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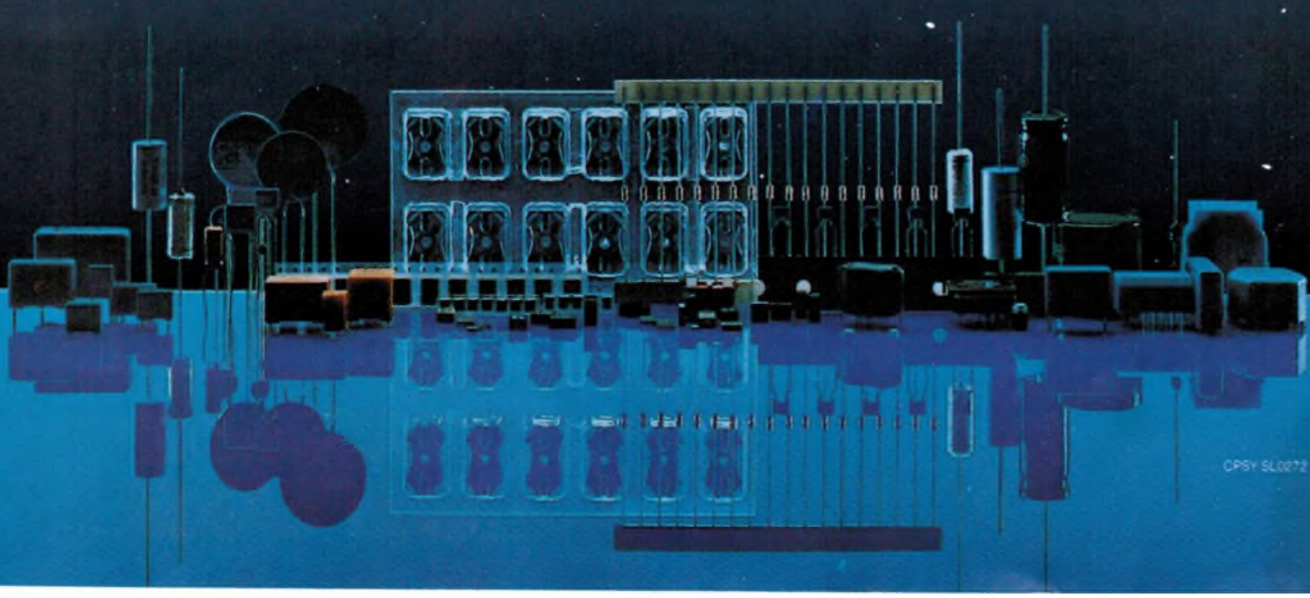

CPSY SL0272

Electronics Australia

Volume 52, No.3

March 1990

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE – ESTABLISHED IN 1922

Building our new VHF receiver

Yes, the constructional details for our new low cost VHF/UHF NBFM receiver are in this month's issue (see page 84). Sorry for the delay – we just didn't have room last month!

Simple crystal frequency calibrator

When your scope says a pulse lasts for 100us, can you believe it? Here's a low cost source of crystal-locked calibrating signals – see page 78.

OTHER PROJECTS: A low cost battery-operated fluoro lamp (page 70); the 'Super Vulture' deluxe car alarm (page 94); a 'universal' battery eliminator for valve sets (page 104).

On the cover

Our main picture shows technicians loading the big Mali steel wire stranding machine at Alcatel-TCC's new submarine optical cable plant, in Sydney. See our feature story starting on page 18. At lower right is the incredible new Icom IC-R9000 communications receiver, tuning from 100kHz to 1999.8MHz (see pages 10-11, 34-37).

Features

Entertainment Electronics

Projects and Technical

News and Comment

Departments

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LETTERS TO THE EDITOR

Disappointed with FM transmitter

Being a keen 'builder', and wanting as much of my gear as possible to be home built, I waited with 'baited breath' for your VHF transmitter design. But I was disappointed on two counts.

One was the limitation of a single transmit frequency; the other was the need for a 30V supply.

Interest gone! But I still like your magazine.

Ray Turner, VK2COX
Hillsdale, NSW

Comment: Thanks for the feedback, Ray. We've already developed a little 12V to 30V converter, to obviate the need for a separate 30V supply, as you'll find in last month's issue. And we plan to come up with a more elaborate multi-frequency 'front end' before long, too, so stay tuned! We deliberately kept the first version very basic, to show just how simple things could be.

Circuit wanted

I am writing to you to ask some assistance of the readers of *Electronics Australia*, the subject being vintage radio.

I have recently purchased a 'Healing' model 403 mantle radio in a wooden cabinet which is dated from around 1935-36. I now require a circuit diagram of the above model, and wonder if any readers may be in possession of one.

If so, I would be very grateful if they would send me a copy of the circuit diagram (for a fee if required). The radio is an AM receiver and the valves used are as follows: 80, 2A5, 57, 57, 58.

Joe Ciancio,
11 Bath Lane,
Bendigo, Vic.

Easytrax review

As a distributor of Protel products in Victoria I read with interest the article by Tom Moffat regarding the Easytrax program. It is encouraging to see you supporting Australian products in this way. However, I would like to take issue with Mr Moffat on his comment regarding autorouting. He states in his article that he has only used an autorouter once! Obviously this does not make him an expert and perhaps he should restrict his remarks to what he knows most about.

The fact is that if a company invests in quality software tools for PCB design, autorouting is and will continue to be a cost effective aid to PCB design. The RCS Cadcentres design bureau uses autorouting extensively and I would suggest that most of our competitors do too.

If a PCB layout is thoughtfully prepared, our system will provide us with a 100% routed board that is totally manufacturable, regardless of the technology employed.

If Mr Moffat can do the job 'better, and quicker' then I would be pleased to offer him a job.

Ray Smith, MD,
RCS Cadcentres,
Alphington, Vic.

Comment: Tom's remark was in reference to the auto-router supply with early versions of Protel, Ray. He wasn't knocking auto-routers in general, or the new one supplied with Autotrax.

Organ tape

In the December instalment of 'When I Think Back,' I referred to a letter on the subject of organs from Mr R B Morrow, whose wife Nell is a professional organist. Because of pressure on space, I have not been able to refer to it again, as intended, in the regular columns.

With the letter, Mr Morrow enclosed a cassette tape endorsed 'Only Organ' played by Nell on the Wurlitzer 'Omni' electronic organ. Entitled 'Ballroom Memories' Vol.1 and played in the Glen Miller tradition, it is a pleasant nostalgic sound which reflects considerable credit both on the player and the instrument. There are 14 tracks on the two sides. Of special note are the simulated instrumental solos, all done in 'real time' on the organ.

Copies of the tape are available from Bob Morrow's Sounds of the Big Bands, PO Box 242, Dromana 3936. The price: $11.50 including pack and post.

On another subject, I note that Brian

Smart is inquiring on the 'Letters to the Editor' page (December issue) about the term 'Fisk Radiolas', which appeared on AWA receivers for some time.

I have no record of the period over which it was used but, to the best of my knowledge, there was no special story behind it. I assumed then, as now, that the AWA publicity section saw an advantage in using the Fisk name to help focus attention on AWA receivers.

Speaking of Sir Ernest Fisk, my biography in the June 1989 issue prompted a letter from D T of Bundaberg, Qld. I quote:

Can you tell me how I can get more information about the severing of the Australia/Noumea cable? I would like to know what date it happened, who did it and when it was repaired as I understand that it was not replaced by radio until the early '20s.

I can't help, but maybe some other reader can.

Neville Williams,
Carlingford, NSW

Safety problem

I would like to draw your attention to the potentially fatal wiring error in the 'layout' diagram shown on page 155 of the January 1990 edition of *Electronics Australia*. The active and neutral connections to the Master Output are transposed. As a practising Professional Engineer, I do not want to enter debate as to the relative merits or risks of Double Insulated vs MEN systems, only to point out that this error has significant risk, particularly when associated with either faulty or incorrectly wired load equipment.

I trust that an appropriate correction will appear in your next issue, as this is not simply an 'Erratum' item but a safety matter.

May I take this opportunity to point out that this type of error emphasises the need for extra proof-checking diligence where mains potentials are involved, particularly when the intending constructor is, in most cases, not as 'educated' as you or I, and certainly a percentage will follow such diagrams with blind faith. In such cases, a certain additional burden of responsibility and 'duty of care' rests squarely with you, which cannot be shrugged off with a blithe 'all care but no responsibility' statement.

Peter Morgan, B.E. Elect (Hons)
East Perth, WA

Comment: Thanks for pointing out the

Continued on page 114

EDITORIAL VIEWPOINT

Precision high technology – on a very large scale

A few weeks ago I was lucky enough to visit Alcatel-TCC's new factory in Port Botany, just south of Sydney. The factory was very interesting because it's been built specifically to make submarine optical fibre cables, using manufacturing technology transferred from Alcatel's pioneering plant in France. Its first job is to make the 2200km long TASMAN 2 cable, which will soon provide a dramatic expansion of the communications link capacity between Australia and New Zealand.

I suppose what intrigued me most about the factory was the way it combines precision high technology with large-scale manufacturing. For example at the heart of the TASMAN 2 cable are just six tiny optical glass fibres, each about the diameter of a human hair and quite delicate. To produce the functional 'core' of the cable these have to be laid continuously and very carefully into spiral slots in a cylindrical polyethylene extrusion. During this operation the tension on the cables must be maintained at no more than 15 grams, and they must then be covered with silicone jelly and a protective sheath of polyethylene. To prevent contamination the entire operation must be performed under exacting 'clean room' conditions, not far from those required in a semiconductor plant.

On the other hand the very next stage of manufacture involves wrapping the cable in a 'vault', formed from 36 stout high-tensile steel wires – performed by a monster machine which has no less than 75 tonnes of mass rotating at an awe-inspiring 50rpm!

At the output of this same machine a copper tube is continuously formed around the vault, and TIG welded along the seam. The cable is then wound up on enormous temporary storage spools, 3.5m in diameter and weighing no less than 95 tonnes each when loaded with a 150km length. The concrete floor of the plant had to be specially strengthened to cope with this weight.

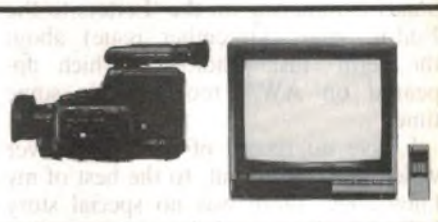
I won't go on about it here – you'll find more details in our story starting on page 18. But hopefully I've given you the basic idea. Making submarine optical cables is state of the art technology, an elegant example of precision manufacture on a massive scale.

Changing the subject, I was also fascinated this month to check out Icom's latest all-singing, all-dancing communications receiver, the IC-R9000. As you can see from our story starting on page 34, it really is an incredible machine – tuning from 100kHz right up to 1999.8MHz(!), in virtually all modes and with built-in memories, scanning and a panoramic adaptor.

And thanks to Icom Australia, one of our own *EA* subscribers will be winning one of these super receivers (half their luck!). You'll find details of our special subscriptions offer on pages 10 and 11. Will YOU be the lucky winner?

Jim Rowe

What's New In HOME ELECTRONICS



Still video camera uses memory card

A new type of electronic still camera system which uses digital technology and an IC memory card to offer improved picture quality has been developed by Toshiba, which is now marketing the system in Japan. It was first exhibited at the 'Electronics Show' held in Osaka in November.

The total system comprises a memory card camera, IC memory card (image memory card), a memory card player and a digital picture file.

The new camera system dispenses with film and stores images electronically. Toshiba believes that the superior characteristics of the digital still camera system will be accepted in such diverse professional fields as the mass media, where swift recording and transmission of high-quality photos is a major priority; as image data files in advertising, libraries and museums and also used as presentation tools by realtors and car dealers.

Several manufacturers have already commercialised electronic cameras, but their products record pictures on 2-inch magnetic floppy disks as analog signals. In March 1989, Toshiba and Fuji Photo Film Co Ltd agreed to jointly develop key technologies for this innovative camera system, and to create a format which will be proposed as an industry standard. Both companies anticipate that the new system will find broad acceptance.

Midi hifi systems

Akai's M370/M380 midi systems comprise a 25 watt stereo amplifier, remote control, 5-band graphic equaliser, 10 station pre-select stereo FM/AM tuner, compact disc player, double cassette deck, semi-automatic turntable and two-way hifi speakers.

The integrated stereo amplifier with less than 0.3% THD at rated output features inbuilt facilities to accommodate CD, tape, phono, and tuner.

The 10 station quartz synthesised stereo FM/AM tuner enables up to five AM and five FM stations to be stored in memory. Selecting any one of these 10 stored stations is easy with the prescan tuning provided.

The turntables have two speed operation and the two-way full range 60 watt speaker system has a frequency range from 60Hz to 20kHz.

For further information, contact Akai, 2 Australia Avenue, Homebush 2140 or phone (02) 763 6300.

New speakers include 'thermal compensation'

British speaker manufacturer Acoustic Energy Limited (AE) is now marketing its range of speakers in Australia.

The AE2 is twice the volumetric size of the AE1 while the AE4 is twice the size of the AE2 and substantially heavier, with considerably more power handling capability. All units use the same 110mm bass-mid range unit and 25mm tweeter. The larger AE4 model uses five drive units, comprising four bass-mid units and one magnesium dome tweeter.

According to AE designer Phil Jones, when loudspeaker voice coils carry heavy current or musical signal peaks they heat up, offering a non-linear impedance to the amplifier. This phenomena is known as thermal compression and is said to result in the musical signal becoming compressed and confused.

The problem of thermal compression is solved in the AE bass-mid range unit by using black anodised aluminium with a graded thickness across its profile. A foam surround eliminates unwanted 'ringing' and the voice coil is edge wound for maximum sensitivity. With the use of a thermally conductive glue, the heat is carried away from the voice coil and into the cone and dust cap.

For further information, contact Audio Connection, Shop 44, Suite 1, Old Town Centre Plaza, Bankstown 2200 or phone (02) 708 4388.

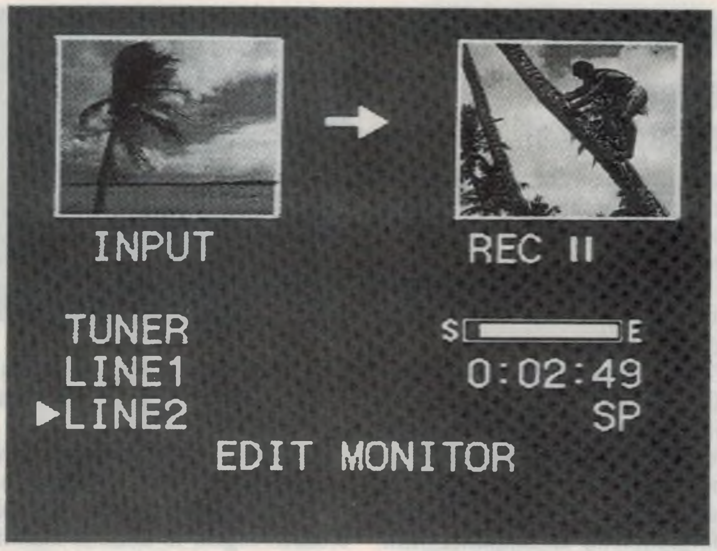
VHS recorders from Sony

Sony has announced three video cassette recorders for the VHS format.

The SLV-X10 has an infra red remote control and a new super access mechanism for quick response and operation, plus a one year eight event timer.

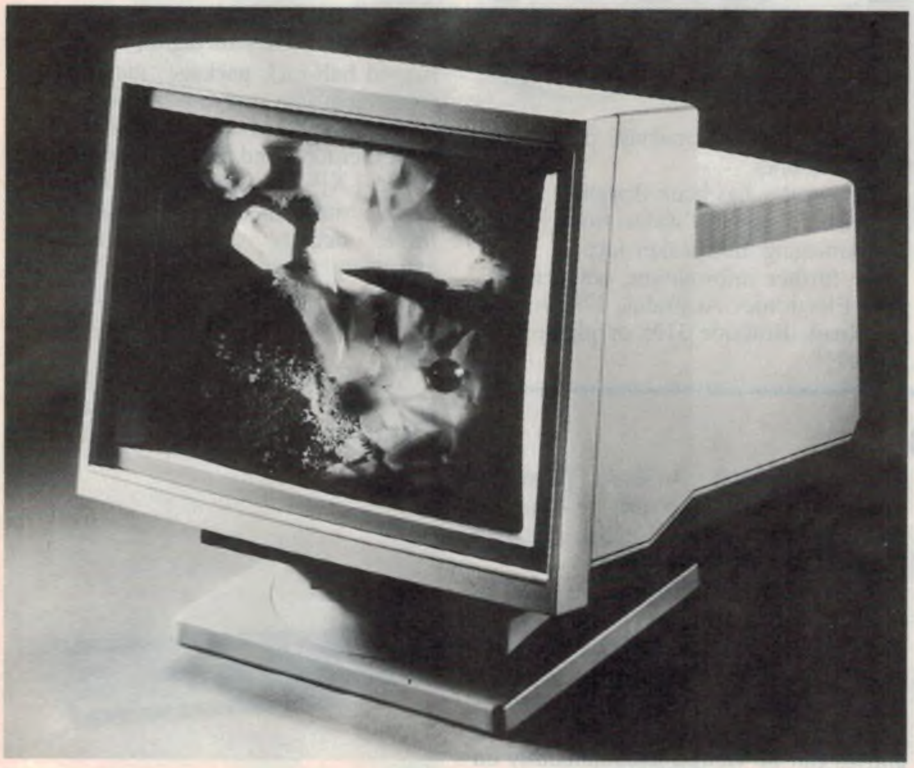
The SLV-353 is a four head VCR for superior performance in both SP (Standard Play) and LP (Long Play) mode, which allows longer recording time making it ideal for that late night five hour golf tournament.

The SLV-757 has extensive editing features plus the benefit of HiFi sound. While recording, it is possible to see one picture from the playback unit and the other from the recorder, making home edits easy. At other times, one can view the VCR playback picture and an inset picture of any selected broadcast channel.



The SLV-757 has a shuttle dial with a total of eight speeds in either direction, for easy control. It also has a timer that can programme eight events up to one month in advance.

For further information, contact Sony (Australia), 33-39 Talavera Road, North Ryde 2113 or phone (02) 887 6690.



High resolution 20″ colour display

Barco has launched its ICD651 high resolution 20″ colour monitor, which is characterised by extremely high reliability, and is intended for applications such as process control, sophisticated CAD and image processing, whether for prepress, textile design or remote sensing.

The ICD651 comes standard with a tilt-and-swivel base, and a dark face plate in order to provide optimal viewing conditions. It is one of the rare colour monitors with digitally driven user controls.

The monitor is normally available as a desktop model, but is also available in a chassis version for console mounting.

For further information, contact Trace Technology, 200 Rouse Street, Port Melbourne 3207 or phone (03) 646 5833.

First 'midi' system with 'Bitstream' technology

The first high-fidelity midi-sized audio-video system utilising the new 'Bitstream' digital technology has been launched in Australia by Marantz.

The system has been designed with an eye to the future, able to handle not only signals from compact disc players, VCR's and tape or record players – but also CD-Video (CDV) discs, digital audio tape (DAT) cassettes and even the digital signals from direct satellite broadcasts (DBS), now under consideration by the Federal Government.

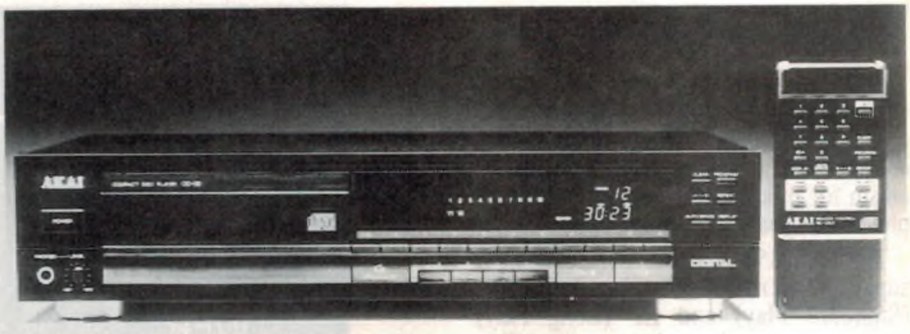
The PM593's Bitstream digital-to-analog converter, operates at tens of millions of times a second. Its single-bit 256-times oversampling technique is claimed to achieve new levels of crisply detailed sound, free of the errors and distortion of some conventional four and eight times oversampling techniques.

The 70 watts-per-channel amplifier has three digital inputs, one of which is an optical-fibre link for even better sound quality, and an electronics direct-digital output for recording onto DAT tapes. Other components included in the MX593 system are twin-cassette tape decks and an FM/AM radio tuner.

In standard form, the Studio 593 system, complete with remote control, sells for a recommended $1999.

For further information, contact Marantz Australia, Australia Centre, Figtree Drive, Homebush 2140 or telephone (02) 742 8480.

Mid-range CD player from Akai



Akai has introduced the CD-52 16-bit four times oversampling compact disc player, using similar advanced technology and offering many of the same features as the company's CD-93/73 flagship CD players, but at a more affordable price.

The CD-52 rests on four acoustically dampened feet, minimising the effects of unwanted vibration. It also provides gold plated RCA sockets plus both a digital fibre optic output socket, and a digital signal output jack to transmit digital information to an amplifier with digital input. Internal inspection reveals a 3-beam laser pick-up, and dual digital to analog converters.

Technical specifications include a frequency response of 4Hz to 20kHz +/– 0.5dB with channel balance within 0.06dB. Signal to noise is maintained at greater than 95dB. THD is quoted at less than 0.004%, dynamic range at 95dB and wow and flutter below measurable limits.

The CD-52 has an RRP of $649 and is available at selected Akai dealers and department stores.

Marine audio products

Two 16cm marine speakers and a marine audio cover designed to protect radio cassettes from spray and moisture damage have been released by Pioneer Electronics.

Both speakers and the audio cover have been developed incorporating the latest anti-corrosion and moisture protection, then rigorously tested with hundreds of hours of constant salt water spraying and direct exposure to ultra violet rays.

The speakers feature gold plated lead wire and connection terminals, stainless steel mountings, injection moulded water resistant polypropylene woofers, corrosion resistant magnet plates and speaker frames.

The tweeter has been designed to fire inwards, to prevent water from hitting and damaging the speaker face.

For further information, contact Pioneer Electronics Australia, 178 Boundary Road, Braeside 3195 or phone (03) 580 9911.

Multi-effects audio processor

The LXP-5 multi-effects audio processor from Lexicon contains an amazingly wide library of digital effects in a rugged half-rack package, making it an ideal recording and production tool. It is designed to complement the LXP-1 Reverberation and Effects Processor.

The LXP-5 is capable of creating up to five simultaneous effects as well as three octaves of pitch shifting, extremely wide range delay sweeps, chorusing, flanging, high and low equalisation, ambience and reverberation.

All of the LXP-5's parameters are accessible via its simple front panel controls or through Lexicon's Dynamic MIDI facility. Parameters can be modified in real time using MIDI note number, velocity, aftertouch, continuous controllers or its internal sweep generator.

The unit has 64 permanent factory presets and 128 user programmable memories.

For further information, contact Amber Technology, PO Box 942, Brookvale 2100 or phone (02) 975 1211.

More versatile calculators

Texas Instruments has released a new range of calculators, including a 93,000-word spelling checker, an electronic phone book capable of storing up to 150 names and telephone numbers, two paper-free printing calculators and a personal banking system.

The hand-held TI Ready Reference Spell-Checker has an 'endings' key which eliminates the confusion users often have about doubling a final consonant or dropping an 'e' when they use a different form of a word. With the 'Wildcard' or 'Missing series' keys, a user can enter a symbol to represent a single or group of missing letters, and each key can be used more than once in any word entered.

The pocket-size TI-2400 Phone Bank stores up to 150 names and numbers for easy reference and at the touch of a button doubles as an eight-digit calculator. The two-line liquid-crystal display shows up to 19 characters (seven letters and 12 numbers). A secret password can be used to protect private information such as automatic teller machine personal information numbers.

The TI-2800 Pocket Paper-Free Printer and the Desktop TI-5038 Paper-Free Printer do not have paper or ribbons. Up to 99 line entries can be stored in the memory even after the calculator is turned off. Any six of these entries can be viewed simultaneously on the six line, eight digit liquid-crystal display.

The Personal Banker performs complex statistical and financial functions, which enable the calculation of loans and mortgages, loans and mortgages with balloon payments, savings with periodic deposits and investments without periodic deposits.

For further information, contact Texas Instruments Australia, 6-10 Talavera Road, North Ryde 2113 or phone (02) 887 1122.

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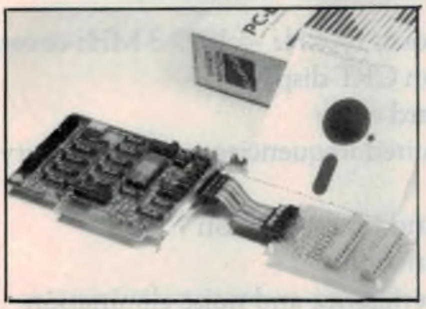

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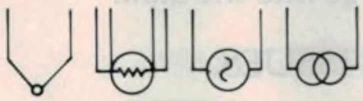

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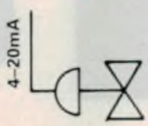
AND
CONTROL



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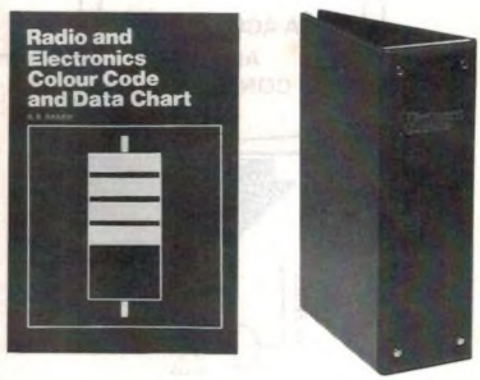

(Hurry — offer ends June 29th, 1990)

(Valued at over $7,700.00)

(Offer runs — March, April, May & June 1990).

To enter simply fill out the coupon attached and place it in the reply paid envelope supplied — if the coupon and the envelope are missing, send your name, address, phone number, cheque, money order or credit card details (card type, card number, expiry date and signature) to: Federal Publishing Company, Freepost No. 4, P.O. Box 227, Waterloo NSW 2017. Any enquiries can be made by phoning (02) 693-6666. Unsigned orders cannot be accepted.

1. The competition is open only to Australian residents authorising a new/renewal subscription before last mail 29.06.90. Entries received after closing date will not be included. Employees of the Federal Publishing Company Pty Ltd and Icom Inc., and their families are not eligible to enter. To be valid for drawing, the subscription must be signed against a nominated valid credit card or, if paid by cheque, cleared for payment.

2. South Australian residents need not purchase a magazine to enter, but may enter only once by submitting their name, address and a hand-drawn facsimile of the subscription coupon to Federal Publishing Company Pty Ltd, P.O. Box 227, Waterloo NSW 2107.

3. Prizes are not transferrable or exchangeable and may not be converted to cash.

4. The judges decision is final and no correspondence will be entered into.

5. Description of the competition and instructions on how to enter forma a part of the competition conditions.

6. The competition commences on 22.02.90 and closes with last mail on 29.06.90. The draw will take place in Sydney on 04.07.90 and the winners will be notified by telephone and letter. The winners will also be announced in The Australian on 09.07.90 and a later issue of Electronics Australia.

