows MS-DOS and application software to reside in ROM, creating an all-silicon computer for use in hostile environments.

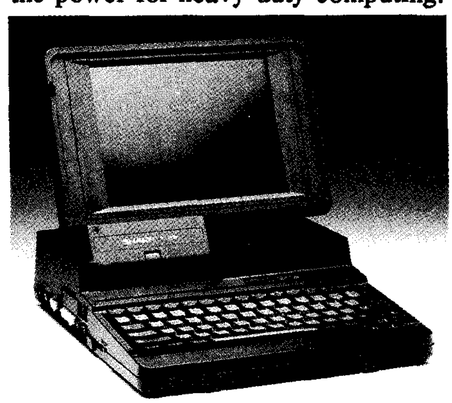
All CMOS construction gives low power consumption as well as extended temperature operating capabilities.

For further information circle 166 on the reader service coupon or contact DBE systems, 103 Broadmeadow Road, Broadmeadow 2292; phone (02) 69 1625.

386SX laptop from Sharp

Sharp Corporation has expanded its range of portable, notebook and lightweight laptop computers with the addition of a powerful 80386SX laptop.

The PC-5700 is available in two models: the PC-5741 with 40MB hard disk drive and PC-5751 (120MB hard disk drive). It is a robust product with the power for heavy duty computing.



The 386SX processor runs at a fast 20MHz and 2MB of RAM is provided as standard, with the ability to expand to 12MB.

The PC-5700 employs Sharp's

'Page White Illuminated Double Super Twist' LCD for excellent quality in text and graphics. It emulates VGA in 16 grey scales, thereby supporting the most sophisticated graphics applications.

Battery or mains operation is supported with an average 2 hours battery life or five hours with the addition of the add-on battery pack. Sharp's battery saving utilities optimise battery life. The AC adaptor is auto voltage sensing, making it suitable for use in overseas countries.

For more information circle 168 on the reader service coupon or contact Sharp Corporation of Australia, 1 Huntingwood Drive, Huntingwood, Blacktown 2148; phone (02) 831 9111.

Buffered extender card for PCs

Your IBM PC/XT or compatible becomes a more flexible test bed for PC cards with this new plug-in card from ICs. Working on all IBM PC/XT/AT's and clones, the card allows you to remove and replace cards without turning off your PC — so you won't inadvertently blow your power supply or disk drives.

It's fast and easy — one switch opens all the connections between the card and your PC, sequential turn on/off eliminates the need to reboot and bus speed is not affected.

LED indicators tell you the extender's operational status and the card can be left in its bus slot when the cover is closed. And a thoughtful addition is a connecting brace so you won't be plagued by any wobbles.

Further information is available by circling 167 on the reader service coupon or by contacting RF Devices, 9 Lyn Parade, Lurnea 2168; phone (008) 023 674.

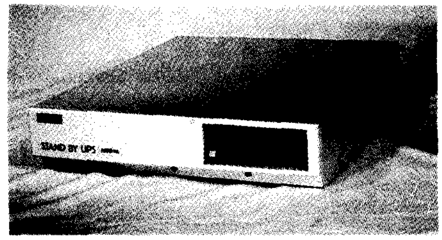
UPS range for PCs

The Dataguard range of standby uninterruptible power supplies are specially designed for personal computers and derivatives.

They are available in a range of output powers from 350VA to 1000VA and all include integral batteries.

The range includes network interfacing systems and models designed to power only one computer or several computers in close proximity.

The units are supplied in an aesthetically pleasing cabinet for desktop or underdesk location and are fitted



with standard power point leads and sockets which allow them to be plugged in between the normal power source and the protected equipment. Front panel controls include battery status indication and alarm silence.

Further information is available by circling 169 on the reader service coupon or by contacting the distributors, Online Control, Unit 2, 7 Waltham Street, Artarmon 2064; phone (02) 436 1313.

Super VGA monitor

AST Research has launched the Super VGA colour monitor offering brilliant, high resolution viewing — up to 1024 x 768 (interlaced).