7. The prize is: One Icom Communications receiver. Valued at $7,714.00.

8. The promoter is Federal Publishing Company Pty Ltd, 180 Bourke Road, Alexandria NSW 2105. Permit No. TC89/0000 issued under the Lotteries and Art Unions Act 1901; Raffles and Bingo Permit Board Permit No. 89/0000 issued on 00/00/89; ACT Permit No. TP89/0000 issued under the Lotteries Ordinance, 1964.

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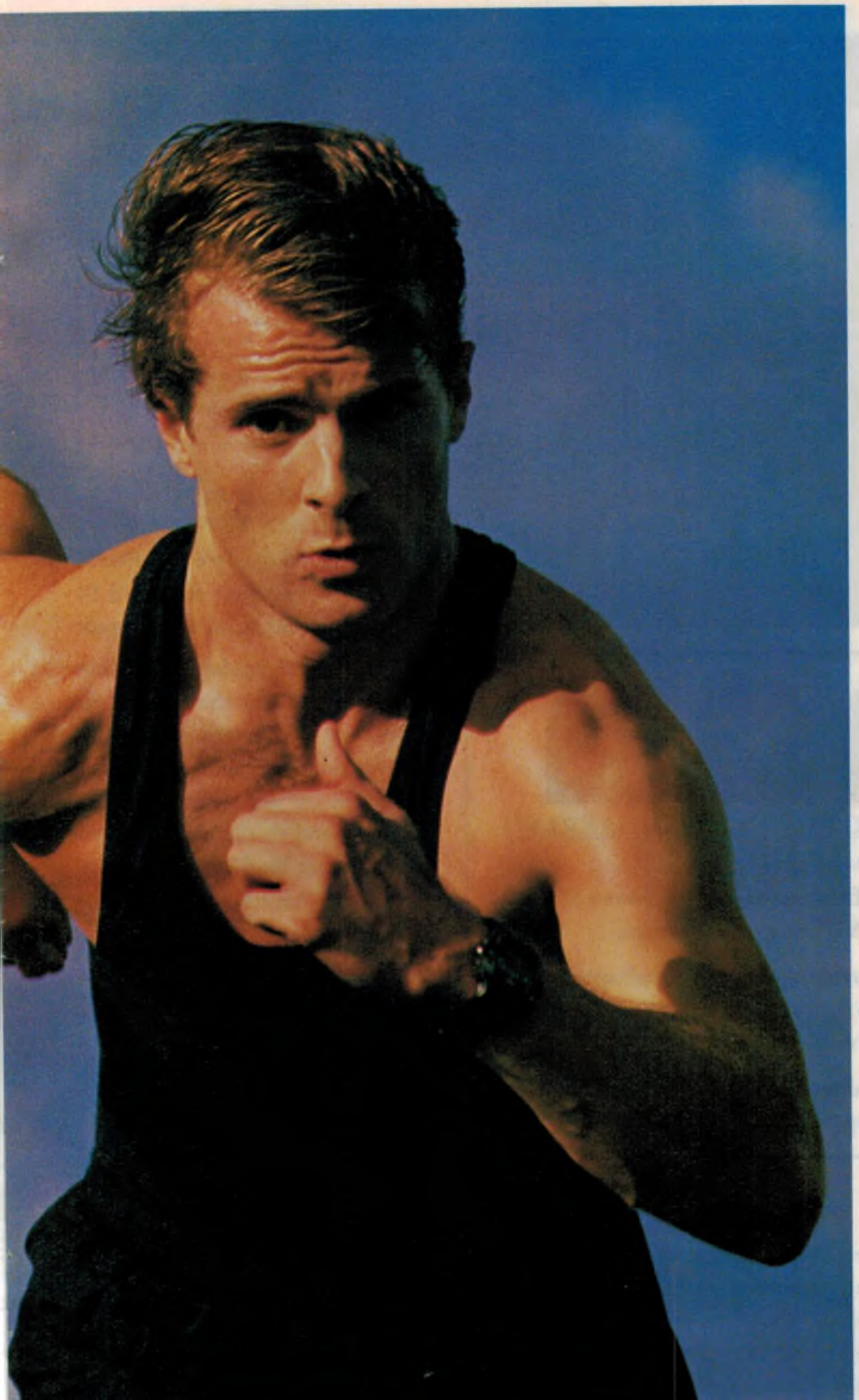

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*ETS. Electronic technical systems	Radars – sonar navigational aids weapon control systems
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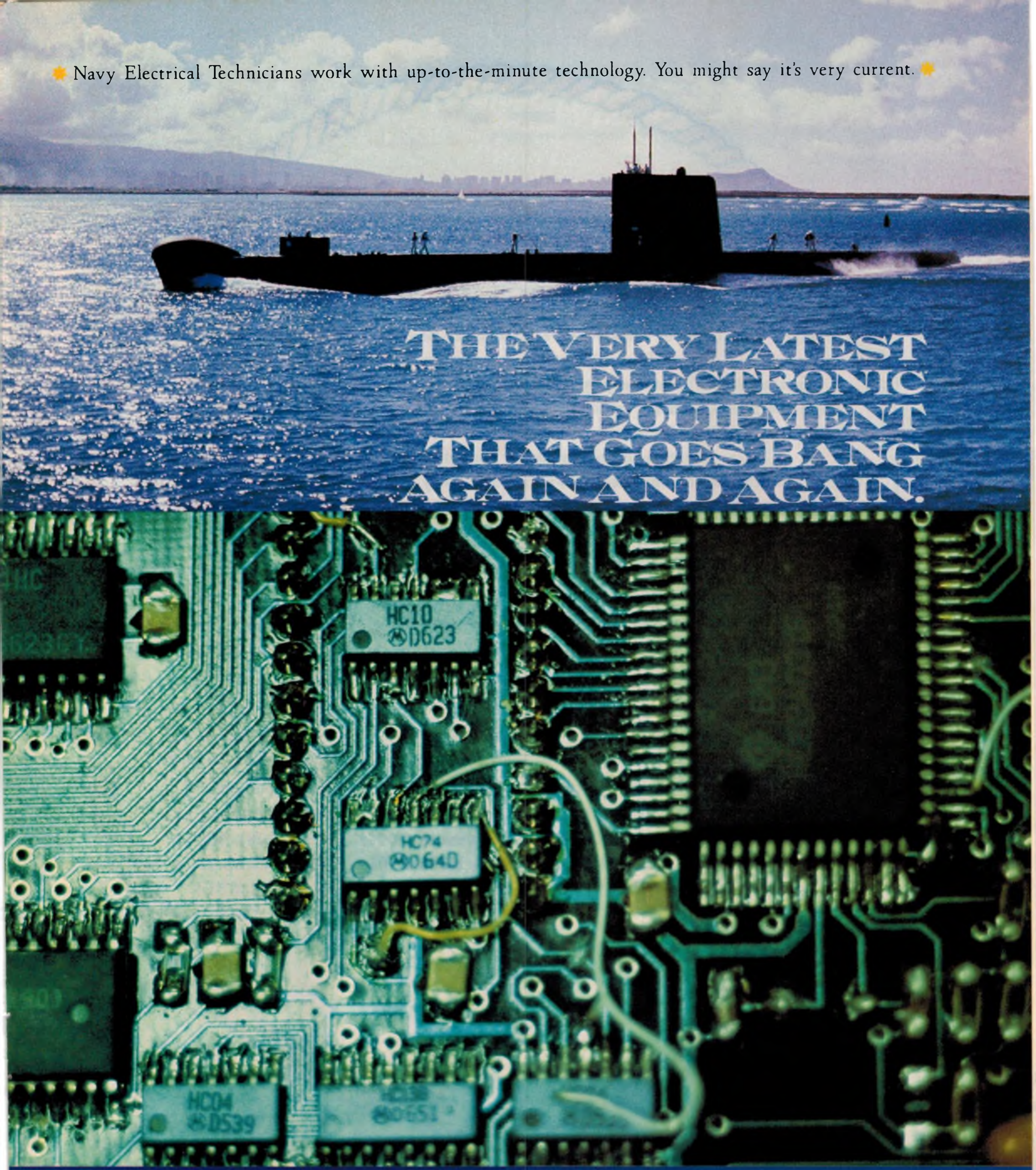
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SPECTRUM

Communications News & Comment

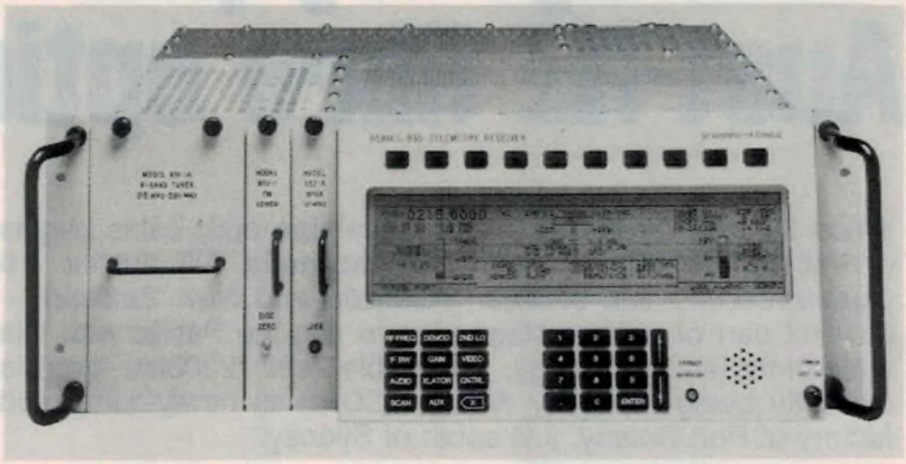
SCIENTIFIC ATLANTA WINS AUSSAT

Scientific Atlanta has won a $500,000 contract from AUSSAT for Telemetry Receivers to monitor and control the AUSSAT B series satellite to be launched in 1991.

Announcing the contract in Sydney, the General Manager of Scientific Atlanta Australia, Mr. Steve Dean, said the series 930 Telemetry Receivers had been originally developed by Scientific Atlanta's Electro Products Division for missile testing and still had widespread application in that area.

Another mainstream use for the product was a cost-effective solution for general tracking systems and monitoring satellite conditions as well as for reception of satellite remote sensing and meterological data.

Mr Dean said the series 930 Telemetry Receiver is a dual or triple conversion, solid state, general purpose, receiver, highly flexible in its configeration for specific applications. It has been carefully designed for easy operation – minimising the operator attention so often required in highly automated and sophisticated operational environments.



The Scientific Atlanta telemetry receiver purchased by AUSSAT.

AUSTRALIAN MEDICAL TELEVISION SIGNS WITH AUSSAT

Australian Medical Television has signed a contract with AUSSAT for satellite delivery of continuing medical education videos to the medical profession.

AMTV is Australia's first subscription medical television channel and it is expected that within a few years over 20,000 subscribers will be receiving the programs. The company will produce most of its programs locally, while sourcing major overseas material from medical television counterparts in Britain and the USA.

In support of AUSSAT's belief that there is a market for Subscription Television in Australia, the company has entered into a unique business arrangement with AMTV.

Mr Graham Gosewinckel, AUSSAT's Managing Director, said "AUSSAT is delighted to be involved in such a pioneering education service which will benefit all those involved with health care."

"And in recognition of the risks involved in introducing this new subscription based service, AUSSAT will share the risk by adopting a progressive pricing philosophy. This philosophy means that the charge for use of the satellite is partly dependent on the number of subscribers serviced, so that AUSSAT shares the risk in the early years, and benefits in later years," he said.

TELECOM TO 'DIGITALISE' MOBILENET

Telecom Australia has called for expressions of interest for the supply of equipment for the $345 million 'digitalisation' of the national cellular mobile telephone service.

The digital upgrading of the network is part of a billion dollar spending programme over the next six years to develop the cellular mobile service according to Telecom's managing director, Mr Mel Ward.

He said Telecom had earmarked $1.15 billion to the end of the 1994-95 financial year, for investment for the mobile network.

The network, known as Mobilenet, is expected to have a digital capacity by mid-1992.

TINY DATA/FAX MACHINE

A US company has produced a new 213-gram device that is predicted to supplement the up-market laptop PC and the portable phone as 'must-have' yuppie status symbols.

The small, lightweight, portable appliance is a combined fax modem and data modem that lets fax machines and PCs communicate with each other.

Called the WorldPort 2496 Portable Fax/Data Modem, the economically-priced unit is manufactured by US company Touchbase Systems Inc. It is being distributed in Australia by data communications specialist Dataplex Pty Ltd of Lilydale, Victoria.

The unit offers facsimile operation at speeds up to 9600bps conforming to CCITT Group 3 standards, while the full-featured data modem facility operates at up to 2400bps.

The unit runs on its own self-contained battery as well as a calculator plug pack and is approved for connection to the Telecom network. It also features proprietary software for unattended fax transmission and reception. It retails for less than $1000.

For further information, contact Dataplex at 7–9 John Street, Lilydale 3140 or phone (03) 735 3333.

Companies or organisations with communications news items, or information on new communications products which they believe would interest our readers should send them to the Editor.

State of the art technology:

New Sydney plant making Aust-NZ fibre optic cable

When the new TASMAN 2 submarine fibre optic cable begins operating late next year, it will provide a full duplex 1.6 gigabits/second link between Australia and New Zealand – the first part of a three-stage plan to ring the Pacific with this state-of-the-art technology. The cable itself (2200km long) is currently being made by Alcatel-TCC at its newly-completed factory at Port Botany, just south of Sydney.

by JIM ROWE

Nowadays, I suppose most *EA* readers will be at least aware of the existence of optical fibres – those tiny filaments of highly purified special glass, about the diameter of a human hair, which can carry information over long distances. You're probably also aware that they do this by acting as a kind of tiny 'optical waveguide' for laser light, which has been digitally modulated with the information concerned. A photodetector at the end of the cable converts the modulated light back into electrical signals, which can then be processed in the normal way.

Currently a single fibre can carry over 500 megabits of data per second, which can be used for any desired combination of telephone messages, fax, television and radio signals, or computer data.

This exciting new technology has already been used by Telecom to upgrade and expand the telephone and data links between many of Australia's capital cities, and is to be used very shortly to provide enhanced services for business subscribers. Eventually even domestic subscribers will probably have a small fibre-optic cable coming into their homes, and making available a staggering range of information and entertainment services.

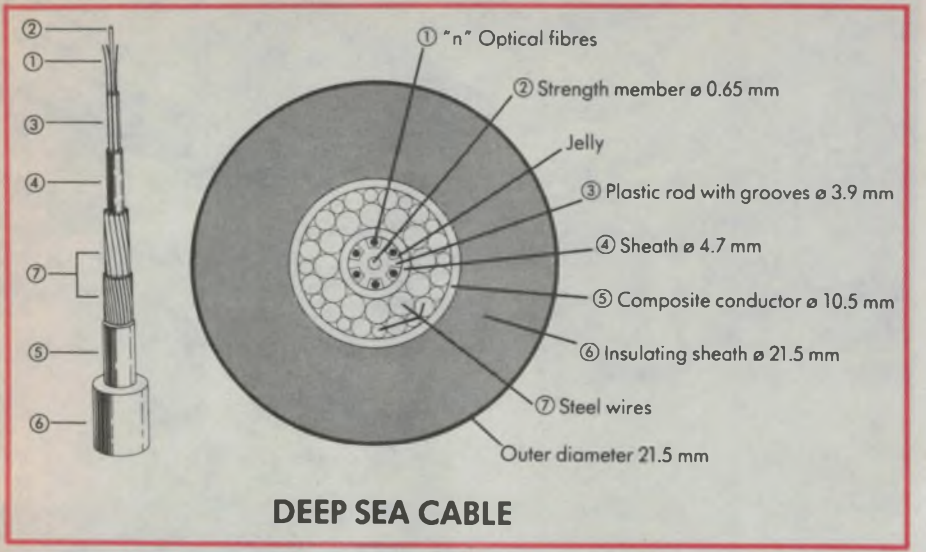
Needless to say, the same technology has attractions for the links between countries and continents. The TASMAN 2 cable is part of a three-stage plan by regional administrations to ring the Pacific Ocean with some 25,000km of optical fibre submarine cables, extending by the mid 1990's to North America and Asia. Already there is an optical fibre cable link between the USA, Japan and Guam, with Hong Kong and Korea due for connection this year.

TASMAN 2 is a joint venture between Australia's OTC and the Telecom Corporation of New Zealand (TCNZ). Due for completion in November 1991, it will link Sydney and Auckland with six optical fibres – each carrying data at 560 megabits per second using IR (infra-red) light with a wavelength of 1550nm. This will give the cable a capacity equivalent to some 100,000 simultaneous telephone calls, in full duplex. Currently the existing electrical cables have a capacity of only 4000 simultaneous calls, so that the optical link will provide a dramatic increase in communication capacity.

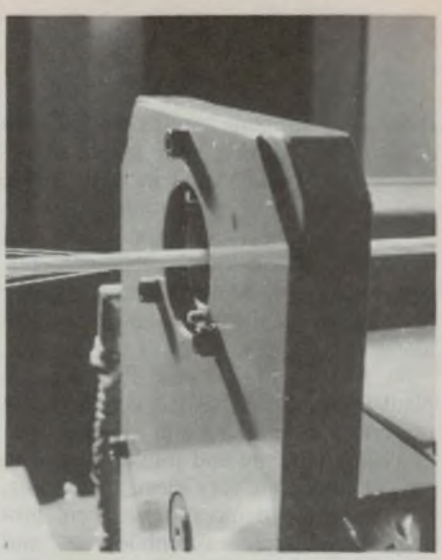
The overall length of the TASMAN 2 cable will be 2200km, with 19 intermediate 'repeaters'. These convert the optical signals back to electrical form, amplify and regenerate them, and then re-modulate laser diodes for transmission along the next segment of cable.

Manufacturing and laying the entire TASMAN 2 project is being carried out

A general view of one of the two machines used to lay the delicate optical fibres into the slotted central polyethylene core. The actual stranding machine is visible in the background.



Basic construction details for the TASMAN 2 cable. The actual fibres are slotted into the central core, with a 'vault' of high-tensile steel wires enclosing them for mechanical strength.



Close-up of the fibres actually entering the slotted core, at 10 metres/minute.

by Alcatel TCC, a joint venture company of the huge international Alcatel NV group – claimed to be the world's largest communications systems company, with operations in some 110 countries and annual revenues of $18 billion.

Alcatel TCC itself consists of Alcatel STC of Australia, together with French firms Les Cables de Lyon and Alcatel CIT. The TASMAN 2 contract won by the company in late 1987 is worth around $100 million, but it is investing virtually the same amount in building its new optical fibre submarine cable factory in Port Botany, and also in upgrading its factory in Liverpool to manufacture the cable's underwater optical repeaters.

If that sounds like a break-even exercise, it is. However the nations of the Asia-Pacific region are expected to need many new optical fibre submarine cables over the next decade, and Alcatel TCC's new Port Botany facility is the latest of only five optical fibre submarine cable making plants in the world.

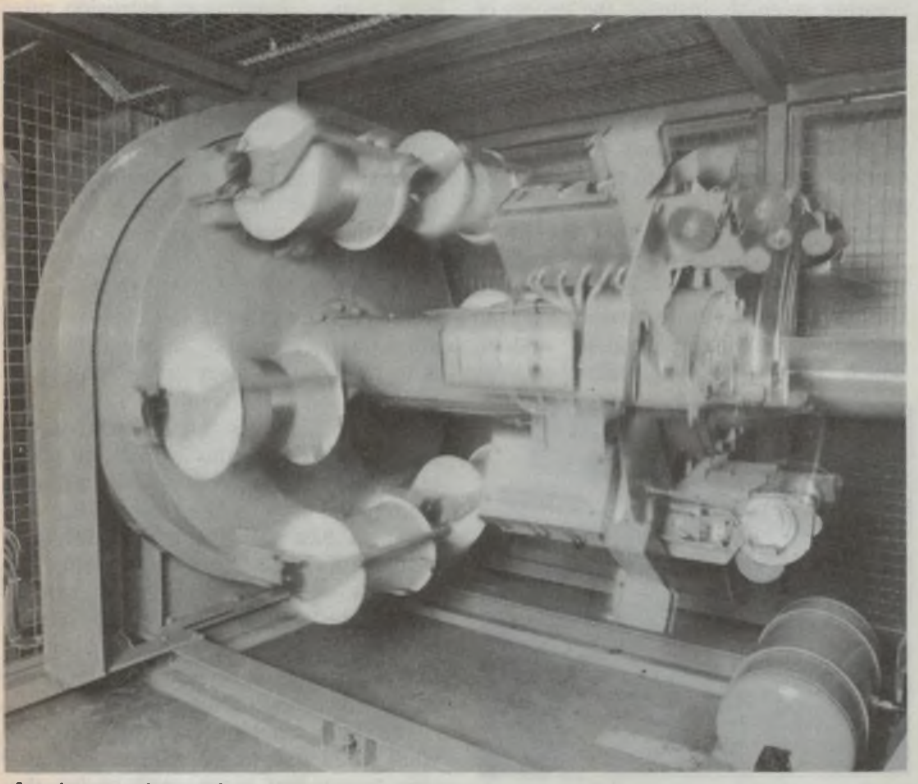
Later this year the Auckland-Hawaii link will go to tender, followed by that for the cable to link Sydney and Guam. Alcatel TCC is naturally hopeful of landing these contracts, and should be in a good position to do so.

The total world market for undersea cables is projected at about $5 billion by 1995, with about half of this in the southern hemisphere. So the company's investment of $100 million could bring into Australia up to $1 billion in export business, between now and the end of the century.

So much for the background and economics, then. But what about the cable itself? Optical fibres themselves are delicate little filaments, which are easily kinked or broken – so that they have to be handled with great care. To ensure very low optical losses they must be prepared and joined together extremely accurately, using fusion welding.

All six of the fibres which will form the functional heart of TASMAN 2 would together fit through the eye of a typical sewing needle – so how could such a tiny and delicate cable, complete with repeaters, be made rugged enough to be laid across 2200km of Tasman Sea bed?

Not surprisingly, this can only be done by encasing them in a specially-designed protective sheathing structure. And it's this composite structure that the Port Botany plant is designed to produce, with great care and precision yet at the same time in very large amounts.



A closer shot of a stranding machine in action. Some of the control electronics rotates along with the spools of fibre, to ensure reliable control of fibre tension at a mere 15 grams.

Optical cable

The TASMAN 2 cable alone will require 20 continuous lengths, each 120 to 150km long. These will be manufactured, tested and stored in large tanks, and then joined together via the repeater modules, to form a single final assembly 2200km long, which after further testing will be fed directly into the hold of the cable-laying vessel moored alongside the plant.

So Alcatel TCC's new Port Botany plant seems at first sight a contradiction in terms: a hi-tech plant dealing with precision handling and joining of fragile optical fibres, in very clean conditions, but also able to incorporate them into very large scale assemblies – and assemblies which after being laid on the bottom of the sea must operate reliably at depths of up to 8000 metres for at least 25 years.

To get more of an insight into how all this is achieved, I was invited by Alcatel TCC to tour the new plant. This proved to be most illuminating (sorry for the pun!), especially as I was shown around by Michael Thomas, TCC's cable manufacturing manager. Needless to say Mr Thomas was the ideal person to answer the many questions that came to mind during the tour.

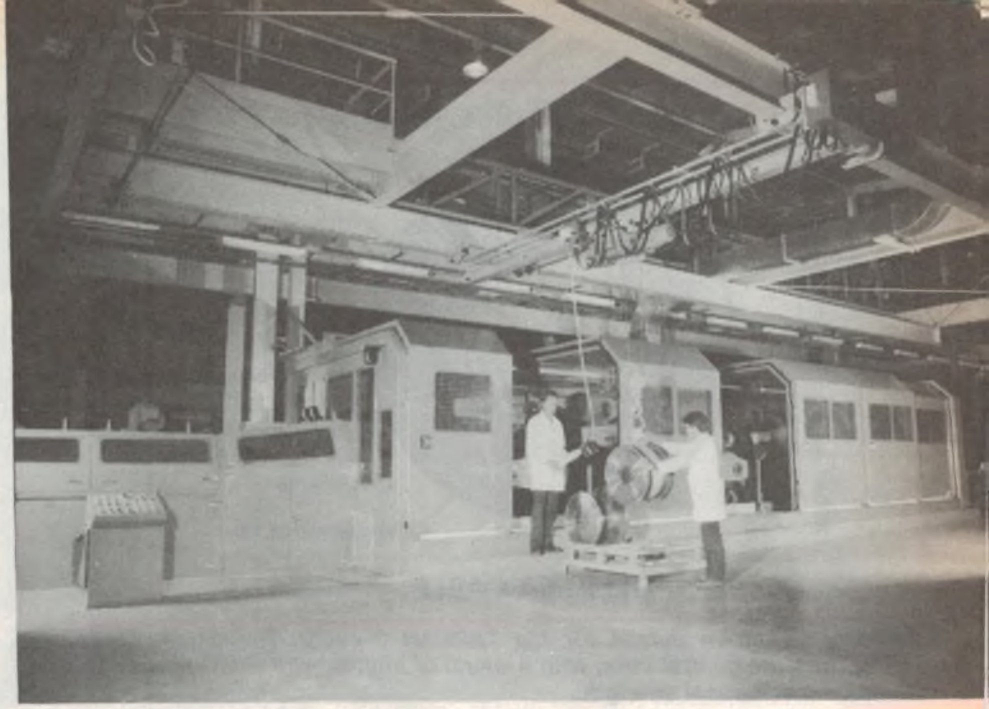
Making the cable

As you can see from the diagram, the final cable has quite a few components. At the heart of the assembly is a continuous polyethylene core, some 3.9mm in diameter. To give the core sufficient tensile strength for the earlier stages of assembly, it is initially moulded around a central steel wire 0.65mm in diameter, using a continuous extrusion process.

Around the core's outer periphery are moulded a series of spiral grooves or slots, and it is these which receive the actual optical fibres – after the latter are tested and colour coded by applying coloured dyes. The individual fibres are supplied by the manufacturer in lengths of 20km maximum, so frequent joints are needed. As noted earlier these must be made by very accurate fusion butt welding of the fibre ends.

The fibres are laid into the grooves of the core using one of two special stranding machines, one of which can handle 12 fibres and the other six. The TASMAN 2 cable only requires six, of course.

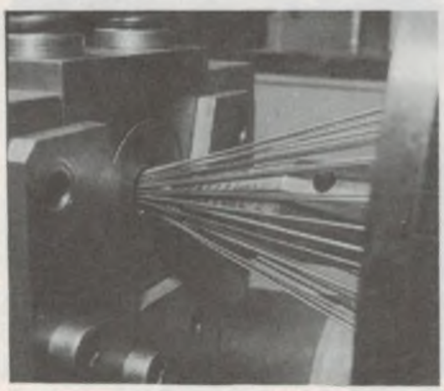
The stranding machines are intriguing, as they have a large rotating assembly – about 2m in diameter – yet are designed to lay the fibres into the spiral grooves of the core with great accuracy and delicacy, at the rate of 10 metres per minute. The fibres are laid into the grooves with only 15 grams of tension (about the weight of three sheets of A4 paper), carefully controlled via electronic sensors.



An overview of the big Mali stranding machine, used to wind the 36 steel 'vault' wires around the central fibre core.

It is because the grooves in the core are spiralled that the main 'works' of the stranding machines must rotate. The rotating assembly includes the spools of fibre, fibre drive system, sensors and tensioners – plus much of the associated electronics. It's apparently too difficult to ensure reliable signal connections via rotating contacts, so the electronics rotates along with the rest of the mechanism.

How do they ensure that the fibres lay neatly into the grooves without twisting and tangling – especially since they're under so little tension? By an ingenious automatic control system, which varies the longitudinal spacing between the output guides of the rotating fibre feeding system and the point where the fibres actually enter the spiral grooves.



A closeup of the heart of the wire stranding operation, with the wires meeting the core.

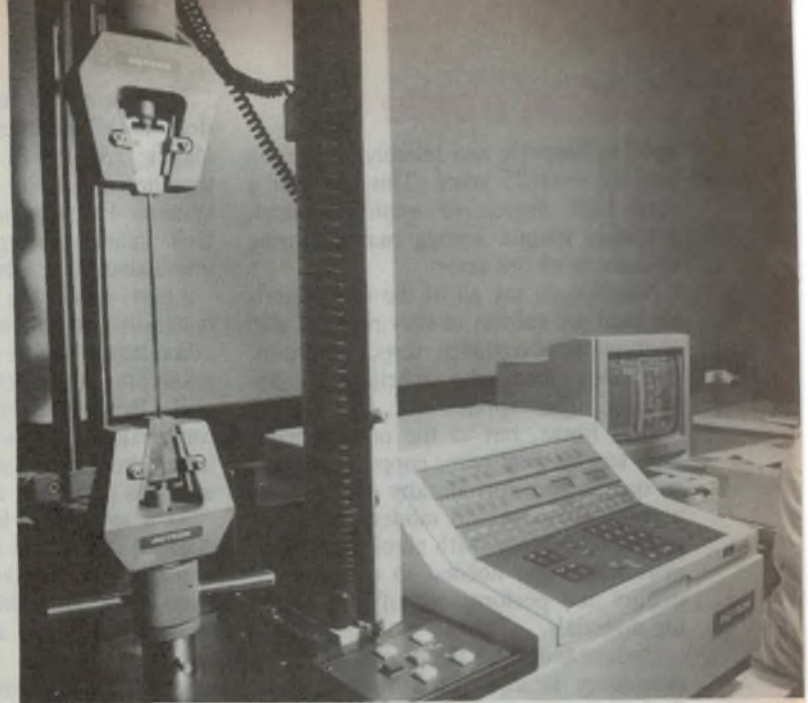
Following this very critical process, the grooves on the core are filled with a silicone jelly to surround and support the delicate fibres. Then a smooth polyethylene sheath is moulded around the core, using a continuous extrusion process very similar to that used to make the core itself. This forms the basic 'core' of the fibre-optic cable, some 4.7mm in diameter.

While rather more sturdy than the original fibres, this core cable is still nowhere near rugged enough to withstand the rigours of laying on the surface of the sea. At 5000 metres, the maximum depth for TASMAN 2, the water pressure is some 460 times normal atmospheric pressure. So the next step is to provide it with a very strong steel jacket – called the 'vault'.

The vault is not *solid* steel, of course. You couldn't form this around the polyethylene-and-glass core cable without melting the cable in the process. But it's the next best thing: some 36 different strands of high tensile steel wire, of carefully chosen diameters, wound around the core in spiral fashion in two layers so that they 'key' together (rather like the stones in an arch) to form an extremely strong tubular sheath.

The Mali machine used to wind the vault wires around the core is considerably larger that those used to lay the optical fibres into the core. This is partly because it requires 36 rotating

The control console for the 'composite' line, which includes winding on the steel wires and adding the copper conductor.



In the quality control lab metals, plastics and other materials are tested for tensile strength.

bobbins of wire (instead of 6 or 12), and partly because these each carry relatively heavy-gauge steel wire. With a rotating mass of over 75 tonnes, spinning at over 50rpm, it's quite impressive.

Immediately following the winding on of the steel vault wires, a continuous copper strip is formed into a closely-fitting 'conduit' around the outside of the vault. The butting edges of the copper are then welded together using TIG (tungsten/inert gas) arc welding, to produce a continuous watertight seam along the cable.

The welded copper 'composite conductor' layer serves two functions. One is to act as a barrier against the ingress of hydrogen – when dissolved hydrogen in the seawater is absorbed by optical fibres, they lose transparency and the cable becomes 'lossy'. The other function of the copper layer is to act as an electrical conductor, for the power fed along the cable to operate the repeaters. The sea itself forms the 'return' conductor for the repeater power circuit.

Because the vault winding machine must be stopped from time to time to replace exhausted wire bobbins, the vaulting and application of the copper conductor layer cannot take place continuously for the full length of a 120-150km run. As the next step must be done continuously, the completed copper-clad composite is therefore fed onto huge storage spools, each of which holds a full 120-150km length ready for the next step. The storage spools are 3.5 metres in diameter and 3.2 metres long. When carrying a 150km length of copper-clad composite they weigh just on 95 tonnes apiece – so that they must be handled using a 100-tonne overhead crane.

At this stage the diameter of the copper-clad composite is 10.5mm.

The next and penultimate step for the basic deep-sea submarine cable is to apply a thick outside sheath of polyethylene insulation, to insulate the copper composite conductor from the surrounding seawater. This polyethylene sheath is applied by continuous extrusion, in a similar process to that used in producing the slotted core and applying the small sheath around the optical fibres – only scaled up.

To completely coat a 150km length of cable takes 10 days of non-stop operation. This builds the diameter of the cable up to 21.5mm, a little smaller than that of a 10-cent coin.

The completed cable runs are then coiled into giant storage tanks, 7.5m in diameter and about 6m high, where they are subjected to rigorous optical testing as well as a 50,000 volt insulation test. After passing these tests they are then ready for the final assembly stage, which involves joining them together via the repeater modules and passing the completed cable out into the hold of the cable-laying ship.

After the steel vault wires are added, a copper conductor is wrapped around and continuously TIG welded.

Actually before this is done, the lengths of cable which are to lie in less than 3000 metres of water are fitted with an additional outer aluminium tube. This is to discourage sharks from attempting to bite the cable – they are apparently attracted by the electric field associated with the repeater power!

The cable runs which are going to lie in even shallower waters – i.e., on the continental shelf – are also wrapped with several further layers of heavy steel wire, to protect them from damage due to currents and being caught by ships' anchors.

Hopefully this description of the cable itself and how it's made will give you an idea of the *scale* of the operation. The complete TASMAN 2 cable will involve 14,000km of optical fibre, plus thousands of tonnes of extremely pure polyethylene, high tensile steel wire and high-purity copper strip. All of these materials are being supplied by Australian manufacturers, by the way.

Quality control

Of course, as noted earlier, despite the large scale of the operation, a submarine optical fibre cable must be made with great care and precision if it is to

Optical cable

operate properly and reliably on the sea bed for over 25 years. This calls for a very high degree of quality control, probably unique among manufacturing operations of this scale.

Needless to say all of the raw materials used are subject to very rigorous and continuous acceptance tests, to ensure that they meet the specified quality criteria. This applies not just to the optical fibres, but to the polyethylene, high tensile steel wire, copper strip and so on. So the Port Botany plant boasts a comprehensive and modern materials testing laboratory, with all of the hi-tech instrumentation needed to confirm the quality and performance of the incoming materials.

Understandably the manufacturing machinery is also fitted with a great deal of instrumentation, to monitor and control the actual processing. There are what seems like countless sensors, at virtually every step of the cable manufacture – monitoring diameter, tension, temperature, pressure, viscosity and so on. And inevitably a fair number of automatic controllers, to take the necessary steps to control all critical parameters.

There are also computer systems evident at all main manufacturing steps, logging the QC data and linking together all of the sensing and control systems. Essential aspects of modern hi-tech manufacturing, of course, but impressive nonetheless.

Apart from the attention to raw materials and manufacturing plant, the other crucial aspect to this kind of high-reliability manufacturing is operator skill. Because of the high degree of complexity at key steps in the manufacturing process, the skill of the operators is just as important as the technology.

As a result, the key operators at the Alcatel TCC cable plant have all been trained in France, at the Les Cables de Lyon plant. In addition, they must also be 'qualified' on a weekly basis, to ensure that their work continues to meet the plant's rigorous quality control standards.

This will apply also to the staff at the company's Liverpool plant, which is to make the repeaters.

The existing manufacturing plant at Liverpool was set up in the early 1980's to manufacture repeaters for conventional co-axial 'electrical' submarine cables. It is currently being upgraded to produce the optical repeaters, and will feature a 2000-square-metre clean room – the largest in the Southern hemisphere. This will cost $10 million alone, with a further $6 million to be spent on a huge moulding plant to encase the completed repeaters in high grade polyethylene.

Alcatel TCC's factory in New Zealand will make the terminal equipment for each end of TASMAN 2, including the power supplies which will feed 6000V AC along the cable's copper 'composite conductor' tube to power the repeaters. Based in Upper Hutt, near Wellington, the NZ plant will also be producing the overall supervisory system, to monitor operation of the entire Australia-NZ link.

So all in all, the manufacturing operation for TASMAN 2 is an impressive example of precision hi-tech manufacture on a large scale. And of course all of the technology and skills will be available for future projects of the same kind – a very welcome addition to Australia's manufacturing base and export earning capability.

My thanks to both Michael Thomas and Veronica Kennedy-Good of Alcatel TCC, for their help in providing much of the information and all of the illustrations used in this article.

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HDD/FDD Controller, 1:1 Interleave RLL, 'AT'	275.00
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NEWS HIGHLIGHTS

BELL LABS DEVELOP VOICE-ACTIVATED ROBOT

For even the most sophisticated computer, understanding a stream of human speech is a difficult task.

After four years of research, scientists at AT&T Bell Laboratories in New Jersey have developed a computerised robot that not only understands instructions spoken in complete sentences, but responds with its own synthetic voice, and uses its vision and touch sensors to complete the tasks assigned to it.

SAM (an acronym for Speech-Activited Manipulator) is claimed to be unique. Although its attributes of comprehension, sight, touch and speech can be embodied individually in other machines, SAM is said to be the first robot to contain all those 'senses'.

Physically, SAM is a 450-pound mechanical arm attached to a six square foot table that is its environment. Its TV 'eyes' and ultrasonic rangefinder spot objects that are described to it, its 'memory' knows the location of all objects on the table, and its touch-sensitive 'fingers' are able to move objects without crushing them or bumping into other objects.

SAM's sole purpose is to aid research in speech recognition and machine intelligence. By questioning its operator, the machine learns new words and their meanings, and is able to apply that knowledge to future assignments. And SAM also reasons about any difficulty it might encounter, which is an attribute of an expert system -- a branch of artificial intelligence.

SAM's ability to understand speech resides in an AT&T-designed BT-100 parallel processor that puts the power of a supercomputer within a desk-top cabinet. Its 32-bit digital signal processing chips are capable of one billion operations per second. The processor is particularly well-suited for real-time comparison of word patterns occurring in normal speech.

Because SAM is a research tool, the machine is speaker-dependent and responds only to its creators. However, it can be made speaker-independent, and its vocabulary could be increased by enlarging its environment and its tasks.

PERTH-ADELAIDE OPTICAL FIBRE LINK OPENED

The South Australian and Western Australian Premiers officially commissioned Telecom's new optical fibre trunk cable between the States' capitals during a live video link-up recently.

Their voices and 'live' television pictures were carried to audiences in Perth and Adelaide across more than 2600 kilometres of optical fibre cable.

Telecom Managing Director, Mr Mel Ward, said the link was the latest addition to Telecom's $400-million, trans-Australia optical fibre cable route.

He said the 12 fibres, each about the diameter of a human hair, contained in the Perth-Adelaide cable could carry 8000 simultaneous telephone conversations or handle 8000 fax sheets in two seconds.

"By the mid-90's, equipment will be available to quadruple that capacity".

IBM SUPPORTS MONASH RESEARCH

Computer company IBM Australia has donated US$100,000 (about A$135,000) to Victoria's Monash University, towards research in Computer Science aimed at making an advanced programming language more generally usable.

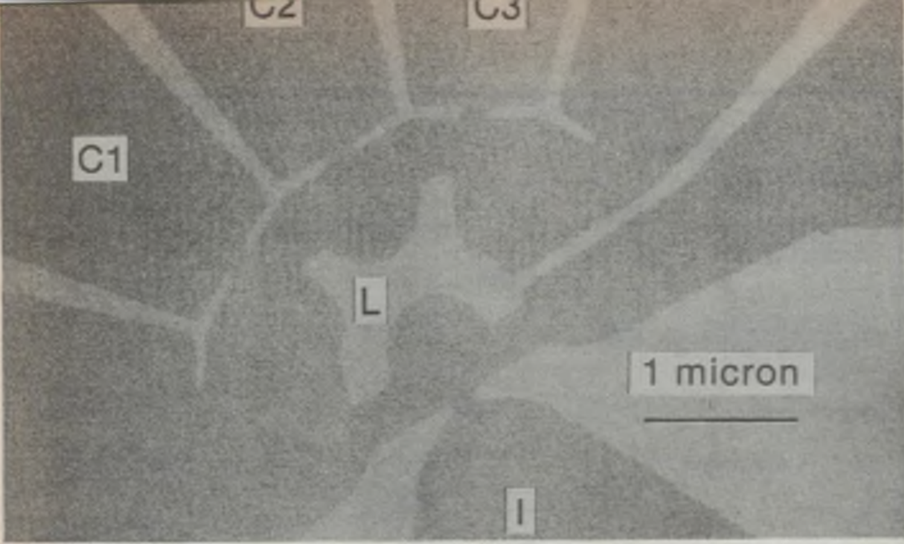
The language, which makes use of a system known as logic programming, simplifies the statement and solution of mathematical problems, and is particularly suited to applications in the area of sharemarket trading and the design of electrical circuits.

The first logic programming language, Prolog, could manipulate only symbols and whole numbers. A second language, Constraint Logic Programming (Real Numbers) [CLP(R)], which could cope with fractions and decimals, was developed at Monash. The IBM money will be funding a project to develop software to allow other mathematical systems to be incorporated.

Already a research team, led by Professor John Crossley of Pure Mathematics, has three systems up and running and is working on a larger, more sophisticated fourth system.

"We hope this grant will allow us to strengthen the ties between Monash and IBM's Thomas J.Watson Research Center at Yorktown Heights, just outside New York City," Crossley said.

He said that Melbourne had been an important centre of research into logic programming before it had attracted attention in the US. In fact, two formerly Melbourne-based researchers, Dr Joxan Jaffar (ex-Monash University) and Dr Jean-Louis Lassez (ex Melbourne University) are leaders in IBM's research effort in the field of logic programming.



IBM DEMONSTRATES BALLISTIC ELECTRON DEVICE

IBM researchers have demonstrated for the first time that fast-moving 'ballistic' electrons can be focused and steered as they travel at very low temperatures through gallium arsenide, a semiconductor material with promise for future computers.

The finding is the latest from a team led by Dr Mordehai Heiblum, studying the movement of ballistic electrons at the Thomas J Watson Research Center in Yorktown Heights, NY. The research group previously showed that ballistic electrons can travel through ultra-thin layers of gallium arsenide at speeds greater than one million miles per hour.

The discovery raises the interesting idea that 21st century computer architects might be able to use directed beams of electrons in computer chip circuitry, though substantial development hurdles would have to be crossed before the idea could find application.

Under normal conditions, electrons moving through a semiconductor travel only a short distance (called the 'mean free path') before colliding with atoms, other electrons, or impurities in the semiconductor and scattering, in the process losing energy and changing direction. In these experiments, however, the mean free path is lengthened, so the electrons can travel across the semiconductor ballistically, that is, without scattering. At –220°C, the normal motion of atoms inside the semiconductor material is greatly reduced, lessening the chance of collision with the electrons as they speed past. As a result, at that cold temperature, the mean free path can exceed one micron, providing room for the scientists to insert a tiny metal focusing lens just above the electrons' path.

To conduct their experiments, the scientists 'injected' high-energy electrons on one side of a tiny region of semiconductor material, two microns across and 'collected' them at the other. The experimental set-up, where a beam of electrons travels from one location to another, is a type of microelectronic switch. The very small size is typical of switches used in today's computers.

DSTO DESIGNS OWN MISSILE SIMULATOR

The RAAF has taken delivery of four Harpoon sea-skimming missile simulators designed by the Defence Science and Technology Organisation (DSTO).

At more than $1 million a throw, to use the airborne Harpoon AGM-84 anti-ship missiles in air force training would be unrealistic. The DSTO's solution is a Harpoon Captive Carriage Weapon Simulator (CCWS) that costs $110,000.

The Harpoon CCSW, unlike the weapon, allows aircrews to select the same weapon station repeatedly. By duplicating the electronic responses of the Harpoon missile to communications from the aircraft weapons sytems, the aircrew can initiate and complete several missile launch sequences during a training mission – saving millions in the process.

The simulator is a Mass Simulation Vehicle (MSV) containing a Harpoon Electronics System Simulator Unit (HESSU) or 'black box' which provides all normal Harpoon missile electronic responses to the carrier aircraft.

The microprocessor-controlled unit communicates with the aircraft via the Harpoon launch umbilical. Digital serial communication takes place across a differential data link. All aircraft discrete commands are optically isolated for increased system protection.

UNSW RESEARCHERS DEVELOPING SOLAR CELLS FOR SATELLITES

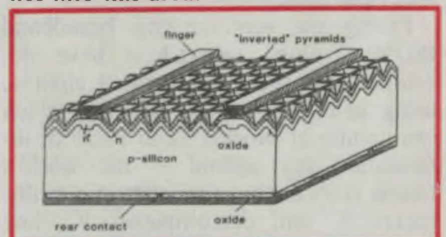
Silicon solar cells play an important role in most satellites and spacecraft.

Researchers in the Solar Photovoltaic Laboratory within the Joint Microelectronics Research Centre at the University of NSW have led the world in the development of the cells.

Led by Professor Martin Green, the team has won an Australian Research Council grant of $57,700 to develop further the high efficiency radiation resistant silicon solar cells for space systems.

"The aim of the research is to improve greatly the energy conversion performance of silicon solar cells used to power spacecraft," Professor Green said. "They form an integral part of the majority of space missions of any duration."

Professor Green said that with a strong local manufacturing base already existing for terrestrial cells, the unique performance levels expected from the present work are expected to offer opportunities for expansion of local activities into this area.



The overall research is progressing in three areas: high efficiency at any cost – space cells would be a commercial application of this work; low cost technology – simplifying cell structures as much as possible without losing efficiency; and long-term application to reduce greatly the amount of materials in the cell. Professor Green's team is working on depositing silicon on glass to reduce the thickness and the cost, of the cells.

One of the keys to each area of research is achieving a high level of energy conversion and it is in this area where the UNSW researchers have led the world for a number of years.

Simulated ground tests and high altitude tests at 48,000ft (15,000 metres), conducted by NASA, have confirmed that the team has achieved 19.8% conversion efficiency for solar cells under the type of sunlight found in space.

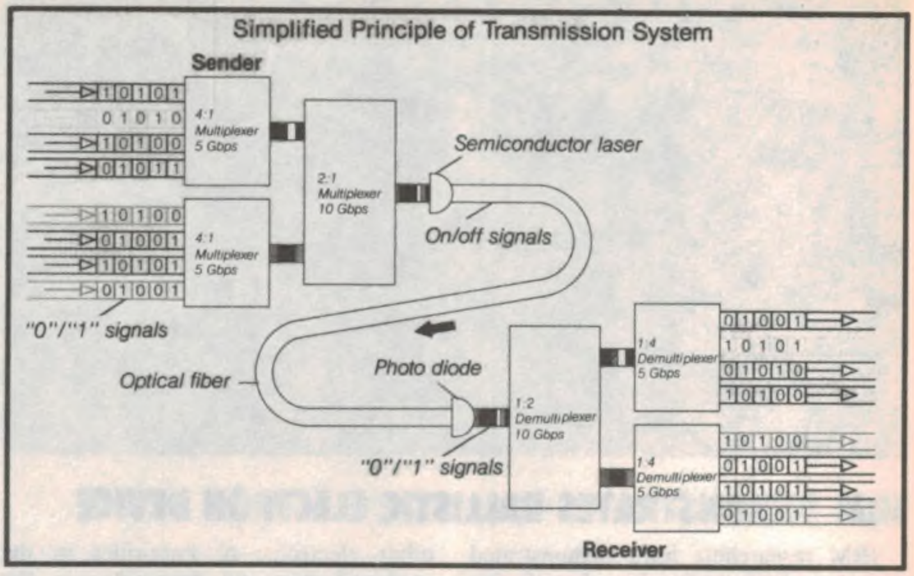
Professor Green is confident the team will achieve 20% within the next few months. The team has already achieved 23.2% on terrestrial cells.

TOSHIBA DEVELOPS GaAs IC'S WORKING AT 19Gb/s

With recent developments in telecommunications technologies, the volume of information which can be sent within a given time is rapidly increasing. Demand is also increasing, especially for data communication including electronic mail, facsimile messages and TV broadcasts. The transmission speeds of the currently commercialised high-speed digital communication network range from 1.6 gigabits (Gb) up to 2.4Gb per second.

By the mid-1990's, next-generation, broadband ISDN (Integrated Services Digital Network) will be able to transmit more than 10Gb per second – equivalent to as many as 100 channels of HDTV (High Definition TV) programs, or the voice signals of about 150,000 telephone lines. In these high-speed digital networks, optical fibre will be used in trunk lines, since it can transmit, noisefree, more than 1000 times the data that conventional metal wires can handle.

Paving the way for this broadband ISDN, Toshiba researchers have developed two sets of integrated circuits, using gallium arsenide (GaAs), which can handle or process 12 to 19Gb of information per second – the world's fastest rate. Each set consists of a multiplexer IC and demultiplexer IC, key components of high-speed transmission systems.



One set of multiplexer/demultiplexer ICs recently developed by Toshiba researchers utilises hetero-junction bipolar transistors (HBT), using aluminium gallium arsenide (AIGaAs) for its emitter layer, and GaAs for its base and collector layers. The HBT multiplexer IC can transmit 15 gigabits of information per second by bundling signals from two different metal wires, while the demultiplexer IC can divide 19 gigabit per second signals into the original two lines.

The other set of multiplexer/demultiplexer ICs from Toshiba use metal-semiconductor field effect transistors (MESFET), using GaAs substrates. The MESFET multiplexer/demultiplexer has achieved a switching speed of 12 gigabits per second. Compared with HBT, MESFET ICs are easier to integrate and will be commercialised before HBT ICs.

Toshiba has already developed multiplexer/demultiplexer ICs that can bundle and divide five gigabits of information per second, from and into four different wires. Thus the company thinks that the new ultra-high-speed devices can be used in the largest trunk line in a network, which bundles, sends and separates data transmitted from remote stations. (See illustration).

Furthermore, Toshiba has already developed a semiconductor laser able to output 15 gigahertz per second signals.

COMPUTER WAREHOUSE SYSTEM

A major Australian pharmaceutical and medical products company has begun converting to a computer-controlled system which will allow its warehousing despatch operation to operate entirely without paper.

Cyanamid has already completed the first phase of the changeover at its Baulkham Hills plant in Sydney, and expects to have the new system fully operational very shortly.

The system, called Pulse, is designed by Intertrack, Australia's largest specialist in computerised warehouse management systems. It is already enabling Cyanamid to show productivity gains, which are expected to improve further.

Pulse incorporates a product database and is able to supply the location, details, status and stock levels of any product in the warehouse at any time. Warehouse staff are directed in stock picking and other duties via mobile units which are radio-linked to the database, and stock can be identified by barcodes. The link allows the preparation of invoices and other documentation relatively quickly, reduces errors and eliminates the need for paperwork within the warehouse.

LOTUS USING DSP FOR A QUIETER RIDE

Britain's Lotus Engineering and the Institute of Sound and Vibration Research at Southampton University have developed an anti-noise system for cars, using digital signal processing (DSP) chips from Texas Instruments.

The TMS320-based system is designed to adaptively cancel the noise inside the car at the firing frequency of the engine – the so-called car 'boom', which is heard in many cars at certain speeds. This is achieved by introducing another sound field inside the car, using two loudspeakers placed under the front seats.

The second sound field is constantly adjusted by the TMS320 control system, to destructively interfere with the original sound field produced by the engine. This is done by using feedback from four microphones in the driver's and passengers' seats.

Engineers at Lotus have used the system in more than a dozen different types of car, and have measured substantial reductions in the noise level – as much as 10-15dB – at critical 'boom' speeds.

Conventional methods of treatment such as adding dampening and stiffening are generally of limited effectiveness at these lower frequencies, and also need to be adjusted to suit each individual vehicle. The adaptive nature of the DSP Anti-Noise System overcomes these problems, and has attracted the attention of several auto manufacturers.

Work is also under way to use the DSP system to control annoying low-frequency "road" noise which also masks the enjoyment of the "sounds you want to hear."

DEMOLISHING TRADE BARRIERS

The world watched in awe as millions of East Germans poured over the border into West Germany to view life in the West – and the goods in its shops. For those with money, quality products were at the top of the shopping list and department stores and electrical shops stayed open late to meet the demand.

Gathered to record the historic scenes were members of the press from around the world – among them Rich Lipski, a photographer with the Washington Post.

He caught this East German couple carrying a microcosm of Western life back to East Berlin – a Philips sound system – while, in the background, East German border guards point the way home.

NEWS BRIEFS

- ***Data Bridge Electronic Communications*** has merged with ***Ungermann-Bass***, adapting the latter name. Offices in Melbourne, Sydney and Canberra will provide customers with a one-stop shop for data communications networks in multi-vendor computing environments.
- ***Rhode & Schwarz (Australia)*** has joined forces with ***Television Australia Satellite Systems*** to handle the CTE range of FM transmitters for public and commercial broadcasters in Australia and Papua New Guinea. It will provide marketing, installation, commissioning and support service to customers.
- Love Controls of America, manufacturer of a range of process controllers and indicators, has appointed ***Email Electronics*** as its Australian distributor. Philips Components has also appointed Email as a distributor of its range of active and passive components.
- ***Elmeasco Instruments*** has become the agent for Advantest of Japan, UK manufacturer Farnell Instruments and its subsidiary Wayne Kerr. This will significantly expand the range of test and measurement equipment supplied by Elmeasco.
- Quentron Optics became Laserex Scientific two years ago and now its Nucleonics division has become a new company, ***Douglas Scientific***. For further information, contact (02) 369 1990.
- Local telecommunications manufacturer ***Exicom*** has purchased a 27% shareholding in Vantronic Corporation, a manufacturer of electronic equipment in San Jose, California. This should provide an entry to the US market for Australian and New Zealand-designed and manufactured Exicom products.
- The 2nd Australian International Electrical and Electronic Industries Exhibition – ***ELENEX Australia*** – will be held from 3-6 June at the Royal Exhibition Building, Melbourne. It will be staged concurrently with the robotics exhibition, ***AUTOMATE Australia***. For further information, phone (03) 267 4500.
- ***AUSSAT*** has recorded its first operating profit, some $2.255 million after tax but before extraordinary items, for the year ended 30 June 1989.
- ***Fastron Australia***, based in Dandenong, Vic, has been appointed sole Australasian agent for EUPEC, the new European Power Semiconductor Company. EUPEC was established as a joint venture between AEG and Siemens on Ist January 1990, to provide a comphresive range of power semiconductors including power thyristors and diodes, GTO's, Darlington power transistors, IGBT's and power assemblies.