The AST Super VGA is particularly suitable for sophisticated modes, to match each graphic adaptor's capabilities and has an analog interface providing a choice of among

COMPUTER NEWS

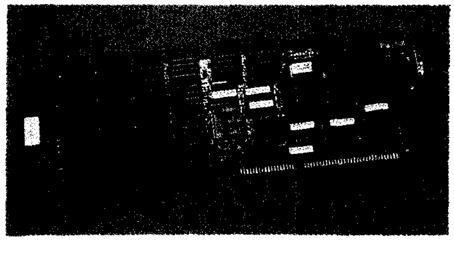
262,244 colour possibilities.Several features built into the display provide convenient and comfortable viewing. For example, its 14" diagonal anti-glare screen helps ease eye strain and in its non-interlaced mode, flickering is eliminated.

The Super VGA Monitor is fully compatible with all leading VGA compatible graphics cards and retails for $1198.80.

For further information circle 171 on the reader service coupon or contact AST Research ANZ, 706 Mowbray Road, Lane Cove 2066; phone (020 418 7444.

512KB-32MB memory board

Hypertec has announced the release of a 32MB add-on memory board to fit the entire range of IBM 'classic' architecture personal computers and compatibles, from the basic PC to the 486. While offering up to 32MB of memory, it can be purchased with as little as 512KB, with more added as required. It can be configured to supp-



ly either extended or expanded memory, or a mixture of both.

The new release follows that of the Hyperam MC 32/16 last year, which also provides up to 32MB of extra memory for Micro Channel machines. The Hyperam Classic fully supports EMS 4.0 in software and hardware.

A multi function version has one serial and one parallel port.

For further information circle 172 on the reader service coupon or contact Hypertec, 408 Victoria Road, Gladesville 2111; phone (02) 816 1211.

PC-based protocol analyser

Alcatel STR in Switzerland has released a new protocol analyser for ISDN and data communication protocols. The unit is labelled KAT-1000 and consists of a plug-in board and software suitable for any IBM compatible or laptop.

It uses 'stack architecture', similar to the OSI model. This allows a simple and more comprehensive analysis with an unprecedented flexibility.

The KAT-1000 offers the following benefits:

- Up to 16 layered stacks, each consisting of seven layers, can be composed based on specific applications.
- Non-standard stacks can also be configured for any specific application.
- Several protocols can be viewed in the exact order that they were transmitted on the line. For example, ISDN call setup messaging and the resulting B-channel can be viewed simultaneously.
- There is no need to go off-line to see the entire decoded message.
- Allows the storage and playback of actual line traces. Can be downloaded to remote locations for further analysis.

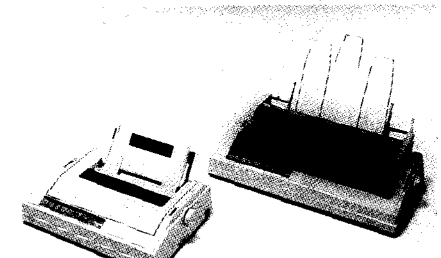
For further information circle 174 on the reader service coupon, or contact Alcatel STC, 58 Queensbridge Street, South Melbourne 3205; phone (030 615 6666.)

High resolution 24-pin printers

With the introduction of the Pro-Writer C-510 and wide-carriage C-515 24-pin printers, C.Itoh offers high print quality alternatives to its recently released 9-pin dot matrix printers, C-240/245.

Two staggered 12-pin rows provide ultra-sharp characters for word processing and high resolution graphics at 180 x 360dpi with draft print out speeds of 240cps and letter quality at 80cps.

The new printers provide excellent reliability and quality, being capable



of continuous usage while providing speed, compatibility and ease of use.

Assuring optimum compatibility, IBM Proprinter XL24 and Epson LQ-850 emulations are built in, along with the IBM graphic character sets. Dual 8-bit parallel and RS-232C serial interfaces are standard for easy linkup to host computers.

A large 28KB data buffer enables up to 14 pages of text to be loaded, freeing the computer to perform other jobs while printing.

For further information circle 173 on the reader coupon or contact Anitech, Unit 52, 2 Railway Parade, Lidcome 2141; phone (02) 749 1244.