NEWS

VDO TRIALS 'HEADS-UP' DISPLAY FOR CARS

Electronic component manufacturer VDO has begun developing a new heads-up display for motor vehicles.

Heads-up displays project important information either onto or in front of a car's windscreen, which can be read by a driver without the need to shift line of sight from the road ahead. This form of display was adopted by the aeronautical industry because of the increasing amount of complex information that had to be monitored by pilots without a loss of concentration on their surroundings.

VDO has been supplying the aircraft industry with mass produced heads-up systems for the past decade. The company has been carrying out extensive tests on the feasibility of a heads-up display for motor vehicles since 1986, and has now developed a functional prototype.

The equipment has been fitted to a VW Passat, where it projects a range of information an arbitrary distance in front of the car's windscreen.

The system differs from other heads-up displays which only project an image onto the windscreen, said VDO Australia's general manager of engineering, Mr Egon Vetter.

"The VDO heads-up display is a computer controlled dot matrix display with a special light source and an optical system of lenses and deflection mirrors" he said. "The system is designed to display information as an image about two metres in front of the driver."

The colour and bandwidth of the light source is adapted to a holographic combiner (colour selective reflector) which is embedded in the windscreen.

IBM CLAIMS RECORD FOR MAGNETIC STORAGE DENSITY

IBM scientists and engineers in San Jose claim to have set a world record in magnetic data storage density after they successfully stored one gigabit of information on a single square inch of disk surface, using experimental components.

The record data density is 15 to 30 times greater than that of current 'hard disk' magnetic storage devices. A billion bits is equivalent to 100,000 double-spaced, typewritten pages – enough paper to make a stack 10 metres tall,

To achieve gigabit storage density, the IBM researchers combined a number of advanced components, including experimental thin-film recording heads, magneto-resistive read heads and disks and sophisticated electronics. The demonstration was performed on a precision test apparatus, but all of the critical hardware components were made by conventional manufacturing processes. Several additional years of development would be required before gigabit technology could be incorporated into products.

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$50 - $99.99	$5.00
$100 +	$7.50

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

Errors and omissions excepted. Prices and specifications subject to change.

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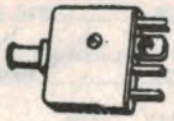
VISA MasterCard

ROD IRVING ELECTRONICS

ROD IRVING ELECTRONICS

TELEPHONE CONNECTORS



TELEPHONE PLUG
AUSTRALIAN
- Solderless Terminal lugs
- Colour: Cream

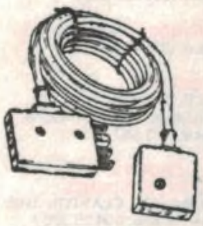
Y16016....................$4.95

TELEPHONE INLINE SOCKET
AUSTRALIAN
- Solderless terminal lugs
- Colour: Cream

Y16018....................$4.95

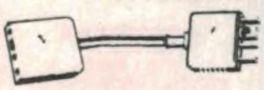
TELEPHONE DUAL ADAPTOR
- Australian plug to 2 Australian sockets
- Length: 10cm
- Colour: Cream

Y16014..................$12.95



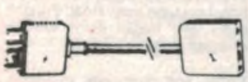
TELEPHONE DUAL ADAPTOR
- Australian socket to 2 Australian plug/ socket
- Length: 10 metres
- Colour: Cream

Y16015..................$11.95



TELEPHONE EXTENSION CABLES
- Australian plug to Australian socket
- Colour: Cream
- Length: 10 metres

Y16012..................$11.95



TELEPHONE EXTENSION CABLES
- Australian plug to Australian socket
- Colour: Cream
- Length: 5 metres

Y16010..................$12.50

TELEPHONE ADAPTOR
- Australian plug to U.S socket
- Length: 10cm
- 6 way/ 4 contact
- Colour: Cream

Y16026....................$6.95

TELEPHONE ADAPTOR
- U.S. modular wall socket
- 6 way/ 6 contact
- Screw terminating
- Colour: Cream

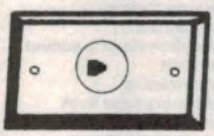
Y16002....................$3.95

MODULAR DUAL OUTLETS
- Single cable input to 2 modular socket outputs
- Surface mounting
- Screw terminating
- Colour: Cream
- 6 way/ 6 contact

Y16004....................$4.95

SURFACE MOUNT SOCKET
- U.S. modular surface mount socket
- 6 way/ 6 contact

Y16003....................$4.95



FLUSH MOUNT - SINGLE SOCKET
- Wall plate with modular socket
- Standard Australian size plate
- 6 way/ 6 contact
- Colour: Cream

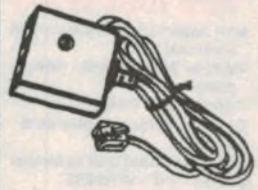
Y16005....................$3.95

FLUSH MOUNT - DUAL SOCKET
- Wallplate with two modular sockets
- Standard Australian size plate
- 6 way/ 6 contact
- Colour: cream

Y16006....................$4.95

TELEPHONE EXTENSION CABLE WITH REEL
- Allows 15 metres of telephone cable to be neatly wound in a portable storage container
- Colour: Cream

Y16013..................$24.95

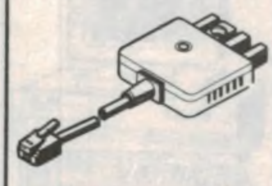


TELEPHONE EXTENSION CABLE
- Australian socket to U.S. plug
- 6 way/ 4 contact
- Length: 5 metres
- Colour: Cream

Y16017....................$8.95

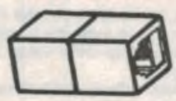
TELEPHONE CURL CORD
- Length: 1.8 metres
- Colour: Black

Y16020....................$3.45



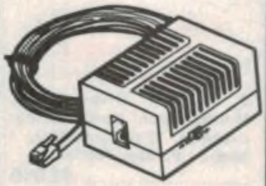
TELEPHONE EXTENSION CABLE
- Australian plug to U.S. plug
- 6 way/ 4 contact
- Colour: Cream
- Length: 2.5 metres

Y16029....................$6.95



TELEPHONE INLINE JOINER
- U.S. socket to U.S. socket
- Colour: Cream

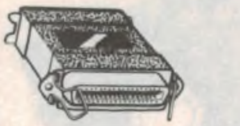
Y16037....................$3.95



TELEPHONE EXTENSION BELL
- Allows you to hear the phone ringing when you are outside
- Colour: Cream

Y16042..................$29.95

GENDER CHANGER

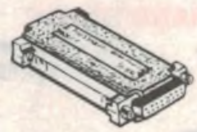


CENTRONICS' GENDER CHANGERS
- Saves modifying or replacing non- mating centronics cables.
- All 36 pins wired straight through.

X15663 Male to Male
X15661 Male to Female
X15664 Female to Female
..............................$29.95

RS232 GENDER CHANGERS
- Saves modifying or replacing non-mating RS232 cables
- All 25 pins wired straight through

X15650 Male to Male
X15651 Male to Female
X15652 Female to Female
....................$11.95 each



DB15 GENDER CHANGERS
- Saves modifying or replacing non-mating DB15 connections
- All 15 pins wired straight through

X15645 Male to Male
X15646 Male to Female
X15647 Female to Female
..............................$14.95

DB9 GENDER CHANGERS
- Saves modifying or replacing non-mating DB9 connections
- All 9 pins wired straight through

X15640 Male to Male
X15641 Male to Female
X15642 Female to Female
..............................$14.95

RS232 NULL MODEM ADAPTORS
- Pins 2 and 3 reversed
- All 25 pins connected

X15657 Male to Male
X15658 Male to Female
X15659 Female to Female
..............................$11.95

9 PIN TO 25 PIN CONNECTOR ADAPTORS
The perfect solution!
Features gold plated pins
- DB9 Plug to DB25Socket

X15668...............$10.95

- DB9 Socket to DB25 Plug

X15669...............$10.95

RS232 MINI PATCH BOX
- Interface RS232 divices
- With male to female 25 pin inputs
- 25 leads with tinned end supplied

X15653 Male to Male
X15654 Male to Female
X15655 Female to Female
..............................$12.95

GENERAL

PLASTIC UTILITY BOXES
Available with metal or plastic tops.

METAL TOP
- 150 x 90 x 50mm

H10101....................$4.50
- 195 x 113 x 60mm

H10102....................$6.25
- 130 x 68 x 41mm

H10103....................$2.95
- 83 x 54 x 28mm

H10105....................$1.95
- 120 x 65 x 38mm

H10110....................$2.95

PLASTIC TOP
- 150 x 90 x 50mm

H10111....................$4.95
- 195 x 113 x 60mm

H10112....................$6.95
- 130 x 68 x 41mm

H10113....................$2.90
- 83 x 54 x 28mm

H10115....................$2.25
- 120 x 65 x 38mm

H10120....................$2.95

(Less 10% for 10 or more cases)

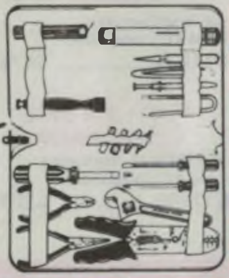
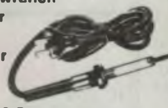
MU SERIES PANEL METERS
DIMENSIONS LISTED BELOW

Q10500	MU45 0-1MA	$16.50
Q10502	MU45 50-0/50uA	$16.50
Q10504	MU45 0-100uA	$16.50
Q10505	MU45 0-50uA	$16.50
Q10510	MU45 0-5A	$16.50
Q10515	MU45 0-10A	$16.50
Q10516	MU45 0-20A	$16.50
Q10518	MU45 0-1A	$16.50
Q10520	MU45 0-20V	$16.50
Q10525	MU45 0-30V	$16.50
Q10530	MU52E 0-1A	$18.95
Q10533	MU52E 0-5A	$18.95
Q10535	MU45 VU Metre	$17.95
Q10538	MU65 0-50uA	$23.50
Q10540	MU65 0-1mA	$23.50
Q10550	MU65 0-100uA	$23.50
Q10560	MU65 0-20V	$23.50

ELECTRONICS TOOLKIT (TK100)

Features:
- 30W soldering iron (220-240V)
- Wire Crimper/& or stripper
- Long nose pliers
- Side cutters
- Phillips head screwdriver
- Adjustable wrench
- Screwdriver
- I.C Insertor
- I.C Remover
- Tweezers
- Solder
- Driver with 8 Seperate removable heads. i.e.Phillips head, Flat blade, Star driver
- Heatsink tweezers
- Pearl catcher
- All of this in a handy Black vinyl carry case featuring seperate areas for each tool.

T12450..............$79.50

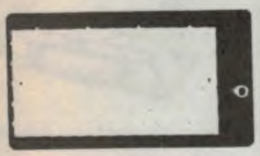



COMPONENTS

UV EPROM ERASER

Erase your EPROMs quickly and safely. This unit is the cost effective solution to your problems. It will erase up to 9 x 24 pin devices in complete safety, in about 40 minutes (less time for less chips)
- Chip drawer has conductive foam pad
- Mains powered
- High UV intensity at chip surface ensures EPROMs are thoroughly erased
- Engineered to prevent UV exposure
- Dimensions 217 x 80 x 68mm

Without timer
X14950....................$119
With built-in timer
X14955....................$129



BREAD BOARDS

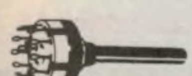
This inexpensive range of modular interlocking units enables a quick, easy way of experimenting with new circuits and ideas. There are two main units consisting of a terminal strip or distribution and a Central plug-in unit.
- 100 holes

P11000....................$2.75
- 640 + 100 holes

P11007..................$14.95
- 1280 + 100 holes

P11010..................$26.95
- 2560 + 700 holes

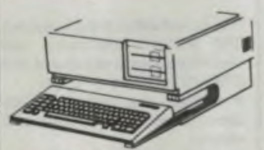
P11018..................$69.95



ECONOMY ROTARY SWITCHES

1 Pole 2-12 Pos.	S13021
2 Pole 2-6 Pos.	S13022
4 Pole 2-3 Pos.	S13033
3 Pole 2-4 Pos.	S13035
1-9	10+
$2.95	$2.75

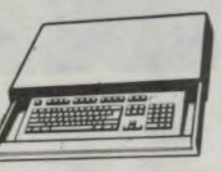
KEYBOARD ACCESSORIES



KEYBOARD SLIDE-AWAY

Slide your keyboard neatly away when not in use. Gives you more desk space. Securely holds any keyboard, wide or narrow.

C21083..................$64.95



KEYBOARD STORAGE DRAWER

Stores keyboard under the PC or monitor conveniently out of the way. Fits PC/AT keyboard or 2 3/4"(H) x 22 1/4"(W) x 9 1/2"(D)
- YU - E21B

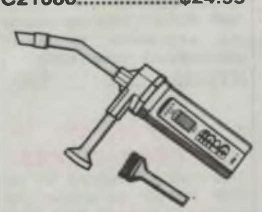
C21081..................$84.75

P.C ACCESSORIES

MAGIC STAGE

A working bench for your Mouse.
- High quality ABS plastic and anti-static rubberised top
- Stationary holder
- Includes pull-out shelf for Mouse
- Dimensions: 280 x 260 x 25mm
- Fits over keyboard

C21080..................$24.95



MINI VACUUM CLEANER

Use it to clean:
- Computer keyboards
- Printers
- Video recorders
- Computer circuit boards

C21087..................$14.95

PRINTERS & ACCESSORIES

EPSON LX-800 PRINTER

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

C22054...............$489.95

STAR NX1000C COLOUR PRINTER

- 120 C.P.S, Near letter quality
- Colours- Red, Violet, Blue, Green, Yellow, Orange, Black

C22045....................$695

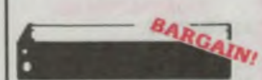
DON'T FORGET OUR DEALER IN
BRISBANE
V.C.R Computer Services
647 Lutwyche Rd.
Lutwyche.
Ph: (07) 857 5617

STAR 2410 PRINTER

- 47 CPS letter quality Pica
- 24 Pin letter quality
- 142 CPS Draft Pica

C22046....................$995

RIBBONS



PRINTER RIBBONS TO SUIT:

- CP80, SX80, DP80, BX100, BX100, MB100

	1-9	10+
C22036	$19.95	$17.95

- MX80, FX80, RX80, FX800, MX70, MX80, LX800

	1-9	10+
C22031	$16.95	$15.25

- MX100, FX100, RX100,LQ1000

	1-9	10+
C22002	$19.95	$17.95

- LX80

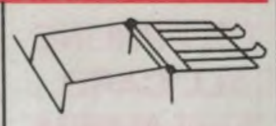
	1-9	10+
C22003	$12.95	$11.95

- C ITOH 8510-1550

	1-9	10+
C22051	$13.95	$12.50

NATIONAL PANASONIC KXM110 PRINTER RIBBON

C22034..................$19.95



PRINTER STAND

"AUSTRALIAN MADE"
- Restores order to your work area
- Conveniently stacks paper printout in document tray automatically
- Made of plastic coated steel
- Suitable for most printers
- Excellent value at this price
- 80 COLUMN

C21054..................$24.95
- 132 COLUMN

C21056..................$34.95

ENCLOSED PRINTER STAND

- Transparent cover makes it easy to check on paper supply
- Paper can be fed from the centre or the rear according to the design of the printer
- Removable drawer which allows paper to be changed without moving the printer
- Retractable rear basket makes print-out collection fast and convenient
- Suitable for most printers

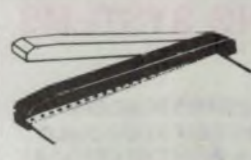
C21055..................$49.95

COMPUTER PAPER

Quality paper at a low price!
- 60 gsm bond paper
- 11 x 9 1/2" 2000 Sheets

C21001..........................$41
- 15 x 11" 2500 Sheets

C21012.........................$69



RIPPER STRIPPER

Remove ugly paper feed edges quickly and cleanly with this simple little gadget

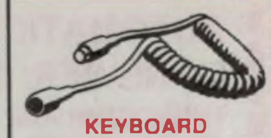
C21085..................$14.95

COPY HOLDER (YU-H32)

- Adjustable arms allows easy positioning
- Copy area 9 1/2" x 11"
- Sliding line guide
- Clamp mounting

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

LEADS



KEYBOARD EXTENSION LEAD

5 Pin Din plug and socket

P19038....................$6.95

COMPUTER EXTENSION POWER LEAD

P10254..................$11.95

rie
ROD IRVING ELECTRONICS

Please quote this advertisement for the prices listed for this month.

SYDNEY: 74 Parramatta Rd. Stanmore 2048
Phone: (02) 519 3134
Fax: (02) 519 3868

MELBOURNE: 48 A'Beckett St
Phone: (03) 663 6151

NORTHCOTE: 425 High St.
Phone: (03) 489 8866

BRISBANE:
(V.C.R Computer Services)
647 Lutwyche Rd. Lutwyche.
Phone: (07) 857 5617

MAIL ORDER & CORRESPONDENCE:
P.O. Box 620, CLAYTON 3168
Order Hotline: 008 33 5757
(Toll free, strictly orders only)
Inquiries: (03) 543 7877
Telex: AA 151938
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

ORDER HOTLINE
008 33 5757
(TOLL FREE)
STRICTLY ORDERS ONLY

LOCAL ORDERS & INQUIRES
(03) 543 7877

POSTAGE RATES:

$1 - $9.99	$2.00
$10 - $24.99	$3.00
$25 - $49.99	$4.00
$50 - $99.99	$5.00
$100 +	$7.50

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VISA MasterCard

ROD IRVING ELECTRONICS

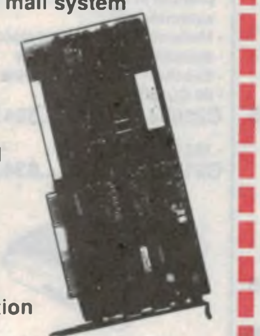
ROD IRVING ELECTRONICS

"NEW"

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



Traditional telephone answering machines are obsolete with the release of the NEW Voice Mail Card.

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 $245

"NEW"

ONSIGHT VIDEO AND AUDIO/ VIDEO MONOTORING SYSTEMS

DEPENDING ON THE CAMERA'S PLACEMENT, YOU CAN SEE AND / OR HEAR IF YOUR CHILD IS AWAKE, SEE AND TALK WITH THE PERSON AT THE FRONT DOOR, OR SEE IF SOMEONE IS IN THE POOL.

WITH ITS BUILT IN INTERCOM, THE VM200 ONSIGHT LETS YOU CONVERSE WITH THE PEOPLE IN THE ROOM WHERE THE CAMERA IS MOUNTED.

OPTIONAL CAMERA'S, MONITORS, AND SWITCHERS ALLOWS YOU TO MONITOR SEVERAL LOCATIONS AT ONCE.

VIDEO ONLY......................$489

AUDIO / VIDEO.............$589

"OOPS!"

AMAZING GOOF! 1/2 PRICE DISKS

These disks don't format to a full 360K. You will get over 300K, We made the mistake, you get the benifit. Ideal for games etc.

ONLY....$2.50

FOR 10 X 5 1/4" Double sided, Double Density Disks

POWER SUPPLIES

150W SWITCH MODE POWER SUPPLY FOR IBM* PC/ XT* & COMPATIBLES

DC OUTPUT:
- +5 / 13A, -5V /0.5A
- +12V/ 4.5 - 12V/ 0.5A

X11096 .... $149

200W SWITCH MODE POWER SUPPLY FOR IBM* AT* & COMPATIBLES

DEC OUTPUT:
- +5 /16A, -5V/ 0.5A
- +12V/ 5A -12V/ 0.5A

X11097 .... $199

180W SWITCH MODE POWER SUPPLY FOR BABY AT* COMPATIBLES

X11098 .... $175

FULL RANGE OF EPSON PRINTERS AVAILABLE ON REQUEST CALL NOW FOR BEST PRICES !!!

DISK DRIVES

5 1/4" 360K COPAL DRIVE

- 500K unformated
- IBM XT* compatible

C11901 .... $175

5 1/4" 1.2 M/BYTE COPAL DRIVE

- 1.6 M/Byte unformatted
- IBM AT* compatible

C11906 .... $225

EXTENSION CARD

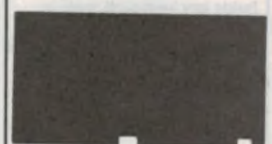
IBM* PC*/ XT* EXTENSION CARD

This board will fit in the standard IBM* PC*/XT* expansion slot and allows you to repair and test IBM* PC*/ XT* add on cards.

It extends the add on cards above the motherboard for easy access.

Standard IBM* PC*/ XT* bus edge connector.

H19115 .... $54



IBM* PC*/ XT*/ AT* WIRE WRAPPING BOARD

This is a half sized wrapped board suitable for research and development.
- Standard IBM* PC*/ XT* bus edge connector
- Tinned plated through holes
- 2.54mm spacing
- 19.4cm x 10cm wire wrapping area.

H19130 .... $89.95

IBM* PC*/ XT* WIRE WRAPPING BOARD

H19117 .... $59.95

IBM* PC*/AT* EXTENSION BOARD

This allows the user to raise add on cards above the motherboard for ease of repair and testing +-5 Volt fuses as power protection.

IBM* PC*/AT* edge connector for expansion to other interfaces via ribbon cable.

H19120 .... $90

IBM* PC*/AT* DECODED I/O CARD

This card is designed for the IBM* PC*/AT* expansion slot and includes data buffering and address section.

The wire wrap area features plated through holes. Extremely useful for R&D, its address range is 0280H to 72F7H. +-5V, +-12V fuse protection and has location for D type 37 pin or D type 25 pin connector.

H19125 .... $84

ACCESSORIES

DATA TRANSFER SWITCHES

If you have two or four compatible devices that meed to share a third or fifth, then these inexpensive data transfer switches will save you the time and hassle of constantly changing cables and leads around.
- No power required
- Speed and code transparent
- Two/ four position rotary switch on front panel
- Three/ five interface conections on rear panel
- Switch comes standard with female connector

2 way RS232
X19120 .... $59

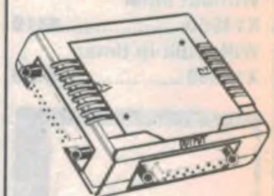
4 way RS232
X19125 .... $79

2 way centronics
X19130 .... $69

4 wat centronics
X19135 .... $79

RS232 2 X 2 Switch
X19140 .... $79

Centronics 2X 2 Switch
X19145 .... $79



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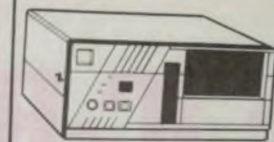

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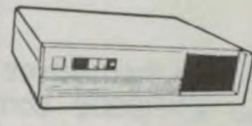

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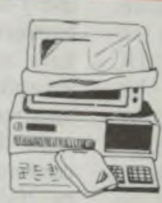

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Communications Receiver Review:

Icom's IC-R9000 'super receiver'

Icom's designers have done themselves proud this time. Their new top of the range IC-R9000 communications receiver offers almost every facility one could want, for reliable and trouble-free reception from 100kHz way down in the LF band right up to – wait for it – an incredible 1.9998GHz!

by JIM ROWE

Ask any radio user what they'd like in their 'ideal' communications receiver, and they'll probably list features like frequency coverage from 'DC to daylight', the ability to receive all modes of modulation, high stability, a facility to let you switch instantly to any desired frequency – or between a number of such frequencies, the ability to tune in adjustable steps when desired, built-in scanning, a built-in spectrum scope, noise blanking, adjustable squelch (muting), switchable AGC and AFC, and so on...

An impossible dream? Not any more, folks. Or at least, not for all of the features I've just listed, except for the 'DC to daylight' frequency coverage bit. That's still in the impossible category. The rest of them are all there, though, available at the touch of a button or the turn of a knob on the new top-of-the-range Icom IC-R9000 professional communications receiver.

As for frequency coverage, the IC-R9000 doesn't go down to DC; it stops short at about 100kHz. Not that there's anything much down below 100kHz, of course, except perhaps command signals to a few US nuclear submarines – and most of us don't have enough real estate for an antenna to receive these frequencies, anyway.

At the top end it doesn't go to daylight, either. But it *does* go right up to within 200kHz of 2 gigahertz – that's right, 1999.8MHz. So about the only signals it won't tune directly are those from communications and broadcasting satellites, and microwave communications links. Sorry about that, but you can always use down-converters!

Of course up until now, to tune over the range from 100kHz to 2GHz has generally required a number of different receivers. Most general-coverage receivers have only covered to the top of the traditional 'HF' bands: 30MHz. Above that, you could get receivers to cover specific VHF and UHF bands, and in specific modes – but very few indeed that would qualify for the title 'general coverage'.

Even most of the VHF/UHF scanners that have appeared in recent years have tended to concentrate on certain relatively small bands, with fairly large gaps between them. And very few receivers have covered above 1GHz, a notable exception being those covering the 23cm amateur band.

So the fact that the IC-R9000 tunes continuously all the way from 100kHz to 2GHz, in steps as small as 10Hz if desired, puts it into a very special class indeed. A class all of its own, I suspect, especially when you consider all of those other operational goodies listed above.

That's why I was most interested to try out an early sample of the receiver, when it became available a few weeks ago. Icom Australia could only spare it for a few days, so things were a bit rushed; but the opportunity was too good to miss!

First impressions

The IC-R9000 is not a small receiver. It measures 424 x 150 x 365mm (w x h x d), and weighs a hefty 20kg. But I guess that's not too bad when you consider what's inside it.

Probably the first thing you notice about the IC-R9000 is the 135mm-diagonal CRT display, in the upper centre of the front panel. This performs a number of functions, including indicating all relevant receiving parameters – frequency, mode, bandwidth, tuning step and so on – and presenting in graphics form the slice of spectrum surrounding the signal to which you're tuned.

Incidentally the spectrum scope facility is of the digital sampling type, in keeping with the fairly heavy digital emphasis evident in the rest of the receiver.

The CRT also displays various selection menus, for programming of various parameters, and the contents of the receiver's 1000 (that's right, *one thousand*) memory channels.

In addition, the display will also function as an ASCII video monitor for RTTY or packet radio.

For tuning, the IC-R9000 offers a number of options. The basic tuning system is a digital synthesiser, of the latest 'DDS' (direct digital synthesis) type, so that it offers high stability plus the ability to change frequency very rapidly and cleanly. Rated stability is a very impressive +/-25Hz below 30MHz, and +/- 0.25ppm above 30MHz.

The most obvious tuning control is the large rotary knob, which is in this case connected to an optical encoder. This plus its associated circuitry appears to split one revolution of the knob into 25 increments, each of which corresponds to a tuning 'step'. And you can set the IC-R9000 to make each step correspond to any of 10 different frequency increments: 10Hz, 100Hz, 1kHz, 5kHz, 9kHz, 10kHz, 12.5kHz, 20kHz and 100kHz. Very handy for tuning within bands that are divided into pre-assigned channels spaced a fixed distance apart – as well as providing a number of 'gears' for fast or slow coverage of a frequency range!

A nice feature here is that for tuning steps of 5kHz or more, a mechanical 'click' or detent function operates, so that the tuning knob effectively becomes a channel switch. This appears to be controlled by an internal relay or solenoid, so that it disappears when the three smallest tuning steps are selected.

Quite apart from the tuning knob, you have the ability to simply punch in a new reception frequency using the numerical keypad. This is very straightforward; you merely key in the significant digits for the new frequency, and then press the 'Enter' key. You're then receiving the new frequency, a fraction of a second later.

The rotary knob and keyboard are not mutually exclusive, by the way. You can use the keyboard to jump to a particular frequency, then immediately use the knob to move up or down from that starting point – very convenient.

In addition, there's also a pair of keys that will take you up or down in 1MHz steps, from whatever is your current frequency. So you can tune initially to 69.75025MHz, then jump to 70.75025MHz, 71.75025MHz and so on, in 1MHz increments.

There's also the ability to store up to 1000 different 'special' frequencies in the IC-R9000's memory channels, and either step between these channels or jump from any one to another, as desired. But more of that later.

Whatever the frequency you choose, you have the choice of six different receiving modes: AM, FM (narrow band), WFM (wide bandwidth FM), SSB, CW or FSK. These are normally selected by pressing the appropriate key, with the SSB button toggling between USB and LSB on alternate presses.

You also have a choice of three receiving bandwidths: Wide, Middle or Narrow. These actually vary according to the mode selected, in absolute terms. For AM they correspond to 15kHz, 6kHz and 2.6kHz respectively; for SSB, CW and FSK, 2.6kHz, 2.4kHz and 500Hz; for FM, 30kHz, 15kHz and 6kHz; and for WFM, 150kHz in all three switch positions.

Happily, both the receiving mode and the bandwidth setting are also stored in the memory channels, along with the frequency. So when you save a receiving 'recipe' in a particular memory channel, all main parameters are recalled automatically. Very convenient indeed!

Incidentally the rated sensitivity of the IC-R9000 is also quite impressive. It's better than 0.16uV for 10dB S/N in SSB, CW and FSK modes below 30MHz, and better than 0.5uV for 12dB SINAD in FM mode, over most of the range from 30MHz to 2GHz. Advanced RF circuits also give a claimed dynamic range of 103.5dB at 14MHz in CW/narrow mode, allowing reception of weak signals despite the presence of nearby strong ones. To ensure performance at VHF and UHF the IC-R9000 uses a combination of GaAsFETs and tuned bandpass filters.

Quite apart from normal reception on a single frequency, the IC-R9000 also offers multi-frequency scanning. In fact there are no less than seven different scanning modes, rather more than you get on many dedicated scanning receivers.

Perhaps the most basic scanning mode is 'programmed' scan, where you specify the lower and upper frequency limits. The receiver then repeatedly scans this range, incrementing by the preset frequency step and at an adjustable rate. Up to 10 different scanning ranges can be specified at any time, and selected at will.

The second scanning mode is 'Δf' scan, which scans through an adjustable-width frequency range centred on your current receiving frequency. The available widths are +/–2.5kHz, +/–5kHz, +/–10kHz, +/–20kHz and +/–50kHz, making this mode handy for signal searching in a relatively narrow frequency range.

The other five scanning modes all involve the IC-R9000's memory channels. 'Memory' scan repeatedly scans either all of the memory channels, or a specified range of channel numbers. 'Priority' scan allows you to listen to a particu-

Icom IC-R9000

lar memory channel while the receiver scans other specified channels. 'Selected Mode' scan allows scanning of only those memory channels programmed to receive in a specified mode. 'Selected Number' scan allows scanning of only those memory channels programmed with a specified 'group number' (1 – 9). And finally 'Auto Memory Write' scan allows scanning between two specified frequency limits, with the receiver automatically saving frequency and date stamp data sequentially in memory channels 900 – 999, when signals are found!

Thanks to the IC-R9000's DDS frequency synthesis, maximum scanning rate is a very fast 13 steps or channels per second. This is adjustable down to a much slower rate for special purposes. There are four selectable 'scan resume' functions, determining the conditions and delay operating before scanning resumes after a signal is found. The resume time can be varied from about 3 to 20 seconds.

Incidentally a selectable 'voice scan control' (VSC) function causes scanning to resume immediately if a received carrier has no voice modulation – preventing it from latching on unmodulated carriers. It is also claimed to ignore beat signals and noise.

These then are what we might call the main functions of the receiver. But there's also a list of 'bells and whistles', almost as long as your arm, which really tops things off.

For example there are two RF attenuator buttons, giving 10dB and 20dB of fixed attenuation respectively (cascadeable), plus an adjustable RF gain control, to allow optimisation of front-end gain and overload margin; a choice of fast or slow AGC action, or no AGC at all; an IF shift control, to allow interfering signals to be moved down the IF filter skirt; a selectable and tuneable IF notch control; a meter switchable between S-meter and centre-tuning functions; a noise blanker adjustable in threshold and with a choice of two bandwidths; adjustable squelch, which is set using the S-meter; dual 24-hour internal clocks with two different 'sleep' timers; selectable AFC; full bass and treble tone controls; a built-in calibration system; a 'dial lock' button, to prevent accidental changes in frequency setting; an interface to allow the IC-R9000 to be programmed from a personal computer; an IF output; line and recording outputs; separate antenna inputs for HF, VHF and UHF; separate adjustments for meter illumination and CRT screen brightness level; a headphone socket; and probably others, which I didn't have time to discover.

Oh – I did spot one other feature, which is apparently an optional extra rather than built in: a voice synthesiser module, which announces the receive frequency (in English), so that signals being recorded on tape are identified for later reference!

So the IC-R9000 really does seem to have almost every function and feature one could wish, and even a few most of us probably hadn't thought about. But what was it like to drive?

Trying it out

Initially, all those controls *were* a bit bewildering. I felt a bit like a Tiger Moth pilot, suddenly finding themselves in the cockpit of a Boeing 747! But it didn't take long to find the basic controls like tuning and audio gain, and then explore the others gradually as needed.

In fact it turned out to be surprisingly easy to use the IC-R9000 as a basic receiver. The tuning dial, tuning step keys and mode keys are really all you need a lot of the time, with an occasional tweak of the audio gain and selection of things like IF filter bandwidth and AGC rate.

Before long I was hopping all over the bands, switching reception modes and swapping between tuning step sizes with great ease.

Then I started using the RF attenuators, noise blanker, IF shift and notch controls, to separate out those weak HF signals from surrounding interference. And up on the VHF and UHF bands, I began relying on the squelch to cut down on the noise level. Gradually I had become used to relying more on the IC-R9000's spectrum scope, to spot channel activity and home in on interesting signal 'blips'.

After a while, of course, it was easier to use the keypad to jump directly to new frequencies of interest, rather than get there using the tuning dial. At about the same time I became more aware of the 'MHz step' keys, with their ability to let you hop up or down the spectrum in 1MHz steps. This receiver was getting really enjoyable to use!

But in some ways the real pleasure comes when you master the use of the IC-R9000's memory system. Then you can jump easily and with the mere flick of a switch between widely differing frequencies, with things like receiving mode and bandwidth automatically selected for each one.

Programming the memories is easier than you expect, too. All you do is select a currently unused channel – from among the 1000 channels available – and then simply tune in the desired signal, setting the mode, bandwidth and other controls for optimum reception. Then you merely press the 'Memory Write' key for a few seconds, until you hear a couple of beeps. From then on, selecting the same memory channel using either the keypad or the rotary memory channel selector switch will restore these settings, and if the signal is still there, you'll receive it again loud and clear!

This may sound like a fancy frill, but I can assure you it works out to be particularly useful in practice. For example on the Sunday morning of the weekend I was trying out the sample receiver, VK2WI was going to put out its weekly news broadcast on the following channels:

1.845MHz AM
7.146MHz AM
10.125MHz SSB
28.320MHz SSB
52.525MHz FM
147.000MHz FM
438.525MHz FM
1281.750MHz FM

I was able to program all of these frequencies and modes into the IC-R9000, and once the broadcast began, I could flip between any of them at will – in a fraction of a second. From MF to HF, VHF or UHF in a trice, and all with the one receiver...

Similarly I could program in a variety of commonly-used channel frequencies in the aircraft band, and flip back and forth between them to monitor communications between pilots and control towers at both local airports. Wow!

How about the scanning function? Well, that's pretty fancy too, and capable of doing just about everything you could want. But it was also the aspect of the IC-R9000's operation which I found a little tricky to master. Perhaps I'm getting a bit thick in my middle age, but programming the scanning functions seemed rather harder and less intuitive than the rest of its operation. I did get the hang of it eventually, but it took quite a while and I suspect the manual *could* have made things a little easier.

Mind you, I'm not exactly a scanning enthusiast, so perhaps those with more experience in driving scanners would find it a little easier. Although part of the complexity seems to arise from the fact that the IC-R9000 is so flexible, offering not only a variety of scanning modes, but also a number of alternative ways to program them.

Tested in the lab, the sample IC-R9000 appeared to meet its quoted specs with ease. But I have to be honest – we really couldn't check some aspects, like its stability at UHF, because our equipment isn't good enough. To check this properly you'd probably need the resources of the National Standards Lab.

We were particularly impressed by the very small number of spurious 'birdies' – pseudo signals, created within the receiver as a result of the frequency synthesis system. We could only find a couple of these over the IC-R9000's full frequency coverage, which compares very well with other synthesiser-based receivers and is a very commendable achievement by Icom's designers.

Summary

In fact overall, the performance of the IC-R9000 is really most impressive indeed. In each area of the spectrum it covers, its basic performance compares more than favourably with that of the best dedicated receivers.

This really does put it in a class of its own, considering that it's a full general-coverage receiver – with all of those extra features and functions to boot.

So all in all, it seems reasonable to describe the IC-R9000 as the communications receiver *par excellence*. Indeed it's the closest thing to a 'Rolls-Royce' of communications receivers that we've seen to date.

And the price? We were pleasantly surprised. It's not cheap, but less than we expected: $7714 including tax, or $6650 exclusive. A little high for private individuals, except the very well-heeled; but well within the likely budgets of R&D labs, communications servicing firms, news services, safety and security organisations, the diplomatic service and so on – probably the main users of this kind of receiver. In fact I gather that these kinds of professional users are snapping up IC-R9000's, almost as fast as Icom can crank them out

I suppose the rest of us will just have to keep on dreaming, at least for the present. Except for one very lucky *EA* reader who signs up or renews their subscription in the next few months, because Icom is offering an IC-R9000 as the prize in our latest subs promotion, as you'll see elsewhere in this issue. What a pity the editor isn't eligible to win – this is one subs prize I'd *really* like!

For further information on the IC-R9000, or any of the other Icom communications products, contact Icom Australia at 7 Duke Street, Windsor 3181 or phone (03) 529 7582. EA

When I Think Back...

by Neville Williams

Father Archibald Shaw and his pioneering radio factory

Not widely known, and seldom mentioned, Father Shaw was nevertheless a true and notable pioneer of Australia's indigenous wireless manufacturing industry. But his life story, pieced together from scattered sources, reads more like a piece of improbable fiction than an actual biography. Unfortunately, few of the people who would have known him personally are still living.*

One is tempted, by way of a titillating introduction, to list some of the improbabilities which mark the life story of this most unusual Roman Catholic priest. But I choose, instead, to let the story unfold as it will.

The records show that Archibald (later Father) Shaw was born at Adelong, NSW, on December 16, 1872 – but certainly not into a traditional catholic family of that period.

His natural father was Charles Shaw, a protestant Scotsman from Aberdeen who came to Australia in about 1849 at the age of 17. On landing, he found his way to Adelong, NSW, not far from present-day Canberra.

Adelong, at the time, was a busy gold mining centre from which, at its peak in 1857-59, something like 60,000 ounces (1.7 tonnes) of gold were extracted annually. In those same years, the local population peaked at about 20,000, including about 2000 Chinese – a significant statistic in days when society was not sensitive about racial prejudice.

Charles Shaw apparently won his share of the rewards as a goldminer, sufficient to set himself up with a house and a bride – Catherine Scanlon, from Campbellfield, now Minto, a remote south-western suburb of Sydney.

The wedding was quite an ecumenical occasion, more commonly regarded in those days as one of those highly dubious 'mixed' marriages: Charles, a Scottish presbyterian, marrying Catherine an Irish catholic in a ceremony conforming to the rites of the Wesleyan church and conducted in Charles' house by a methodist minister, Rev Henry Pinchcombe.

At about that time, readily accessable gold began to cut out and, as often happened in that situation, independent miners drifted off elsewhere, giving place to mining companies with their large crushing mills.

Having had enough of mining, anyway, Charles and Catherine Shaw moved into the hotel business, with Shaw's Adelong Hotel winning occasional mention in the *Tumut and Adelong Times*. Charles himself wins further mention as a noteworthy citizen of the district, although less flattering comment suggests that he may well have been one of his own hotel's best customers!

Five children were born to the couple, of whom Archibald – the subject of this story – was the fourth. At age four, he had an operation at the Sydney Children's Hospital to correct an ankle problem, which left him with a noticeable limp for the rest of his life.

Poverty, hardship

Within months of the operation, young Archibald's world began to collapse; his father died at age 44 and was laid to rest by a presbyterian minister. His mother was left to run the hotel

Father Shaw himself.

but, four years later, at age 37, she also died and was buried a catholic. It fell to the eldest daughter, aged 14 or 15, to travel to Tumut and register her mother's death.

Orphaned, the five children were apparently looked after, as best they could, by relatives and friends in the Tumut area – but exposed to more than their share of hardship and poverty. Young Archibald, it would appear, spent his early 'teens in timber country and may well have worked in one or other of the local timber mills.

Which brings us to the first unresolved question in the life story of Archibald Shaw: why would an orphaned country kid from a 'mixed' religious background, with limited education, working as a rouseabout in a timber mill, decide to enter a catholic religious order – the Congregation of the Passion, at the Presentation Retreat in Goulbourn, NSW?

The most likely answer is that he got a job in the Post office at Goulburn and, while there, was influenced by a mission held in the town by an itinerant catholic evangelist.

Lack of relevant documentation suggests that his stay with the Order was a brief and unremarkable one, probably as a probationary or a novice, and subsequently disqualified from appointment by reason of his permanent limp.

What is known is that, after leaving the Goulburn Passionists, he turned up on Yule Island in British New Guinea

* This present biography has been based primarily on material made available by Father J.F. McMahon, Archivist of the Sacred Heart Monastery, 1 Roma Ave, Kensington, NSW 2033. We also had access to research carried out by Stephen Rapley for the *Bright Sparks* series of radio programs, in particular 'The Wireless Priest' broadcast by ABC Radio National on May 7, 1989.

in February 1894, as a lay missionary, with a group of Missionaries of the Sacred Heart.

Archibald Shaw's job on Yule was to act as a secretary of sorts to the leader of the Mission, Father Navarre, a Frenchman with a limited knowledge of English. He was also required to act as an English language tutor to French, Belgian and Dutch students who had been sent to complete their theological training at Yule Island.

In this environment, Shaw applied to join the Order and was finally allowed to begin his Novitiate on the Island. In September 1896 he began his formal studies for the priesthood.

In no sense a brilliant student, he had nevertheless learned Latin, French and the local language quite well and, if Fr Navarre had had his way, 'Brother Placid', as Shaw came to be known on the Island, would have completed his studies on the spot.

Priest/Procurator

Mission Headquarters had other ideas, however, and Shaw was directed to the newly founded Sacred Heart Monastery at Kensington, near Randwick in eastern Sydney. He was ordained to the priesthood in June 1900 and temporarily assigned as Chaplain to soldiers encamped on the nearby Kensington racecourse, prior to their departure for the Boer War.

Presumably because of his experience in the mission field, Shaw was made Assistant Procurator for the Sacred Heart Missions in 1900. His task was to look after the supply needs of catholic missions in the Pacific region, principally those in Pomerania (New Britain) British New Guinea (Papua) and the Gilbert and Ellis Islands (Kiribati). It was a tough assignment, which required more funding than was forthcoming from Europe.

But, again, we find one of those odd twists to the story of Archibald Shaw.

The 76m antenna tower and mast erected at the rear of 4 Dutruc Street, Randwick around 1911.

Although completely untrained in art, the young priest had displayed a natural talent as a painter. He managed to sell two of his paintings for £50 ($100) each – a lot of money in those days – and then set about painting two large religious canvasses – about 10ft or 3m square – one of which is still preserved in the Monastery at Kensington.

He soon realised, however, that as a copyist rather than a true creative artist, his work could have only limited value. Consequently he cast about for a more effective way to raise money locally for the missions.

To add to the problem, the Mission bought a property in nearby Randwick, in 1907, to serve both as headquarters for the Procurator and as a sanatorium for sick and convalescent missionaries. Supervised by Fr Guis, with Fr Shaw as his procurator/assistant, this more ambitious 'Procure' had to be supported in any way possible.

It was at this point that Archibald Shaw – country kid, orphan, semi-cripple, rouseabout, missionary priest, amateur artist – turned his attention to the science of wireless telegraphy, which was in its infancy worldwide, let alone in Australia.

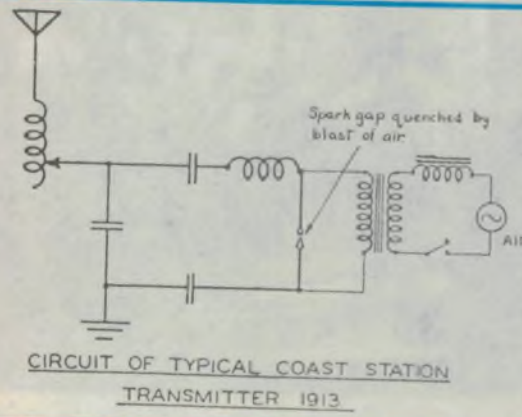
In seeking an explanation as to how Shaw could arrive at such a decision, Archivist Fr J.F. McMahon quotes this snippet from one of Shaw's letters:

I had a knowledge of electricity and engineering before I entered the Order ... and determined to use my knowledge in the engineering line to create money for the Procure ...

In an academic sense, his knowledge probably didn't add up to all that much, but I spent enough time in the country myself to know that country people with an aptitude for mechanical things quite commonly acquire impressive skills as 'bush mechanics'. Certainly, as 'Brother Placid' in New Guinea, Shaw had won the respect of his superiors as a man 'of very practical bent'.

Added to that is the fact that, in those days, wireless telegraphy involved gadgetry that was more mechanical and electrical than 'electronic' – a word that had yet even to enter the language. It was the kind of gadgetry that could well be assimilated by a self-educated handyman.

Again, Shaw had worked for a while in the post office in Goulburn, then a busy rail centre in the southern highlands of NSW. In a large post office, he would have been exposed to the ceaseless clatter of the telegraph sounder and, according to historian Philip Geeves (*EA*, May 1974) he became a qualified PMG telegraphist, very much at home with Morse code.



Shaw's spark transmitter circuit looks disarmingly simple, but the voltage at the spark gap was measured in kilovolts and RF power output was around 5kW.

Bitten by the 'bug'

Exactly how Father Shaw came to be bitten by the proverbial wireless bug is open to speculation, however. One thing that is certain is that a fellow priest, Father Joseph Slattery, had been conducting experiments in wireless telegraphy since 1903 at St Stanislaus College, Bathurst, NSW, as part of a course in natural science. As Science Master of the College, his interest was purely academic and he was content simply to demonstrate wireless transmission over a distance of 3 miles (4.8km).

However, like Marconi before him, Shaw was fascinated with the idea of purposeful two-way communication by wireless, and obviously made it his business to learn as much as he could about it with a view to putting it to practical use. He obtained a wireless experimenter's licence in 1910, enabling him to operate a station of his own, when he could manage to get one together.

As Assistant Procurator, responsible for purchasing a wide range of materials for the Mission, Father Shaw had built up a circle of friends and acquaintances in the business fraternity. One such was a certain Mr Kirkby who, with his two sons, ran a small electrical appliance manufacturing business.

In 1913, Raymond Allsop joined Shaw's factory as an apprentice. Here he is shown assembling a spark transmitter.

Shaw's interest in wireless telegraphy proved infectious, and it wasn't long before the Kirkbys became involved in making up wireless parts to Father Shaw's specifications. Since there was obviously a market for such parts, a profit sharing arrangement was worked out whereby Fr Shaw would attend to the design and paperwork and the Kirkbys would be responsible for production.

From Archivist Fr McMahon's account of what followed, it would seem that the Shaw/Kirkby team displayed a dedication and enthusiasm unique even amongst the early wireless cranks. The Kirkbys moved into the house called 'Ascot', owned by the Mission and adjacent to the Procure building, and began manufacturing wireless parts full time. Shaw's own wireless station began to take shape in another room in the same house.

It was a strange involvement for an ordained priest, but tolerated because it was the means to a legitimate end. Rarely indeed did Fr Shaw get to perform any of the normal duties of his priestly office.

As the scale of the operation grew, they formed a limited company in 1911: the Maritime Wireless Company (Shaw System) Ltd. Some of Shaw's designs were patented, while Kirkby patented a Fire Alarm System, which was taken up by the NSW Fire Brigade.

A timber wireless mast required for the wireless station was erected in the grounds of the Procure, but was demolished in fairly short order by an unfriendly cyclone. Nothing daunted, Shaw rallied support from neighbours and the business community – both catholic and protestant – to erect a 170ft (52m) steel tower. When a new wooden mast was added, it rose some 250ft (76m) above the Randwick landscape.

1911-14 were boom years for Father Shaw. In 1911, his wireless station, according to a story in the Sydney *Daily Telegraph*, was the most powerful in Australia. His manufacturing activities in a large galvanised iron building at the rear of 4 Dutruc St, Randwick constituted the first substantial wireless factory in the nation.

Nor was there any lack of customers for Shaw's wireless communication equipment, prominent among them being local shipping companies, and planters and traders in New Guinea. Staff numbers at his factory built progressively to 170 (according to Shaw).

Three good years

Establishment of the factory also coincided with a move by the Australian Government to establish a chain of land-based wireless stations to communicate with shipping in the area. The obvious companies to tender for their

A view inside the machine shop of Shaw's factory, taken around 1912.

Another view inside the radio factory in 1912, this time showing the motor/alternator winding and fabrication area. Note the windings hung up to dry, after varnishing.

installation would normally have been Marconi, based in Britain, and a German consortium headed up by Telefunken.

Between them, the two groups held most of the key patents to do with wireless telegraphy, but the rivalry between them was bitter in the extreme – particularly in Europe. Contracts for the first two Australian stations, Sydney and Perth, had gone to Telefunken, operating through a group of Sydney businessmen who had formed a company trading as The Australasian Wireless Co.

Reacting to this, a young and ambitious Marconi operator named Ernest Fisk had set up an office in Sydney, in 1911, to promote the products and services of the Marconi company (see 'Sir Ernest Fisk', in *Electronics Australia* June, 1989).

In fact, the Fisher Labor government, elected a few months previously, opted for the local manufacturer and Shaw's Maritime Wireless Company won contracts to install the next 17 land-based stations. While this coincided with the Fisher government's 'buy Australian' policy, Fr Shaw also had a keen supporter in Cabinet in the person of Senator James Long, who greatly admired what he was doing, and whose son was employed in the Randwick wireless factory.

In his paper 'A Quarter-Century of Radio Engineering in Australia' (*IRE World Radio Convention*, 1938) AWA Chief Engineer A.S. McDonald gives details and photographs of Telefunken's powerful Pennant Hills (Sydney) transmitter using a 400ft (120m) lattice steel antenna support tower and powered from a 500-cycle alternator driven by a 75hp diesel engine.

Circuit-wise, the transmitter circuit looks no more complex than that of a crystal set. But the actual equipment, as pictured in McDonald's paper, occupies a room with a 20ft (6m) ceiling – a reminder that the ostensibly simple circuit operated with a spark gap breakdown voltage of 60kV and delivered a nominal RF power output of 8kW in the range 300 to 3500 metres (100 to 11.7kHz).

At Pennant Hills, according to McDonald, the receiver was a crystal type using a zincite/boronite, steel/carborundum, steel/galena or electrolytic detector. At the time (1912) coherers were obsolete, magnetic detectors were no longer used in land stations and Fleming thermionic diodes were still few and far between.

(Crystal type receivers served the purpose mainly because they were normally used with the large transmitting aerial and, since there were few signals on air at any one time, sensitivity did not need to be compromised in the interests of selectivity.)

Patents trouble

McDonald notes that stations supplied by the Australian Shaw Company operated at somewhat lower power level than the Pennant Hills transmitter (5kW instead of 8kW), using a quenched spark gap which relied on a blast of air for de-ionisng that in the immediate vicinity of the spark gap. (See circuit). Seventeen such stations were installed around the Australian coastline, including Melbourne, Adelaide, Geraldton, Broome, Port Darwin, Thursday Island, Port Moresby, Cooktown, Townsville and Brisbane.

The Marconi and Telefunken companies, alike, were exasperated at being effectively shut out of the Australian market, and instituted court proceedings in respect to patents which they claimed were being infringed by the local manufacturer. Incredibly, the Federal Government made available the Crown Solicitor to represent Shaw and even guaranteed to meet his liabilities, should he lose the case.

In the long run, both companies withdrew their action. But Shaw still had to face action by John Graeme Balsillie, who claimed that Shaw had stolen some of his inventions. Balsillie, a young Australian, with considerable overseas experience in wireless, had been appointed by the Fisher government as an 'expert adviser' on wireless to the Postmaster-General.

To this point, Father Shaw's biography reads like a classical success story. The partially crippled orphan from the bush had taken an idea, a hobby, and turned it into Australia's pioneer wireless works. He had developed successful locally designed wireless telegraphy stations and set them up around the Australian coastline.

His idea of supporting the Sacred Heart Missions had succeeded beyond his wildest dreams. And if his brother priests were critical of his technical and commercial rather than parish/pastoral commitments, Fr Shaw had the enthusiastic support of Cardinal Moran, who felt that the priesthood should be seen to be responsive to social and scientific change.

Wide interests

In fact, the boy from the bush seemed better able to cope with hard work at a modest level than with run-away success and the publicity that went with it.

An archive photograph shows a husky Fr Shaw, Mr Kirkby and a dozen or more apprentices grouped near the base of the Randwick transmitting tower. With the Government's concurrence, the party was to take wireless equipment to New Guinea to assist in the search for the British Administrator Stanford Smith, who had become lost in the jungle. As it turned out, the wireless equipment was not required – but the emergency served to emphasise the need for effective communication facilities with mission stations in the territory.

Shaw was also consulted about supplying wireless equipment for Mawson's expedition to the South Pole, and commissioned to install a wireless station on King Island in Bass Strait. More than that, he was invited to become official Technical Adviser to the Federal Government on matters to do with wireless.

As if such diversions were not enough, a prototype of an electric car was built at the rear of the Procure, and an experimental windmill that would hopefully generate a useful amount of electricity. Even an aeroplane reached the drawing board stage, in response to a current competition offering a prize of £10,000 ($20,000) for one designed and built in Australia.

The Group even dreamed up a remote controlled submarine which could conceivably be launched in Sydney Harbour and be directed out through the Heads to attack a lurking enemy warship.

Had the affairs of Shaw's company been under close scrutiny and control, such diversions of interest might not have mattered all that much – but they were not well controlled, and the diversions did matter! Moreover developments, both commercial and political, were taking shape which were destined to put an end to the company's brief dominance of the wireless field.

New company

In 1913, Ernest Fisk pulled off what appeared to be an startling coup by forming a new Australian company, partly government owned, which would acquire and administer the patent rights for Australia and New Zealand of both the Marconi and Telefunken groups.

Perhaps it was that, having failed to make any headway against a government committed to Australian-made products, the two companies had realised that their only hope lay in co-operation rather than rivalry, and in establishing an Australian identity. The Fisk proposal provided exactly that opportunity and AWA (Amagamated Wireless A'Asia Ltd) came into being, with Ernest Fisk as its General Manager and, later, Managing Director.