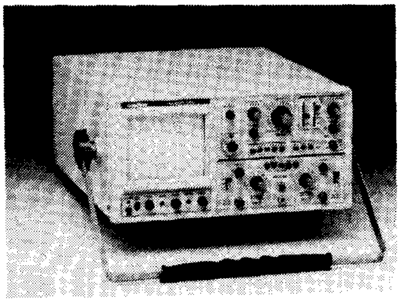
Colour video digitiser

A colour video digitising package for the IBM PC and compatibles has been released at a recommended retail price of $950.

The 'ComputerEyes/Pro' video digitiser package from Lako Vision lets you easily capture high quality full colour images from any standard video source — video camera, camcorder or VCR. It includes an interface board, system software on a 5-1/4" disk and comes with a full warranty and an owner's manual.

For further information please circle 170 on the reader service coupon or contact Lako Vision, 45 Wellington St, Windsor 3181; phone (03) 525-2788. ■

ELMEASCO NEWS



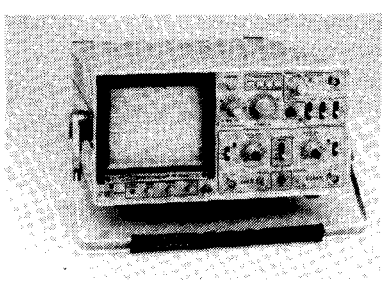
Goldstar Release 100MHz, 3 Channel Scope Under $2000

The new OS-8100 100MHz scope joins the popular Goldstar low cost oscilloscope range. It offers 3 channel, eight trace capability using a new 150mm rectangular CRT with internal graticule. Key features of the OS-8100 include high sensitivity (1mV max) and a bandwidth limiting circuit. For X-Y phase measurements the bandwidth can be expanded. Trigger view is also incorporated together with single sweep.'B' sweep sampling enables improved observation of critical parts of waveforms. A variable 'Hold-Off' circuit and TV sync separation circuits are also provided.

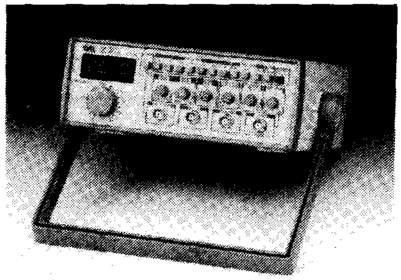
The Goldstar OS-8100 is very competitively priced at **$1950** ex tax

...Joins Popular Scope Range

Goldstar also produce 20MHz and 40MHz dual trace and a 20MHz readout oscilloscope with measuring cursors.



TMI102C Sweep/ Function Generator Has Built-In Frequency Counter

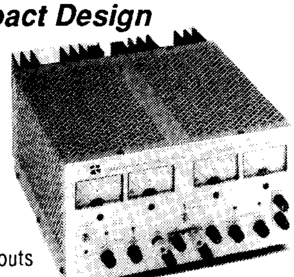


- ***0.02Hz to 7MHz in 7 ranges***
- ***Multifunction Output with Sweep***
- ***Built-In 4 Digit Counter***
- ***External Sweep Control***
- ***CMOS/TTL Output***
- ***<0.5% Distortion from 10Hz to 20kHz***
- ***Variable DC Offset***

Order TMIT102C $340 ex tax

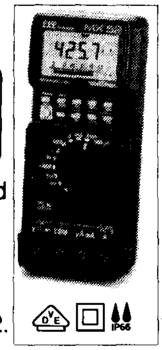
Low Cost Topward Bench Supplies Have Extensive Metering

- ***Tough aluminium cases for good heat dissipation***
- ***Constant Voltage & Constant Current Modes***
- ***Short Circuit Protection***
- ***Single & Triple Outputs***
- ***Two or Four Meters***
- ***Compact Design***



Model	Outputs
2303	30V 3A
4303	Dual 30V, 3A plus fixed 5V, 3A

Metrix DMMs First To Offer New Level of Safety



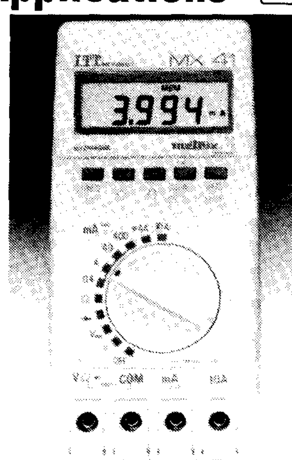
Metrix have announced that their popular MX50 Series digital multimeters have been tested and approved to safety standard VDE411, Class 2.