No less to the point, the Fisher Labor government was replaced, in June 1913, by a Liberal government under Joseph Cook, which switched its support to AWA for the provision of wireless communication equipment.

In an impassioned speech, in the following year, Senator Long praised the contribution that Shaw's Wireless Works had made to Australian communications during the previous administration. He also complained that the Cook government had totally boycotted them since then, even to preferring equipment from an enemy country (Germany) and leaving idle a well equipped factory and 250 young Australian workers in Sydney.

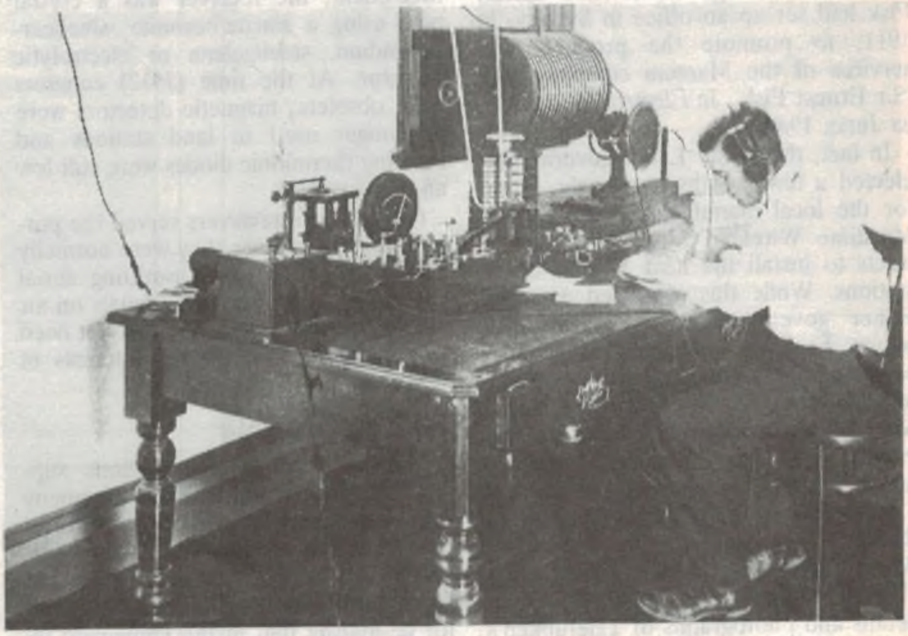
By that time, Fr Shaw was becoming chronically tired, and was often racked with pain and disabled from what he described in his letters as 'sciatica'. He was being challenged in the courts in respect to patents and, with little opportunity to perform priestly functions, was thinking of seeking release from his vows.

Worst of all, his once prosperous company was facing a liquidity problem, in part because he had been too easily persuaded to accept shares in various enterprises rather than actual cash repayments. More to the point, Fr Shaw was not a good business man and managing the affairs of the Wireless Works and its off-shoots, plus the Procure accounts and his own affairs proved too much for him to handle.

When news of the crisis reached Rome, a special Visitator, Fr Robert Linckens, was despatched from the Society headquarters to sort out the financial affairs of Fr Shaw's enterprise. Ironically, while a native of Holland, he was also a naturalised German citizen, and found himself trapped in Australia for six years following the outbreak of war.

The financial affairs of the Wireless Works, the Mission and of Father Shaw personally proved to be hopelessly interwoven, with cheques sent from Europe to support the Missions having been diverted to buy machinery for the factory with which Shaw could earn more money to donate to the missions!

Technically, it amounted to embezzlement and a 'scandal', although it is doubtful whether Fr Shaw's diversion of the monies was motivated by personal gain. In the long-run, the Visitator demanded that Fr Shaw sell his patents and the factory and use the money to



Father Shaw's transmitting station, in a room at the rear of the house called 'Ascot'. The operator may well be Raymond Allsop.

A group photograph of the employees at Father Shaw's radio factory, around 1912. The department managers are also visible. At its peak, there were around 170 employees.

make good his indiscretions, including £8700 ($17,400) owed to the island Missions.

The final chapter

Disposing of assets in wartime proved no easy task and, when Fr Shaw offered the factory and patents to the PMG Department for £60,000 ($120,000), they turned them down.

Talk of selling his patents also reawakened his differences with Balsillie, who regarded Shaw not only as an embezzler but a thief and a liar, who had stolen his ideas and claimed them as his own. The confrontation took up two or three months of Shaw's time, most of it spent in Melbourne.

Finally, with the assistance of Senator Long, Shaw approached the Federal Government, with a view to offering the enterprise to Senator Jensen, the Minister for the Navy. With the outbreak of war, the Navy had assumed responsibility for the administration of wireless communications in Australia.

After considerable haggling, a deal was finalised for £55,000 ($110,000) and the Wireless Works became a Naval establishment, under the Command of the nearby Garden Island Naval Base. For some years thereafter, it continued to produce a wide range of wireless, telephone and other communications equipment – plus engines and generators for the armed forces.

The purchase money was duly banked and much of it used to discharge liabilities identified by Fr Linckens. But one major withdrawal in August 1916, in notes of large denomination, was never accounted for.

At a subsequent Royal Commission (1918) into the Navy's acquisition of the Wireless Works, Senator Long admitted having received a payment of £1290 from Shaw 'for services rendered', but Senator Jensen denied ever having received anything at all personally from Shaw. Even so, following the Commission, Long resigned and Jensen was dismissed.

Unanswered questions

What happened to the missing money remained a mystery.

Shaw himself was not able to testify. Having made the withdrawal on Saturday, August 19, 1916, he booked into Melbourne's Coffee Palace Hotel, in mufti, as plain 'Mr Shaw'. On the Monday, he was found unconscious in his room, was taken to a private hospital and died in a coma five days later, reportedly from 'apoplexy'.

His death could have been accidental, due to heart seizure and a fall. Suicide was also mentioned, but considered unlikely because a Miss Evie Hoad testified that Shaw had proposed marriage to her, conditional on his being able to leave the priesthood. He had already made overtures with this objective to the Apostolic delegate, saying that he planned to leave Australia and seek employment in America.

A post-mortem examination gave the cause of his death as: 'chronic nephritis/-cerebral haemorrhage/indefinite'. Having in mind his earlier complaints about sciatica and chronic back pains, his death could well have been due to kidney failure, therefore to 'natural causes'.

But the large amount of money that was withdrawn and never accounted for also suggested that he could have been the victim of robbery and murder – a theory favoured by the Administrator of St Patrick's Cathedral, who ministered to him on his deathbed.

Father Shaw was buried after a solemn Requiem Mass at the Randwick Parish Church, followed by a funeral procession to the Randwick Cemetry formed by employees of what had formerly been the Shaw Wireless works.

After the war, the Randwick workshops passed from the Navy to the Dept of Repatriation, where they provided employment and training for returned soldiers. But the machinery began gradually to become obsolete, or simply wear out, and work ceased in 1922.

After that, the former factory was used to build the Wackett Widgeon trainer plane. The houses which Shaw used, 'Ascot' in Dutruc St and 'Archina' in Avoca St, are still occupied by Government personnel.

The role of Australia's prime indigenous wireless manufacturer was taken over by AWA, along with the training of marine operators in AWA's Marconi School. Father Archibald Shaw is but a dim memory. His body was transferred in the 1940s to the MSC community cemetry at Douglas Park NSW, a few kilometres south of Campbellfield/Minto, his mother's home town.

How he died remains a mystery, as also does the question of who got the £5000-odd ($10,000) that remained of his assets – money that might otherwise have paid for a new start in life in America!

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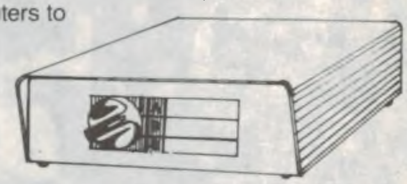

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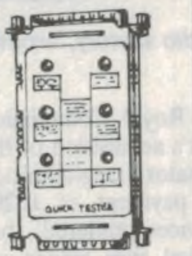

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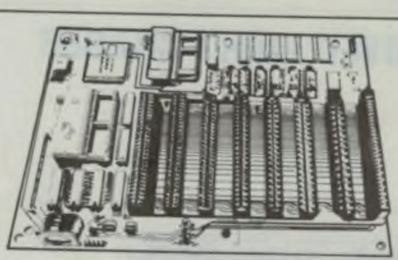

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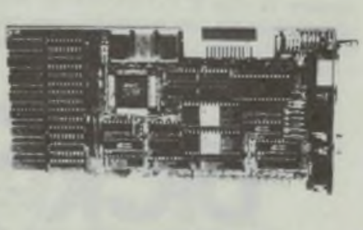

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Add colour to your music at parties and dances! Our new Chroma Vox uses the latest technology in Triac Driver IC's and gives you three channels which can be connected directly to speaker or headphone outlet. There's a master level control and each channel has adjustable sensitivity. With a high level of insulation between mains and signal output, insulated case and front panel, and specially selected potentiometers for the maximum safety. Will drive up to 2400W of incandescent lamps. Kit comes complete with a pre-punched, silk screened front panel and pre-punched rear panel.

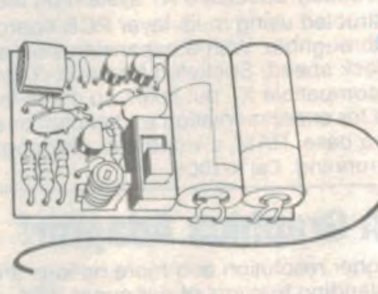
IMPROVED LIGHT CHASER

$99
Cat K-3161

Our new Light Chaser is low in cost, easy to build, incredibly flexible and it's designed with safety in mind. With 6 chasing patterns, 8 speeds, an enhanced front-panel monitor display and the ability to run lamps to a total of 2400 watts. It's been designed as a 'dedicated' chaser for the ultimate in safety. This also allows many more functions without getting into complex construction techniques. Comes complete (full form), right down to the last bolt!

Incredibly Small!

FM WIRELESS MICROPHONE



$16.95
Cat K-5006

SILICON CHIP

The FM Wireless Microphone is small enough to be inserted into a matchbox, can be tuned to operate at around 90MHz (On your FM receiver), it's incredibly stable with extremely sensitive circuitry and relatively easy to build. It's fantastic! Comes as a short form kit with components and PCB. Also includes batteries.

VK POWERMATE 25

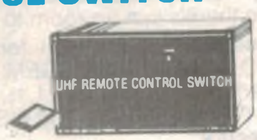
SHORT FORM KIT
CASE (CAT H-2481) &
TRANSFORMERS (CAT M-2010)
NOT INCLUDED

$249
Cat K-3210

The perfect kit for amateurs with all the grunt you need to get the most out of your shack. A high power 13.8VDC supply giving a huge 25 amp continuous current rating with a peak of 35 amps. It's capable of running transmitters and amplifiers in the 100-150W class. And it's fully protected with both foldback current limiting and an over voltage crowbar circuit. Short Form Only - Includes PCB components and necessary hardware.

UNIVERSAL UHF REMOTE CONTROL SWITCH

$79.95
Cat K-3258



It's easy to build and can be used for switching security systems, lights, doors... almost anything you can think of! The kit consists of a 304MHz receiver, decoder IC and output relay driver on a single board. Full form kit including pre-punched panel, panel label, PCB and all necessary components. Also comes with Department Of Communications (DOC) approved transmitter!

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50V Ceramic

Value In uF	Cat No.	Price
1PF	R 2215	$0.18
1.5PF	R 2217	$0.18
2.2PF	R 2219	$0.18
2.7PF	R 2221	$0.18
3.3PF	R 2223	$0.18
3.9PF	R 2225	$0.18
4.7PF	R 2227	$0.18
5.6PF	R 2229	$0.18
6.8PF	R 2231	$0.18
8.2PF	R 2233	$0.18
10PF	R 2235	$0.18
12PF	R 2237	$0.18
15PF	R 2239	$0.18
18PF	R 2241	$0.18
22PF	R 2243	$0.18
27PF	R 2245	$0.18
33PF	R 2247	$0.18
39PF	R 2249	$0.18
47PF	R 2251	$0.18
56PF	R 2253	$0.18
68PF	R 2257	$0.18
82PF	R 2259	$0.18
100PF	R 2285	$0.18
120PF	R 2287	$0.18
150PF	R 2289	$0.18
180PF	R 2291	$0.18
220PF	R 2293	$0.18
270PF	R 2295	$0.18
330PF	R 2296	$0.18
390PF	R 2297	$0.18
470PF	R 2299	$0.18
560PF	R 2301	$0.18
680PF	R 2303	$0.18
820PF	R 2305	$0.18
0.001MF	R 2307	$0.18
0.0022MF	R 2309	$0.18
0.0033MF	R 2311	$0.18
0.0047MF	R 2313	$0.18
0.0056MF	R 2315	$0.18
0.0068MF	R 2317	$0.18
0.0082MF	R 2319	$0.18
0.01MF	R 2321	$0.18
0.022MF	R 2323	$0.18
0.033MF	R 2325	$0.18
0.047MF	R 2327	$0.18
0.1MF	R 2360	$0.30
0.22MF	R 2370	$0.45

3KV Ceramic/NEW

Value In uF	Cat No.	Price
100PF	R 2375	$1.55
120PF	R 2376	$1.55
150PF	R 2378	$1.55
180PF	R 2380	$1.55
220PF	R 2381	$1.55
270PF	R 2382	$1.55
330PF	R 2383	$1.55
390PF	R 2384	$1.75
470PF	R 2386	$1.75
560 PF	R 2387	$1.85
680 PF	R 2388	$1.85
820PF	R 2389	$1.95
0.001MF	R 2390	$1.95
0.0022MF	R 2392	$1.65
0.0033MF	R 2393	$1.85
0.0047MF	R 9394	$2.05
0.0056MF	R 2395	$2.25
0.0068MF	R 2396	$2.45
0.0082MF	R 2398	$2.65
0.01MF	R 2400	$2.85

50V Monolithic/NEW

Value In uF	Cat No.	Price
10PF	R 1981	$0.30
15PF	R 1982	$0.30
22PF	R 1983	$0.30
33PF	R 1984	$0.30
47PF	R 1985	$0.30
68PF	R 1986	$0.30
100PF	R 1987	$0.30
120PF	R 1988	$0.30
150PF	R 1989	$0.35
220PF	R 1990	$0.35
330PF	R 1991	$0.38
470PF	R 1994	$0.40
680PF	R 1995	$0.45
1000PF	R 1996	$0.30
1500PF	R 1997	$0.30
2200PF	R 1998	$0.30
3300PF	R 1999	$0.30
4700PF	R 2002	$0.30
6800PF	R 2003	$0.35
0.01mf	R 2000	$0.35
0.015mf	R 2004	$0.38
0.022mf	R 2005	$0.38
0.033mf	R 2006	$0.40
0.047mf	R 2007	$0.45
0.068mf	R 2008	$0.48
0.1mf	R 2001	$0.50
0.15mf	R 2180	$0.35
0.22mf	R 2181	$0.45
0.33mf	R 2182	$0.55
0.47mf	R 2183	$0.60
0.68mf	R 2184	$0.65
1.0mf	R 2185	$0.70

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Get your tool box in order with these high quality, great value screwdrivers. All have insulated handles and Chrome Vanadium shanks for long life.

Philips Head

Size	Cat No	Price
6 x 38mm	T 6025	$2.95
3.2 x 75mm	T 6035	$2.95
5 x 75mm	T 6037	$2.95
5 x 100mm	T 6045	$3.95
6 x 100mm	T 6047	$3.95
6 x 125mm	T 6055	$3.95
8 x 150mm	T 6065	$5.95

Flat Blade

Size	Cat No	Price
6 x 38mm	T 6020	$2.95
3.2 x 50mm	T 6028	$2.50
3.2 x 75mm	T 6030	$2.95
4 x 100mm	T 6032	$2.95
5 x 100mm	T 6040	$3.95
5 x 150mm	T 6050	$3.95
6 x 125mm	T 6052	$2.95
8 x 150mm	T 6058	$5.95
8 x 200mm	T 6060	$5.95
8 x 250mm	T 6062	$5.95

30-150 WATTS!

SCOPE 12V SOLDERING IRON

Only $79.95

Cat T-1635

Ideal for outdoor work. Rated at 30-150 watts, so it's suitable for a wide variety of applications. Lightweight, easy to handle and beautifully balanced to make work easier. Comes with 6 metre power cable fitted with 2 alligator clips for easy connection to car battery, etc. Pack also contains spare elements and tip. It's fantastic value!

GENERAL PURPOSE SOLDERING IRON

Just $29.95

Cat T-1620

Rugged and reliable from Scope! It's rated at 20 watts which makes it ideal as a general purpose iron for around the home, workshop, etc. Plugs straight into the mains and it's fitted with air cooled handle to make work more comfortable. Tips and elements are easy to replace so maintenance is a breeze.

DSE SOLDERING STATION

Only $135

Cat T-2000

A professional quality soldering station at an affordable price! Ideal for hobbyist or technician. Features fully variable temperature control (from around 200 - 500 degrees Celsius), temperature meter, iron holder, tip cleaning sponge, comprehensive instructions and full service manual. You won't buy better at the price!

Ideal For Site Work!

3-IN-1 MODULAR TOOL

- It's a DRILL
- It's a SCREWDRIVER
- It's a SOLDERING IRON
- It's RECHARGEABLE

Cat T-5712

Just $99

DICK SMITH ELECTRONICS

Silicon Valley NEWSLETTER

Motorola joins IBM in X-ray lithography

Motorola has become the first major semiconductor firm to join IBM's pioneering research into the development of new X-ray semiconductor lithography and processing technology known as 'synchronous' X-ray lithography.

In recent months, synchronous X-ray lithography has become somewhat of a corporate crusade among key IBM executives. In recent statements, several top executives of the giant computer manufacturer have stated that X-ray lithography is vital to the long-term survival prospects of US semiconductor companies in their battle with the Japanese in the mid-to-late 1990s.

X-ray lithography offers the prospects of reducing chip features by as much as a factor of 100 from current state-of-the art optical and E-beam lithography technologies.

Recently, IBM showed off its new Advanced Semiconductor Technology Center in East Fishkill. New York, IBM chairman John Akers said his firm is planning to spend more than US$1 billion to develop the necessary technology to break the wave-length barrier of visible light.

Akers vowed that IBM expects to have its first full-scale X-ray lithography wafer fab in operation in time to produce 64 megabit DRAMs, chips that are expected to enter the market by 1994.

Thomas D. Sege, retiring chairman and CEO of Silicon Valley pioneering microwave tube maker Varian Associates. The company is currently looking for a replacement for Mr Sege, and hopes to boost its sagging profitability.

New report doubts HDTV prospects

A newly released report on the prospects for the high-definition television (HDTV) market concludes that the market for the revolutionary TV's may well turn out to be 'a turkey,' and a far cry from the holy grail the US industry has been seeking in regaining their world leadership in various technology markets.

The report was published by the Cato Institute, an independent research centre. The report's author, Thomas Arthur Moore, said the US government is well advised to stay away from getting involved in the HDTV industry, and let the marketplace determine its winners and losers.

Moore said that despite all of the early promises, the HDTV market could turn out to be "the biggest turkey of all time." This is because the development of this market will most likely be much more evolutionary than US proponents are projecting.

The market for the highly advanced TVs, because of their high cost, will remain relatively small in the early stages of development, says Moore. Thus HDTV will not do much to help America's high-tech industries become much of a force in the television business, let alone play a key role in reviving overall competitiveness of the US industry.

European HDTV deal

Less than a week after the announcement of a landmark HDTV technology exchange agreement with Japan, the US semiconductor industry announced it has agreed to cooperate with European electronics manufacturers to develop components for future advanced television products.

The two agreements are considered crucial to the future of the US semiconductor industry – which today has virtually no position in the consumer electronics market – is expected to become a huge part of the chip business in the 1990s. The agreements could also boost efforts to develop HDTV end-products in the US, where manufacturers, reluctant to invest the necessary funds in HDTV development, will be able to obtain critical components from domestic sources.

The agreement with Europe was announced during a round of trade negotiations in Paris. At the same meeting, Japanese and European electronics trade representatives were scheduled to meet to discuss cooperation. If successful, the talks could establish a three-way cooperation on HDTV development.

Industry observers agreed that the efforts are aimed at preventing the adoption of different television standards in the three major markets for advanced television products. Such standards would make it very costly for manufacturers to develop products for each market and would deny them the economies of scale. That in turn would cause HDTV prices to remain high and slow down the development of the market.

TI to spend US$2.4 billion in Italy

In the latest move by an American chip manufacturer to secure its European business ties beyond 1992, Texas Instruments has announced plans for a massive US$1.2 billion expansion of its Italian-based semiconductor operations.

As part of the program, TI said it will build a new facility to produce the planned new generation of 16-bit DRAM chips. Also, the company will set up a new IC application research centre and upgrade existing assembly and testing facilities.

The new program follows less than a year after TI said it would spend US$250 million to build a 4 megabit DRAM plant in Avezzano. The Italian government agreed to contribute up to 30% of the cost of that facility, which is scheduled to come on line by the end of 1990.

The latest plans also include "significant investment incentives from the Italian government," according to a TI spokesman.

The US$1.2 billion program includes the Avezzano facility, but TI refused to specify what other incentives the Italian government had made to put the latest proposal together.

The IC application centre will focus on the development of components for end-user products specifically designed for the European market.

Compaq-IBM deal puts EISA bus in doubt

In a move that could signal the beginning of the end for the effort to establish a market for EISA bus-driven personal computers, Compaq announced a technology cross-licensing agreement with IBM that will give Compaq access to the vital MicroChannel bus architecture IBM has been using for most of its PS/2 line of personal computers.

The Compaq move comes as a major blow to scores of companies who, only last September, aligned themselves behind Compaq in their endorsement of the Compaq-proposed EISA bus.

Even upon the announcement of the technology exchange agreement with IBM, Compaq officials denied their firm had jumped ship and that it has any plans to build PS/2 compatible machines.

"While this license covers MicroChannel-related patents, Compaq is not developing, nor do we have any plans to develop MCA-based products," said Compaq president Rod Canion. "We remain fully committed to the industry standard architecture and its enhancements such as EISA."

Industry analysts said that despite Compaq's disclaimers, the agreement still seems to weaken the company's endorsement of the EISA bus.

Sun, Unisys turn down US Memories

US Memories was dealt another damaging blow when Unisys and Sun Microsystems announced they would not join as members of the DRAM start-up, which aims to establish a major new US source for critical DRAM components. At Sun, company officials said in the wake of a review of the firm's long-term DRAM purchasing needs and vendor relationships, they feel there are currently adequate sources to obtain DRAMs.

Meanwhile, at Unisys, a spokesman for the firm said an investment in US Memories did not make good sense for the company at this time.

US Memories presdident, Sandy Kane acknowledged that the decisions by Sun and Unisys were disappointing. Earlier, Apple Computer also turned down an invitation to join US Memories. But Kane said the rejections were not catastrophic.

"Sun is only one of 18 companies considering investing in US Memories – more than enough to make US Memories happen," Kane said. But he added that "considering the violent swings in the DRAM market over the past two decades, it is difficult to understand why a company dependent on DRAMs would not actively support this venture.

Bush cuts HDTV funding

The Bush administration appears to have confirmed reports circulating in Washington that it is planning to drastically cut funding for a number of high-tech development projects that are viewed as critical for the ability of US electronics companies to regain their international competitiveness.

The Administration's 'Office of Management & Budget,' according to officials in the Pentagon and Commerce Department, has ordered the Pentagon to withdraw its recently initiated three-year US$30 million HDTV development program.

President Bush is also said to be planning to propose to Congress to cut back funding for Sematech, the chip industry's manufacturing research consortium. Those cuts would begin as early as fiscal 1991 which begins next July.

Industry observers say the cuts would effectively kill all of the recently enacted high-tech development programs with the exception of Sematech, which is a joint venture between the industry and the government.

The White House move drew immediate fire in Congress and around the industry. "The Bush Administration appears to be on the brink of abandoning the bulk of the high-technology industry in the name of budgetary expediency," said an angry Norm Mineta, a Democratic congressman from San Jose.

National finds no pot of gold

When Japan's patent office recently granted Texas Instruments a patent for the invention of the integrated circuit, officials at National Semiconductor got very excited over the prospects that their company may also be in a position to reap in hundreds of millions of dollars in royalties from Japanese chip makers. After all, Fairchild Semiconductor, which National acquired in 1987, co-invented the IC.

National officials, like treasure hunters, immediately began searching frantically through dusty old Fairchild records in search of a Japanese patent application that could bring the company fame and fortune.

After nearly a week of research, the hope for patent application was finally discovered. But to National's enormous disappointment, it turned out that the Japanese had granted Fairchild a patent in the early 1960s. The patent subsequently expired in 1980, long before Japan became the big force in chips it is today.

National, thus, wound up with little more than the bills to pay for the week-long search by legal experts.

FORUM

Conducted by Jim Rowe

Project problems, parts availability and the benefits of whingeing

I've had some more letters on the subjects of problems with construction projects and kits, and whether or not parts are easier to get here or in the USA. There's also a letter from a kit supplier suggesting that if you strike a problem with a kit, you really *should* complain to the supplier.

Following our discussion of construction project/kit problems and parts availability in the December issue, a trio of further letters have turned up – largely prompted by the comments of correspondents like Len Spyker, Eli Montebello and John Day. So I thought we'd spend this month's column taking a look at them – if nothing else, it will make a break from that thorny topic of fancy audio cables!

Two of the letters are quite long, and I won't be able to reproduce them fully. However I'll try to pick out the sections of each that are most interesting, and raise points other than those quoted from the earlier people.

The first letter to come in was from Norm Bush, of Canterbury in NSW. Mr Bush's letter was *very* long – about 6-1/2 closely typed A4 pages! – and discussed all sorts of interesting side-issues. However I hope he won't mind if I just print the following quotes:

Over the years I have built up quite a few kits, and they've generally worked first go. But many years ago my attempts at building up a project were often fraught with disappointment – they wouldn't work!

Looking back now, I can see just why that happened. Firstly, some of the kits that I bought in the beginning were just too complicated for an inexperienced beginner. Secondly, I rushed into putting them together because I couldn't wait to 'try it out'. These are bad mistakes, and a real trap for the inexperienced.

Fortunately though, my approach is totally different now. I learnt the hard (and expensive) way. To gain success with any electronics project, regardless of its complexity, one MUST be thoroughly methodical.

Even so, there are certain things that can be a real pitfall for the novice. Quite often a PCB is designed to accept a given component – say a capacitor, for example – and the hole spacing is drilled to accept only that component. A run of kits will be produced, and for some reason or other THAT particular sized component will not be available, so a substitute is put into the kits.

Perhaps due to pressures involved with a production run of kits, no-one has tried to see if the substitute part will actually fit the PCB. I guess this is a common occurrence, as I have struck it quite a few times. I know that it's REALLY frustrating, to say the least!

Now if the PCB is not fully loaded with other components, it is quite possible to alter the PCB to fit the supplied part. Or if the correct part is relatively common, then I look for one that WILL fit the board as it stands. But if one is methodical and checks over all the parts first, before soldering any into place, it is quite possible to prevent a problem before it happens.

Mind you, even with experience one can still get 'caught out' occasionally. Not that long ago I drilled the plastic 'Jiffy' box for a kit made for your Stroboscopic Tuner project, before putting the electronics together. When I did wire up the electronics side, it worked beautifully – but the damned thing wouldn't fit into the plastic box!

It turned out that the kit firm concerned had supplied the wrong box. I wrote them a letter, and they sent back a very nice letter with apologies and the correct box together with the remaining parts I needed to finish the tuner. I was certainly most pleased at their attitude.

Of course much of the success of a project, apart from having the correct sized parts to fit on the PCB, depends upon a person's ability to solder properly, wire up properly and lay out the PCB in a neat and sensible fashion. Quite apart from the overall appearance of the finished project, if everything is laid out neatly it makes faultfinding – if required – just that much easier.

Finally, I have an axe to grind with some of the component manufacturers, who for some reason best known to themselves have decided to 'muck up' the existing marking system.

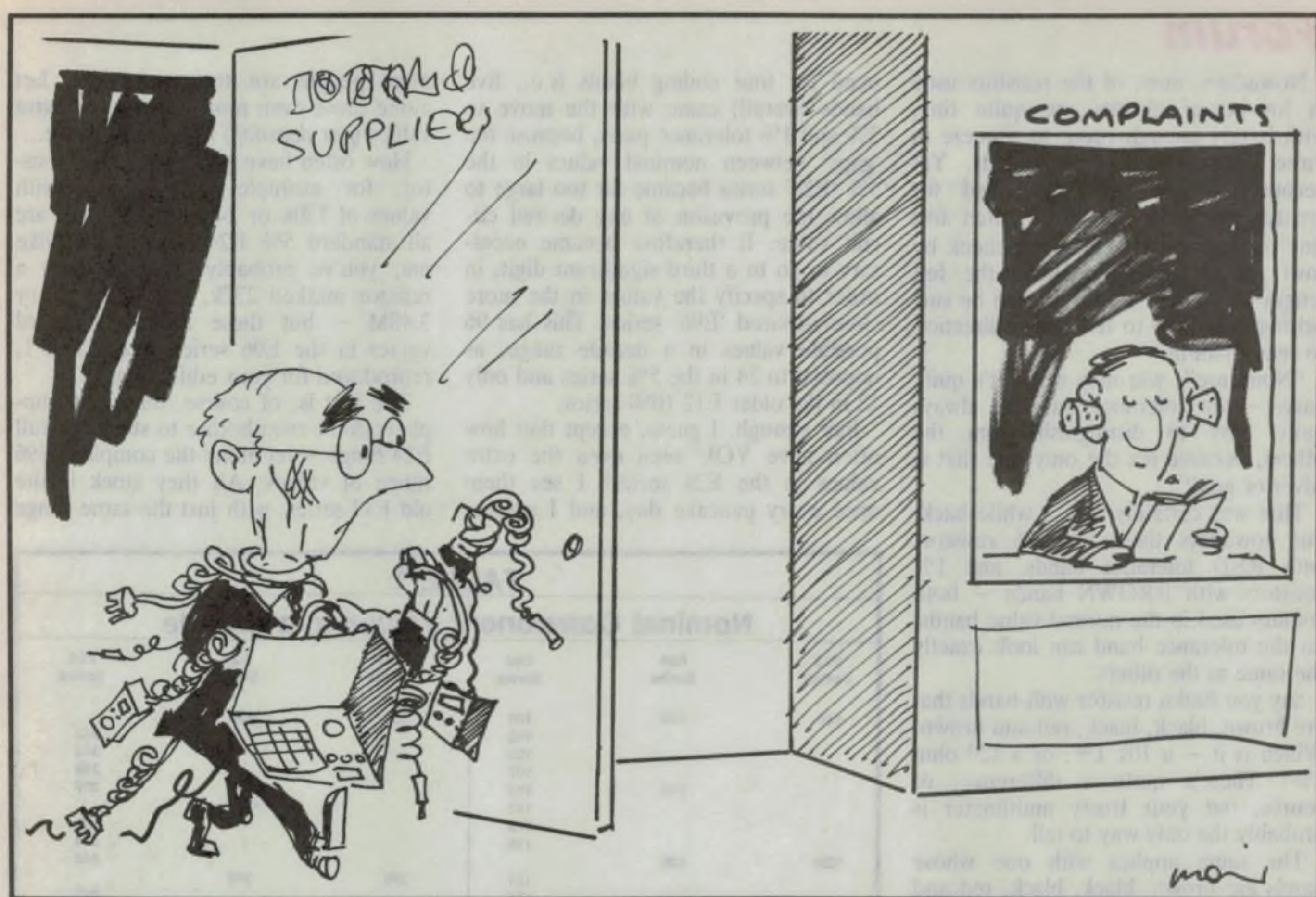
For many years capacitors were marked in either pF or uF values. Now some use a 'secret code' which requires a conversion chart to decipher, while others have chosen to give the values in nanofarads or units of nanofarads.

As if that's not bad enough, resistor manufacturers have chosen to use either a 4-band or even a 5-band colour code! I would like to know WHY? After all the years of using three bands for the value of the component, and one band for the tolerance, why in the blazes was it necessary to mess around and upset the apple cart by changing things!

Mr Bush's letter went into both these and related topics in rather more detail than this, as you might suspect, but I hope he'll forgive me for condensing it here. Incidentally he also included a sketch to illustrate, in whimsical form, what might perhaps happen if a kit maker were to substitute oversized 'substitute' parts in an amplifier kit – forcing the builder to bolt them to the top of the case because they wouldn't fit inside. I'm reproducing his sketch here, so his effort won't be wasted; the caption is his work, too.

I fully agree with him that it's a very good idea to check not only that you have all the parts for a project, before you begin construction, but that they're all going to fit into the PCB without hassles. As he notes, if there are going to be any problems it will always be a lot easier to sort them out at this stage, before the board is loaded with relatively fragile components.

Many of the manuals provided with kits a few years back used to recommend checking all of the parts upon opening the kit, to make sure everything was there. Mr Bush's suggestion that you also check their compatibility



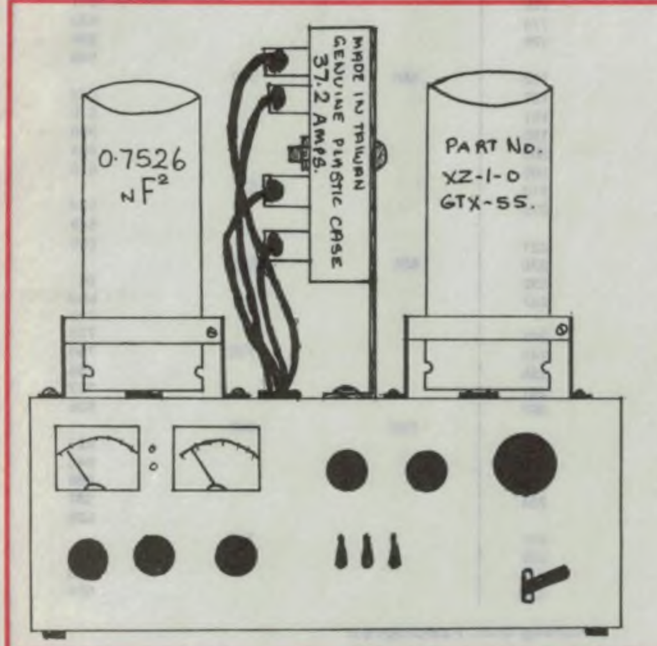
with the PCB seems equally good advice, bearing in mind how many of today's projects and kits are based on PC boards. Perhaps the kit suppliers should add this kind of note to their instruction manuals, as a helpful hint to constructors. We'll try and remind readers of it more frequently, too.

Needless to say *all* kit suppliers will have to substitute parts from time to time, due to component availability problems, and occasionally there will be resulting problems with PCB compatibility. So cautioning buyers to check things over is not really an admission of inefficiency – just a recognition that accidents do happen occasionally, even in the best-run organisations.

I have to confess to having sympathy with at least *some* of Mr Bush's complaints about resistor coding bands. Not that I can't see *why* we now have so many bands on resistors, because I know there are reasonably sound reasons why this is so. It's just that I'm finding it more difficult, as times goes on, (a) to tell exactly what colour some of the bands are; and (b) to work out in which direction to read them! I wonder if these aren't Mr Bush's real gripes, too.

Part of the problem seems to be the ever-shrinking size of resistors and other parts. In the old days even the lowest-rated resistor was a fair size, allowing the coding bands to be applied up near one end so that it was fairly clear at a glance in which order they were to be read.

Often there simply wasn't a tolerance band, as Mr Bush suggests; it was just assumed that the tolerance was 20% and that this would be 'near enough'. But if there *was* a tolerance band, it would generally be spaced away from the others and clearly visible as such.



Norm Bush's graphic comment on oversized substitute parts supplied in kits. His suggested caption is 'Nice amplifier – pity the substitute parts wouldn't fit inside the case!'

Forum

Nowadays, most of the resistors used in low-power circuits are quite tiny, with barely enough room to squeeze in three decent-sized coding bands. Yet because of the professed need for greater precision, there are often five tiny coding bands jammed in, cheek by jowl and occupying virtually the full length of the part's body. It can be surprisingly difficult to tell which direction to read them in.

"Nonsense", you may say, "It's quite easy – the tolerance band is always quite easy to distinguish from the others, because it's the only one that is silver or gold!"

That was certainly true a while back, but nowadays there are 2% resistors with RED tolerance bands, and 1% resistors with BROWN bands – both colours used in the normal value bands. So the tolerance band can look exactly the same as the others.

Say you find a resistor with bands that are brown, black, black, red and brown. Which is it – a 10k 1%, or a 120 ohm 1%? There's quite a difference, of course, but your trusty multimeter is probably the only way to tell.

The same applies with one whose bands are brown, black, black, red and red – is it 10k 2%, or 220 ohms 1%?

And what can add to your difficulties (or at least, it certainly adds to *mine*) is that often the body of the resistor is itself finished in a colour which seems to shift those of the coding bands, so an orange band tends to look red while a yellow band can look orange and a red band can look purple.

I find this happens particularly with metal film resistors, which mostly seem to have a *blue* coloured body – I think it's another semi-standardised coding system. But there are also some composition types with a dark tan coloured body, which can also make the banding colours hard to distinguish. It's all very confusing!

(Incidentally, have you examined those tiny surface-mount resistors? As well as being much tinier again, they seem to have abandoned the colour coding system in favour of a number code like ceramic capacitors. So all you need is a good magnifying glass...)

As for the need to go to five bands in the actual coding system, this is traditionally explained in terms of the need for greater precision in modern circuitry. Hence the trend from 20% tolerance parts to 10%, then 5%, and nowadays 2% and 1% or even better.

According to this explanation, the need for four coding bands (i.e., five bands overall) came with the move to 2% and 1% tolerance parts, because the 'gaps' between nominal values in the 5% 'E24' series became far too large to allow the provision of any desired circuit value. It therefore became necessary to go to a third significant digit, in order to specify the values in the more closely-spaced 'E96' series. This has 96 possible values in a decade range, as opposed to 24 in the 5% series and only 12 in the older E12 10% series.

Fair enough, I guess, except that how often have YOU seen even the extra values in the E24 series? I see them once every pancake day, and I suspect most people are the same way. Let alone those even more esoteric 72 extra values (*per decade!*) in the E96 range...

How often have you seen a 36k resistor, for example, or resistors with values of 130k or 240 ohms? These are all standard 5% E24 values. And like me, you've probably NEVER seen a resistor marked 232k, or 576 ohms, or 3.48M – but these are all standard values in the E96 series. See Table 1, reproduced for your edification.

The fact is, of course, that most suppliers don't even bother to stock the full E24 range – let alone the complete E96 range of values. All they stock is the old E12 series, with just the same range

TABLE 1

Nominal Component Values in a decade

E12 Series	E24 Series	E96 Series
100	100	100
		102
		105
		107
	110	110
		113
		115
		118
120	120	
		121
		124
		127
	130	130
		133
		137
		140
		143
		147
150	150	150
		154
		158
	160	
		162
		165
		169
		174
		178
180	180	
		182
		187
		191
		196
	200	200
		205
		210
		215
220	220	
		221
		226
		232
		237
	240	
		243
		249
		255
		261
		267
270	270	
		274
		280
		287
		294
	300	
		301
		309
		316
		324

E12 Series	E24 Series	E96 Series
330	330	
		332
		340
		348
		357
	360	
		365
		374
		383
390	390	
		392
		402
		412
		422
	430	
		432
		442
		453
		464
470	470	
		475
		487
		499
	510	
		511
		523
		536
		549
560	560	
		562
		576
		590
		604
		619
	620	
		634
		649
		665
680	680	
		681
		698
		715
		732
	750	750
		768
		787
		806
820	820	
		825
		845
		866
		887
		909
	910	
		931
		953
		976

(According to IEC Publication 63)

of nominal values as for 10% parts. If you *must* have one of the more 'unusual' values in the E24 or E96 series, you generally have to order them specially – and probably wait quite a while to get them. This might well be because the manufacturers don't even *make* them normally – only in response to special orders.

You can't blame the suppliers, of course. To cover the range of values from say 10 ohms to 10 megohms in a particular type of resistor – say 1/2 watt metal film – they have to stock around 72 different values in the E12 range. If they were to stock the full E24 range this would double to 144 different values, while stocking the E96 range would require a massive 576 different values. Eight times as many as for the E12 range, and for each type and size of resistor!

No wonder most of them stick to the familiar old E12 range of values, even for their range of 1% metal film resistors.

But what does this tell you, the fact that the suppliers can restrict their range in this way, and no-one ever complains? (Well, hardly ever!)

What it tells *me* is that for most purposes, all of those extra nominal values in the E24 and E96 series are pretty well redundant. We simply don't need them, most of the time.

It's quite possible to design circuits to do most jobs using the relatively limited range of values in the E12 series, either alone or in relatively simple combinations. True, there are some situations where this *won't* do, like precision voltage dividers in digital instruments, ADC's and DAC's, and so on. But these are pretty isolated cases, let's face it.

So I guess what I'm saying is that Mr Bush is really not so unreasonable in asking why we've all been lumbered with the five-band colour coding system. The four value bands are really only needed for all of those extra nominal values in the E96 series – which most of us never need, never use, and generally couldn't buy even if we wanted to!

There's really no logical reason why even 1% resistors which have nominal values conforming to the E12 series couldn't be marked with the simpler three-value-bands system. And since these are the only ones that most of us ever use anyway, Mr Bush would be able to relax again. Don't you agree?

Incidentally, did you notice from Table 1 that many of the values in the E96 series are *almost*, but not quite the same as those in the E12 and E24 series? This might make my suggestion a little hard to implement, I admit – although in many cases the difference is much less than 1%.

But enough of that for the moment; let's turn to the second letter, which came from Mr Steve Calder. Like Eli Montebello, Mr Calder runs a company which among other things tackles servicing of equipment built up from kits – Hycal Instruments, of Parramatta in NSW. So he too is well qualified to comment on the causes of trouble in such equipment.

Mr Calder's letter is also fairly long, so I won't be able to quote it in full. But here are some highlights:

Firstly let me say that I believe components are most likely to be found unserviceable if they've been mishandled by someone in the supply chain. For example do the suppliers use an anti-static area and wrist straps, etc., when taking components such as ICs from the anti-static plastic tubes in which they're supplied by the manufacturer, when putting them into the foam/foil packaging used at their shops?

But the most likely cause would have to be the constructor themselves – I don't believe the manufacturers are at fault. Most constructors don't know how to handle semiconductors. Most would not know what an anti-static work area is used for. Most constructors, and for that matter 'technicians' would not have access to anti-static soldering stations in which to install or replace sensitive electronic components.

I must also agree with Mr Montebello in one area – namely that poor soldering is a major area where constructors have problems. I may add, however, that the magazine and the constructor should design/build the project with the aim that it will have to be repaired sometime in its life.

Unfortunately most large projects seem to have no thought put into them about servicing the project. Once all wired up, it's a nightmare to work on because the mechanical layout or wiring layout doesn't allow the PCB to be removed without disconnecting the bulk of the wiring. There are many examples of this, and I don't feel the need of listing any of the projects concerned. I cannot recall reading an article mentioning this point.

As for the parts supply and we being 'lucky' in this country, I believe this to be totally wrong. Designing and manufacturing products is part of what Hycal does, and the USA has a much wider line of parts available to its consumers. Australia is such a small marketplace compared to the USA, being typically one 500th of the electronics market, and in many areas of product lines we're five to eight years behind the USA.

Parts suppliers in this country do an excellent job, but are unable to provide the range of parts that are offered in the USA, for obvious reasons – and yes, I have been there a few times.

One reason why some people in some areas of the USA may not be able to find an electronics shop is simple. The USA is a very decentralised place, unlike the East coast of Australia. As an example, I wonder if there is an electronics shop in Alice Springs – and if so, do they carry the same range of components as a Sydney shop?

In summing up on this matter, I would say this: buy an American electronics magazine and read the advertisements. The prices are good, the advertisements are many, the projects use components that sometimes we can't get here in Australia, and the companies will deliver the parts or kits basically anywhere – including Australia. So how do people have problems getting parts in the USA?

Thanks for those comments too, Steve. Your other comments, specifically about the new Playmaster Pro Series One amplifier, have been passed to designer Rob Evans, who will try to get back to you soon.

Steve Calder's emphasis on the importance of anti-static handling is interesting. It's certainly in line with the recommendations of the manufacturers, although I've seen comments from very experienced technicians and engineers which suggest that they flaunt the anti-static precautions with apparent impunity.

In my own case, I tend to be fairly blase about most devices – the only exceptions being MOSFETs, expensive MOS chips and CMOS logic devices. I found out the hard way that these devices are rather susceptible, and since then I've always tried to ensure that the PCB supply tracks and soldering iron are both connected to a reliable earth. I also try to discharge myself by touching a piece of earthed metalwork, before picking up any of these chips, and to also do likewise with the roll of solder before touching it to the chip pins.

That's as far as I go, though, and to my knowledge I haven't killed any chips lately.

Forum

Steve Calder's comments about parts availability in the USA do seem at variance with those of John Day. I find myself wondering if they're not *both* right, but with regard to different levels of the market.

For example I'm sure that the variety of components available to the professional designer, and to the manufacturer ordering in bulk, are extremely wide in the USA – probably far wider than here. On the other hand I suspect that the hobbyist living in places like Davenport, Iowa or Little Rock, Arkansas or Flagstaff, Arizona and wanting to buy a few parts for their latest project may well find their options far more limited than hobbyists here.

Finally, let's turn to the third letter to arrive, which came from the urbane Mr Clive Chamberlain, MD of the recently-founded kit supply specialist firm Australian Test and Measurement. And I think you'll find Clive's letter makes interesting reading:

I read with interest December's 'Forum' about the trials and tribulations of kit builders. This is a subject close to my heart, because designing and marketing electronic self-assembly kits is the sole business activity of my company.

I am a relative newcomer to kit marketing. But my background is in electronic components importing and distribution, which is about as cut-throat and precarious a way there is to make a living in our contemporary Oz business climate. I truly imagined that designing and assembling do-it-yourself kits would be a very straightforward, relatively easy way to make a quid, relative to component importing.

Well, the revelations keep rolling out! I consider myself to have perspicacity and tenacity in good measure, but I underestimated the difficulties of the task by a factor of about five times.

All our kits are unique, not based on magazine publishers' designs, so it would take some time to build up a nice repertoire of products. I allowed a budget of one year to rattle off 50 kits. Well – shock, horror, surprise, surprise – from May 1988 when I started the project to the market launch in June 1989, one engineer and myself had developed 11 kits. And as of early December we have 25 – at least the pace is quickening!

Developing a kit requires command of a number of disciplines. Obviously a broad knowledge of circuit design, tempered by commercial considerations such as price, availability and component multi-sourcing. But it ALSO requires skill at communication. We needed to develop technical writing and publishing skills, to prepare the instruction manuals so that the constructor – who was not involved in our design and development preamble – can get a grip on the theory of operation and put the thing together successfully.

It was a very prolonged learning curve to develop a thrifty style, but maintain accuracy and clarity of expression. The experience has taught me humility, and put me in awe of the electronics magazines which feature construction projects. That is one tough act to follow!

This background merely serves to hint at the myriad matters we've found that can go wrong. It is not an excuse, but an explanation that kit marketing is not as simple as it looks.

The constructor who purchases a kit expects to get what is offered: a complete set of the correct component parts, and adequate instructions for assembly, testing and application. If any of these requirements are not satisfied, the customer has been dudded in exactly the same way as if he had bought a new car and later found that the maker had forgotten to put bulbs in the tail lights. The car is almost, but not quite useable!

Any product made by man has a propensity for flaws, and just like the car industry, kit suppliers have to be prepared to receive and ACT on rockets from their customers if their quality control is not up to standard. At AT&M we work hard at quality control, and have developed special packaging and work practices to minimise errors – but they can still happen.

The customer MUST complain if something is wrong with the kit; indeed he is doing the kit supplier a favour by whingeing. No one likes to complain(?), but this is the essential negative feedback that closes the servo loop between supplier, product and customer, and hence reduces error.

So my message to the kit builders of Australia is: 'If you have been dudded, get mad and whinge – it's good for business!'

Thanks, Clive. I don't think you should feel bad about only having developed 25-odd kits in 18 months – I suspect that's something of a record, in fact. And having seen quite a few of your designs, kits and instruction manuals at first hand, they all seem to reflect a great deal of careful planning, design and execution.

Clive has written some nice things about magazine projects, but he's achieved a pretty impressive act himself, in the last 20-odd months; just who's following whom nowadays isn't easy to say...

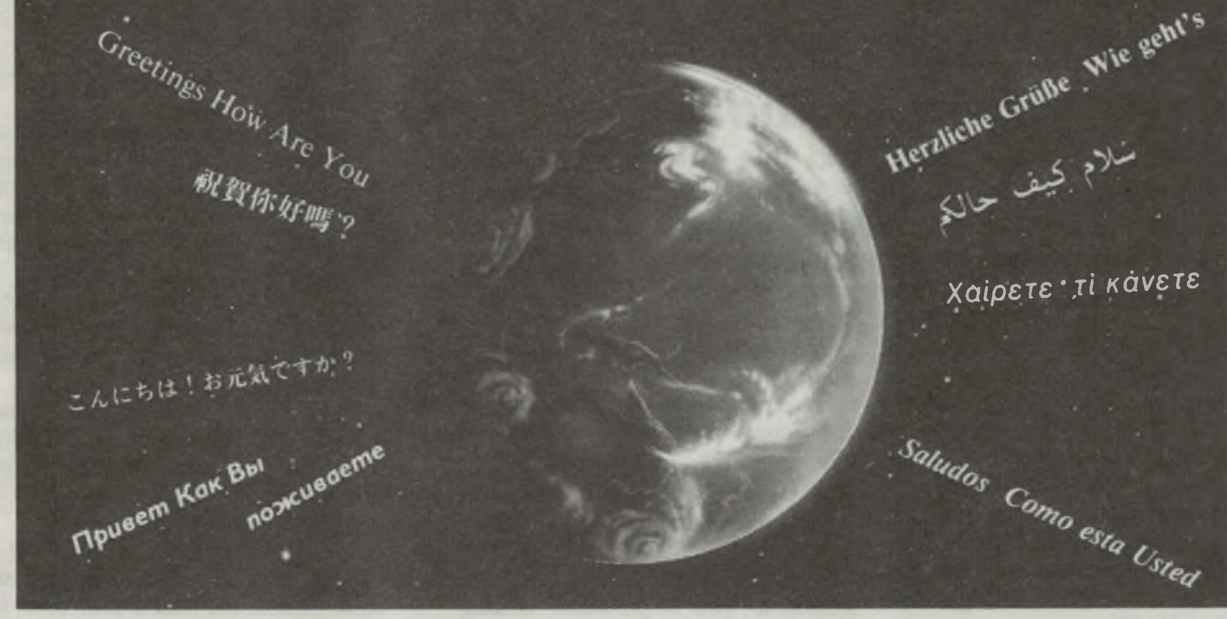
I guess I can't argue with anything Clive has written about the need to complain about kit problems, either. It's all quite logical – especially the bit about feedback being important to 'close the loop'. I only hope he doesn't live to regret having been so up-front and honest about it all.

I have this image of sometime in the future when some unfortunate little bug creeps into an AT&M kit, and the good Clive being literally buried in a mountain of angry letters, telegrams, faxes and whatever – all taking great pleasure in reminding him that *he* advised all unhappy kit builders to get mad and whinge!

Poor bloke, I hope for his sake it doesn't happen – he really has put a huge amount of effort into doing everything properly.

And that's it for another month. I hope you'll join us again next time, same place.

LISTEN TO THE WORLD



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The Serviceman

Three weird faults that were really hard to find!

It's contributors month again, and this time we have three stories about really weird faults. The first two amount to manufacturing defects that should never have happened, while the third relates to unusual symptoms arising from a fairly common cause.

The first story comes from L.K., of Daintree in North Queensland, whose stories have appeared in these pages before.

There's something of a moral in this tale, for those of us lucky enough to have 240V power laid on. I nearly said 'on tap' but with gas and water also laid on, most of us do have everything we need 'on tap'. Not so L.K.'s neighbours up North, as he says:

There are still many households in this part of Australia who do not yet have the luxury of reticulated power, especially those who reside 'over the river'. This refers to people living north of the Daintree River and whose only access is by barge. Many use portable generators, while others have anything from a single battery which alternates with the car, to a full solar system with inverters supplying their 240V needs.

On this occasion the customer explained that he had purchased a 360-watt inverter kit from a popular trading house and had successfully assembled it himself. He went on to point out that the inverter was not to augment his household needs, but rather to use in the field, running it from the tractor battery.

The unit had apparently proved very satisfactory until recently, when it just failed to function and he felt unqualified to effect a repair. These sort of jobs are usually urgent, as it means the family is without power. But in this case he said there was no hurry and would call again when next in the city – "in a week or two!"

He was a meticulous man and as is typical of him he had included the circuit diagram, neatly attached in a plastic bag for protection. (How nice it would be if every job came into the workshop in this manner. Quite apart from the help afforded to the repair staff, it's a bonus to the customer in the form of reduced service charges.)

The 'rainy day' for which I had put it aside finally arrived and I set about the task. Examination revealed it to be an EA design, published some seven years ago. (June 1982 – Ed.)

The assembly had been carried out in a most workmanlike manner, worthy of any professional, even to the extent that he had painted the finished board with shellac to give a protective coating – high humidity being a major cause of trouble in the tropics.

Some inverters are most intolerant of high power source impedance and it is always wise to connect them to a well conditioned battery, capable of supplying continuously the maximum current likely to be required. But other than setting overload protection, however, most repairs can be adequately done under no load conditions.

The inverters I have encountered draw between two and four amps at idle, yet I have had occasions where the normal bench power supply was inadequate, even under this condition, causing the inverter to become quite erratic in performance.

But back to the job in hand!

For those unfamiliar with the operation of this inverter, it employs a 1MHz crystal oscillator driving four series connected decade dividers. The resultant 100Hz signal is processed to produce two anti-phase signals, which drive an output chain – the output of which is transformed into a 230V 50Hz output. A feedback network adjusts the pulse width in accordance with load variations.

Having set it up and switched on, a run over with the multimeter suggested that all was well and that it ought to be capable of normal operation. But it was very inactive.

My CRO confirmed the absence of drive pulses, so I turned my attention to the 1MHz oscillator. This seemed OK as did the first and second dividers. However, there was no signal out of the third decade IC.