They are the first manufacturer in the world to gain this approval.

The MX50 Series now carries the VDE logo indicating their compliance to the standard which requires protection against hazards such as electric shock or burn, excessive temperature, liberated gases and explosion or implosion.

Among the safety features of the MX50 Series are fuse protected current ranges – even on the 10A range, totally sealed case (to IP66 standard) and a unique battery and fuse compartment accessed via the front face of the instrument. To gain access it is necessary to disconnect the safety-designed test leads and Secur'X™ adaptor, thereby protecting the operator from accidental contact with hazardous voltages.

Metrix 40 Series Ideal For Harsh Industrial Applications



- *Exceptional All-Weather Performance*
- *Four Year Warranty*
- *4000 Count Resolution*
- *Autoranging with Manual Override*
- *Hold & Peak Functions*
- *True RMS AC or AC+DC*
- *Safe to IEC348 Class 11*

from $220 ex tax

Australia's Leading Test & Measuring Instrument Company

NEW SOUTH WALES	VICTORIA	QUEENSLAND	SOUTH AUSTRALIA	W. AUSTRALIA
18 Hilly Street, MORTLAKE P.O.Box 30, CONCORD NSW 2137 Tel : (02) 736 2888 Fax : (02) 736 3005	12 Maroondah Highway, RINGWOOD P.O.Box 623, RINGWOOD VIC 3134 Tel : (03) 879 2322 Telex : AA30418 Fax : (03) 870 8972	192 Evans Road, SALISBURY P.O.Box 274 SALISBURY QLD 4107 Tel : (07) 875 1444 Fax : (07) 277 3753	241 Churchill Road, PROSPECT P.O.Box 154 PROSPECT SA 5082 Tel : (08) 344 9000 Telex : AA87519 Fax : (08) 269 6411	32 Teddington Road, VICTORIA PARK, W.A. 6100 Tel: (09) 470 1855 Fax: (09) 470 3173

READER INFO No. 33

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						●	
Geoff Wood Electronics	NSW	●	●	●	●	●	●	
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.

Electronics Australia Reader Services

"Electronics Australia" provides the following services:
Subscriptions: All subscription enquiries should be directed to: Subscriptions Department, Federal Publishing Co. PO Box 227, Waterloo 2017. Phone: (02) 693 6666
BACK ISSUES: Available only until stocks are exhausted. Price: $4.50
PHOTOSTAT COPIES: When back issues are exhausted, photocopies of articles can be supplied. Price: $4.50 per project or $9 where a project spreads over several issues.
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.
PROJECT QUERIES: Advice on projects is limited to postal correspondence only, and to projects less than five years old. Price: $5. Please note that we cannot undertake special research or advise on project modifications. Members of our technical staff are not available to discuss technical problems by telephone.
OTHER QUERIES: Technical queries outside the scope of "Replies by Post", or submitted without fee, may be answered in the "Information Centre" pages at the discretion of the Editor.
PAYMENT: Must be negotiable in Australia and made payable to "Electronics Australia". Send cheque, money order or credit card number (American Express, Bankcard, Mastercard, or Visa Card), name and address (see form). All prices include postage within Australia and to New Zealand.
ADDRESS: Send all correspondence to The Secretary, "Electronics Australia", PO Box 227, Waterloo, NSW 2017.
Please note that we are unable to supply back issues, photocopies or PCB artwork over the counter.

Back Issues .... Photostat copies ....

Total price of magazines/photocopies, including postage and handling.

No off issues reg .... x$4.50 = $..............

Cheque*/Money Order ☐ Please tick box to indicate method of payment:
**Please make payable to the Federal Publishing Company Pty Ltd.*

Mastercard American Express ☐ Visa ☐ Bankcard ☐ Tick ☑

Card Expiry Date ....

☐☐☐☐ ☐☐☐ ☐☐☐☐ ☐☐☐☐☐☐
Credit Card No.

Signature ....
(Unsigned Orders cannot be accepted)

NAME: ....

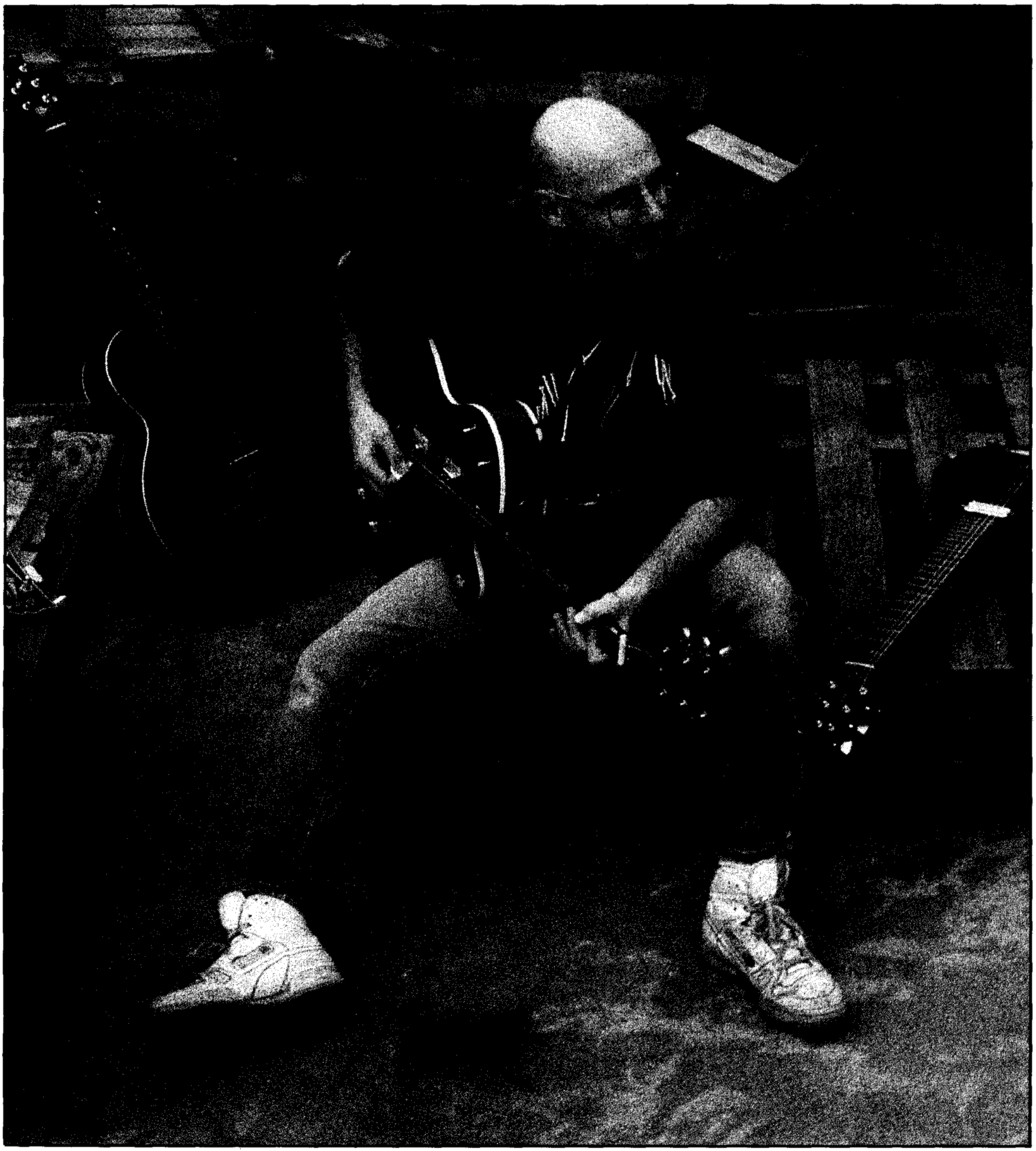
ADDRESS: ....

.... POSTCODE ....

ADVERTISING INDEX

This index is provided as an additional service. The publisher does not assume any liability for errors or omissions.

SONICS



The Australian magazine for music makers