From experience, I expected to see a short to ground at this point but, because it was directly connected to the input of the fourth divider, it was necessary to unsolder the link to determine which IC was at fault.

With the link free, I was quite surprised to find that no short existed, at either the output of the third divider or at the input to the fourth.

While I was pondering this setback to my ego, I idly measured the isolated link to ground. Jackpot – a mere 58 ohms! But I couldn't imagine how this could be. The link didn't go anywhere!

Then I realised that the adjacent track was an earth link. I positioned a strong light behind the board and thus found the trouble. Clearly displayed was a fine line, not 2mm long between the two tracks and enclosed WITHIN the board material itself.

Fortunately, this foreign body was situated very close to the outer edge of the board, with no other intervening tracks, so I decided to carry the investigation a stage further.

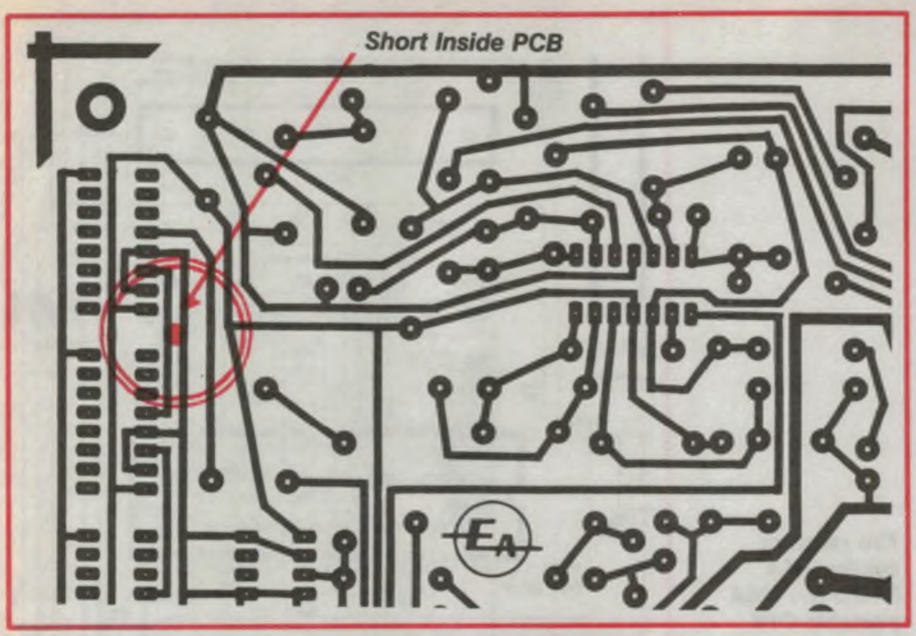
With a fine saw I removed a small rectangular section of the PCB containing the unwanted link, then with the aid of a sharp blade and a magnifying glass, began to pare away until I had freed the object. It appeared to be scaly slivers of some black substance.

Using a small magnet I established that it was some kind of ferrous material, but unfortunately it crumbled to dust at this stage bringing to an end any further investigation, from my point of view.

After bridging the two cut tracks, I filled the gap with Araldite. This time, when I switched on, the inverter came to life and seemed none the worse for its 'operation'.

Later, I pondered the chances of such a small impurity finding its way into a piece of PCB material in precisely the place where two vital tracks will be positioned. Multiply that chance by the possiblity of it being sufficiently close to the surface as to lie dormant for a long period of time, before finally emerging as a near short circuit.

The chances are so remote as to be beyond comprehension. Yet there it was – Murphy strikes again!



The mysterious failure of a 300W inverter built from an EA kit turned out to have a very unusual – and elusive – cause.

Thanks, L.K. Your story was most interesting and suggests a possible reason for many inexplicable faults that we have come across in the past. It's something to keep well in mind for the future. And isn't that what 'The Serviceman' is all about?

Weirdo No.2

The second story comes from L.F. of Woodville, S.A. L.F. is a newcomer to these pages and his story is a warning that things are not always as they seem. He writes:

I'd like to tell the following story, as it was one that happened to me and really gave me a lot of satisfaction when I found the answer.

The unit was a double cassette/radio, which had been returned to us by a large department store for repair under warranty. The fault/repair tag listed the problem as 'Unit will only record at low level'.

As it turned out, one of our other technicians was the first to get the job and he proceeded to eliminate all the common causes of low recording level. In any other equipment these could be (a) worn or dirty R/P head, (b) R/P head leads around the wrong way (with DC bias units) or (c) tape not making proper contact with head.

Unfortunately, none of these applied in this case because the machine was in mint condition and the recorder used AC bias anyway.

When we played back a pre-recorded tape on either deck, the signals were loud and clear. But any attempt to record on a blank tape would result in normal sound for a fraction of a second, then a sudden drop to almost inaudible.

The fault gave all the symptoms of an ALC (automatic level control) problem – as though something was operating the ALC and pulling the gain down as soon as recording began.

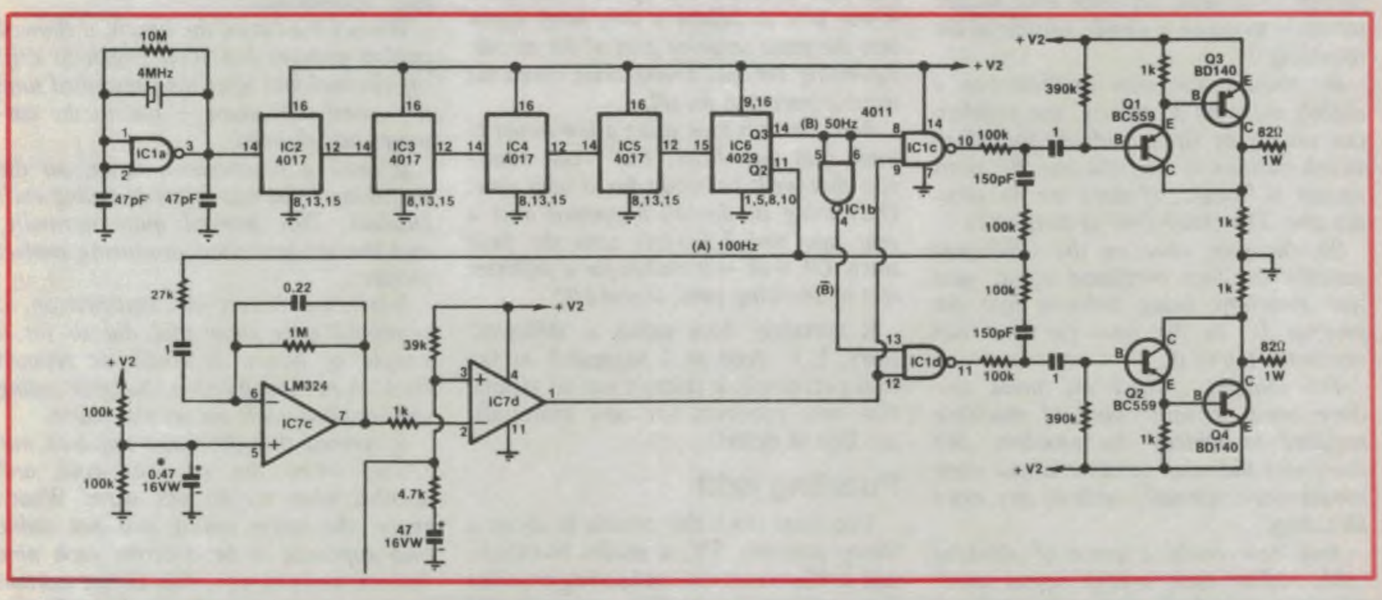
The head amp IC for the recording deck also doubled as a mike preamp and ALC network when in the recording mode. So my fellow technician went for the obvious and replaced the IC. However, the fault persisted.

He wondered if it could be a leaky capacitor, causing the ALC level to build up in some way. But checking all the caps and changing the most obvious ones did nothing to fix the trouble.

It was at about this point that I became involved. Our service manager encourages us to pass on jobs when we seem to have come up against a brick wall. (I know, I've gladly handed on a few myself!) So now I was on the receiving end and quite frankly, I didn't have a clue about where to start.

All the things that I would have gone for had already been tried. It was beginning to look like a factory wiring error of some kind, so the only thing to do was probe deeper into the works.

If the ALC was really the problem, then the ALC capacitor should be charging up as soon as recording started. A quick check with the multimeter showed



Part of the schematic for the June 1982 inverter, for reference. Checking with the scope showed no 1kHz signal present at the output of divider IC4 – hence the lack of activity in the later stages.

that this was indeed happening. So now I had the answer, but not the cause.

I considered a leaky R/P switch, allowing DC to upset the ALC/preamp chip. Or perhaps a supersonic oscillation, that was saturating the preamp and driving the ALC hard on.

I opted for the second choice and probed around the ALC chip with the CRO.

Sure enough, there was a beautiful, high amplitude sine wave blasting its way through the IC, thus causing the chip to think it had a large audio signal and hence operating the ALC system.

So we had another answer to our problem, but still no basic CAUSE! What was causing the IC to take off?

I noticed that when anything was put near the IC, the level seemed to change quite dramatically, and accordingly I became suspicious of lead dress. Then, when I checked the component side of the PCB I spotted a shielded lead which ran right across the chip.

Moving the lead changed the level of the sine wave quite markedly, and provided the best clue we had yet found.

Tracing the lead to its extremities revealed that it came from the bias oscillator, on one side of the board, and ran right across its full width to the 'beat cut' switch on the other side.

(The Beat Cut switch on small radio/cassettes is provided to allow the bias oscillator to be shifted in frequency by a few tens of kilohertz, whenever an audible whistle appears on a tape recorded off air. What happens is that the bias beats with a submultiple of an incoming carrier – or with the pilot tone in FM stereo – to cause a steady whistle in the recording.

By shifting the bias oscillator to a slightly different frequency, the problem can usually be eliminated. As for which switch position is the right one, the short answer is 'Either', if there are no whistles and 'The Other One' if there are!)

So, the sine wave on the CRO was actually the bias oscillator signal, and was somehow being induced into the preamp IC as the beat cut lead ran across the top of it.

The thought crossed my mind that there must be some kind of shielding required to remedy the problem. But then, why did other versions of the same model work normally without any extra shielding?

And how could a piece of shielded cable radiate such a high signal level? Checking it at both ends showed that it was well terminated, with no floating earths. Metering the lead showed that it had no breaks. And then it hit me!

What would happen if someone at the factory had transposed the inner and outer connections of the length of shielded lead? Yes, that was the anticlimactic answer to the mystery.

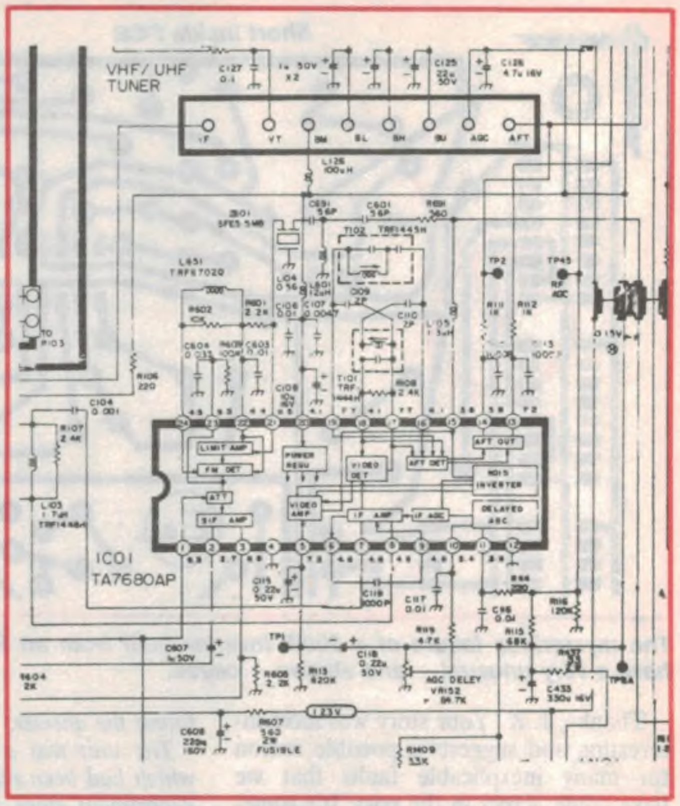
The braid had been soldered to the active section of the bias oscillator, while the inner conductor was connected to earth. Consequently it was radiating away for all it was worth and, because it ran right over the top of the preamp IC it was able to induce a very large signal into the most sensitive part of the circuit. Reversing the lead connections cured the trouble once and for all.

Between us it took quite a few hours to track that one down, but I can assure you that we'll be ready for it next time. Only thing is, this all happened over a year ago and I haven't seen the fault since. Oh well – it makes for a different sort of servicing yarn, doesn't it?

It certainly does make a 'different' story, L.F. And as I suggested in the lead paragraph, it doesn't pay to assume that new products (or new materials) are free of defects.

Puzzling drift

The final story this month is about a Sharp portable TV, a model N-1426A, and it illustrates the misleading troubles that can occur in the IF section of a TV receiver.



The relevant section of a Sharp N-1426A portable CTV schematic, with the detector coil T101 visible in the centre just above IC01.

The story comes from contributor R.G., of West Hobart, who usually services marine electronics equipment. In this case he was called in to help by his overworked colleagues and in the end turned up a most unusual problem. This is how he tells the story:

The complaint was that the set would display normal pictures for 15 to 20 minutes, but after that it would only produce noisy snow. There was no sign of picture, although the set seemed to be fully operational.

When I tried it on the bench, it showed perfect pictures but soon began to drift off channel and after the prescribed time it showed only snow – just as the customer had claimed.

It used a press-button tuner, so the first thing I did was to try re-tuning each channel. This worked quite normally, and the set was soon producing perfect pictures.

Next time the set was switched on, it produced only snow and did so for a couple of hours. It could be retuned back to normal pictures, but this setting only applied while the set was warm.

It seemed that the tuner required one setting when the set was cold and another when the set was warm. What's more, the warm setting was not stable and appeared to be different each time the set warmed up. This is not normal tuner operation, so I set about finding out what was happening.

I tested the 30V tuner supply rail and found that it changed by only a few microvolts between the cold and warm states. I then examined the tuner in minute detail, but could find nothing wrong with it. By every test I could devise, the tuner was perfect – and remained perfect even as the set slowly drifted off channel.

I made enquiries among my colleagues to see if they had ever experienced this effect, but it seemed that I was seeing a unique fault in this set. I contemplated sending the tuner to Sydney for specialist repairs, but in the meantime I would try a substitute tuner, to prove the point one way or the other.

Without an exact replacement tuner, it took a bit of ingenuity and a lot of messing about to get a different tuner to work. The 12V and 30V rails were no trouble, but getting the AGC and AFC voltages correct were a different story. It all turned out to be a waste of time, because the substitute tuner performed exactly the same as the original one.

This was a real let-down. I couldn't imagine any mechanism by which the tuner could go off channel, without going off channel, so to speak. Something funny was going on, but I couldn't think of any condition that would explain the symptoms.

As I understand it, snow is produced in the tuner in the absence of signal. What I was seeing was definitely snow, which had to originate in the tuner. Yet the tuner was now proved faultless, and the snow had to be coming from somewhere else. But to my knowledge there wasn't anywhere else for the snow to come from! I was ready to weep from sheer frustration.

Then, by chance, I happened to touch the main circuit board in the vicinity of the IF circuitry. I saw a brief flash of picture amid all the snow, so I began to wonder if this might not be an IF problem, and not a tuner one after all.

I applied gentle pressure to the board in various places and in different directions. All this probing produced some effect, but as my probing neared the IF chip the picture came back for several seconds at a time. This proved to me that I was looking for some kind of mechanical fault, even if it didn't explain the means by which it produced snow.

Finally, my probing touched the detector coil can (T101), and here I struck the jackpot. Gentle pressure on one side of the can restored the picture to normal, for as long as I cared to press. It was as simple as that – no pressure, no picture.

I removed the coil from the board and examined it carefully. Underneath, between the pins, was some brown powdery material which I couldn't immediately identify. Then I looked at the board where the coil had been and the answer hit me, right in the eyeball. (If I'd used my eyeball earlier, I might have saved a lot of trouble.)

An electrolytic capacitor close by the coil had leaked and the brown powder was the dried-up electrolyte. By great good fortune, it hadn't corroded any part of the coil, but its effect was obviously to change the characteristics of the coil and thus change the frequency at which the IF detector was operating.

I dismantled the coil and can assembly and carefully washed and dried the parts. Then I replaced the leaky electro and thoroughly cleaned the circuit board. When everything was reassembled, the set stayed on channel for hours at a time. There was no further sign of the drifting that had started the exercise.

Once the cause of the trouble was known, a possible scenario for the symptoms became clear.

Most IF troubles lead to a blank white screen. Snow usually shows that the IF strip is OK and working at maximum gain. In this case the IF was OK, and it was working at maximum gain, but at the wrong frequency! And because the tuner AFC voltage is generated at the IF detector, the tuner was being pulled off channel by the wrong information fed back from the faulty detector.

The gunk from electrolytic capacitors is very hygroscopic – that is, it takes up moisture very easily and just as easily gives up its moisture to the atmosphere. In this case, the difference in performance between warm and cold was probably caused by the electrolyte drying out as the set warmed up, then reabsorbing moisture as it cooled down. I hope I never strike one like this again!

And so say all of us! Thanks R.G., that story just about takes the trophy for this year. I think most of us would have wept tears of frustration if faced with that one. Fortunately, we'll know now what to look for, after reading of your experience.

That just about fills the available space this month. Some readers have suggested to me that we should double the size of 'The Serviceman', but I can't see the Editor agreeing to that one. All we can do is to make sure that you get full value from the space that *is* available. Do we succeed?

I'll be back next month with some stories from my own bench. 'Bye for now.

Construction/educational project:

Simple electronics project for scouts

What do you do when faced with 24 eager scouts keen to take up your offer of an 'Electronics Night'? Answer – plan it very carefully. This article not only describes a simple but effective little learning project, but includes all the necessary support material to allow it to form the basis of an educational event.

by PETER PHILLIPS

This is a rather unusual article – hence the dual category label above the heading. It is both a project, and a description of how to use the project as the basis of an event introducing electronics to a group of young people with an average age of 12.

I developed it for use with a group of 24 scouts from the 1st Marton Scout group at Engadine, NSW, and its general appeal makes it suitable for any situation which requires a simple electronics project as the core element of a three-hour 'introduction to electronics' type session.

The project uses the venerable 555 timer, and includes two potentiometers, two flashing LEDs and a buzzer. The potentiometers not only allow individual adjustment of the ON time of each LED, but provide a range of sounds that amaze the kids and send the parents up the wall.

I was able to source a complete kit for the project, including the battery, battery clip, buzzer and all components from Oatley Electronics for $3.00. No doubt other suppliers would negotiate a good price for such a kit, and all that needs to be added to the kit is a PCB. It may be that some suppliers would even include the PCB for a few extra dollars if the demand was great enough.

But having a project that is interesting to the participants is one thing – getting the message across so they can build it is another. So, as well as presenting the project, I'm going to include the support material that goes with it, as the work developing this (believe me) far exceeded the actual project. In other words, here is a complete package for those who might like to take on a group of youngsters keen to experience electronics.

The venue

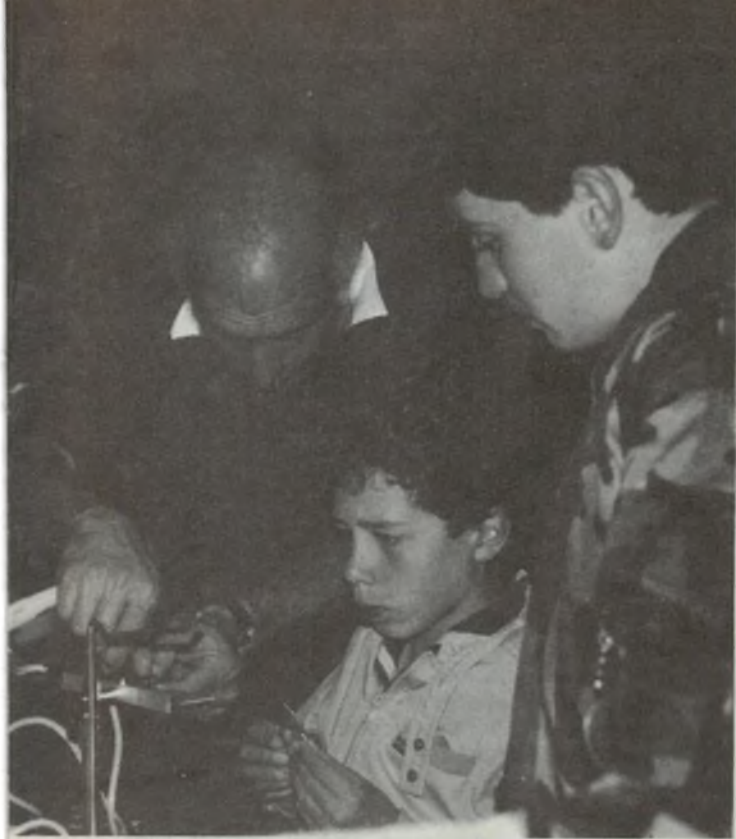
The first question that has to be faced is how to provide the necessary facilities for a large number of beginners to construct a project. It is pointless having one or two soldering irons and a queue of two dozen anxious kids. After all, the aim of the event is to give them actual experience at soldering, as well as identifying components and getting a project up and running.

Because of my ties with NSW TAFE, (whoops – TAFECOM!), I was able to arrange with the local technical college at Gymea to hold the evening at this college and to use their equipment. And there, perhaps, is the answer for others.

Most technical colleges have an Electrical Trades section that would usually be equipped with facilities to support the hands on experience this project calls for. As well, the college Principal is likely to be most supportive of a community based activity, providing the facilities can be made available at the chosen time.

My suggestion is simply to approach the teacher responsible for the Electrical or the Electronics section (if this exists as well). A phone call will get the ball rolling, and negotiations can proceed under the guidance of this person,

Our author Peter Phillips, shown explaining the mysteries of his electronics learning project to Ist Marton Scout Troup, Engadine.



Above: Some of the dads helped out, during the Scouts' electronics evening...

who will advise you of the requirements, such as any written requests to the Principal and so on. Naturally, he may also be unable to help, due to a lack of suitable accommodation and equipment. But try anyway – you may be surprised at the degree of co-operation you will receive.

Alternatively, you may be able to arrange for a loan of a number of soldering irons and the tools required. All that's really needed is a PCB holder (a bulldog clip on a stand is often sufficient), soldering irons and side cutters. The venue can be any room with sufficient power points and work space, although it should also provide seating to enable the theory component to be presented. Don't fall into the trap of placing the kids in front of the equipment and expecting them to listen to you while you describe how to go about building the project. The temptation to rip into the construction will prove too great, and you will lose your audience!

Presentation

When planning the session, I was able to draw on my teaching experience, although I am more acquainted with adult teaching than with school aged students. Fortunately the principles are the same, it's simply the level that varies.

First and foremost is the timing. Any lesson needs to be timed – not only to avoid running overtime, but to ensure the concentration span is not exceeded. In this case, the theory component took around 45 minutes and included a lot of

BUILDING THE DUAL FLASHER

1. What does the letter 'k' mean? ______
2. What does the letter 'M' mean? ______
3. What does the letter 'u' mean? ______
4. Draw the symbol for a resistor: ______

   Draw the picture of a resistor: ______
5. From the circuit, write down the values of the resistors:

   R1 = ______, R2 = ______, R3 = ______, R4 = ______

   Write the colours for R1 and R2: ______

   Write the colours for R3 and R4: ______
6. Draw the symbols and pictures of:

   An electrolytic capacitor — symbol | picture

   A LED: — symbol | picture
7. What does 'LED' stand for? ______
8. What do you look for when putting the capacitor, the LED and the IC in the printed circuit board?

   The LED: look for the ______

   The capacitor: look for the ______

   The IC: look for the ______
9. What sort of IC is it? ______

Fig.1: The work sheet used to present this project to a group of scouts. By following this sheet, and having the participants fill in the blanks, the important points to watch during construction of the project can be described.

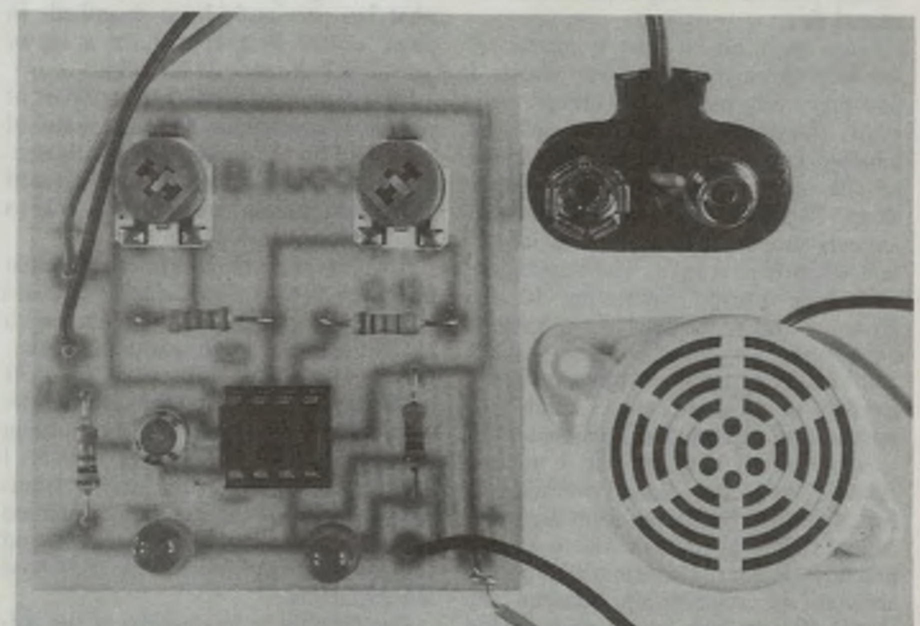


Fig.2: The prototype, showing the final product. The buzzer used is a mechanical type that will give a range of peculiar sounds. A simple project that should have great appeal to younger readers.

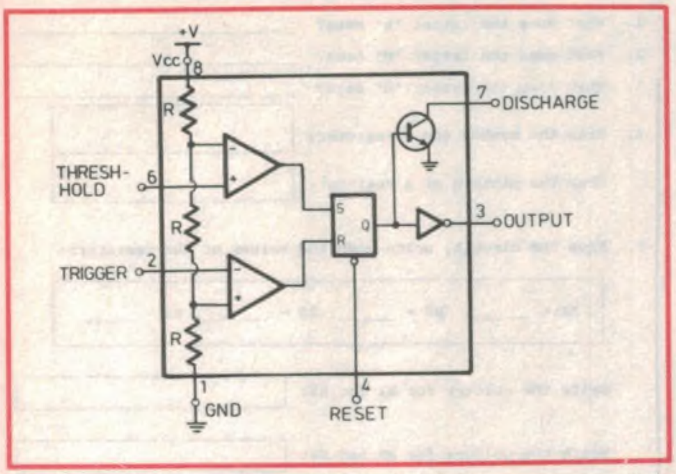


Fig.3: The internal block diagram of a 555 timer IC. The main blocks are two comparators, a flipflop and a transistor. The actual output terminal of the IC is supplied by an inverter driven from the output of the flipflop, meaning the transistor is on when the output (at pin 3) is low.

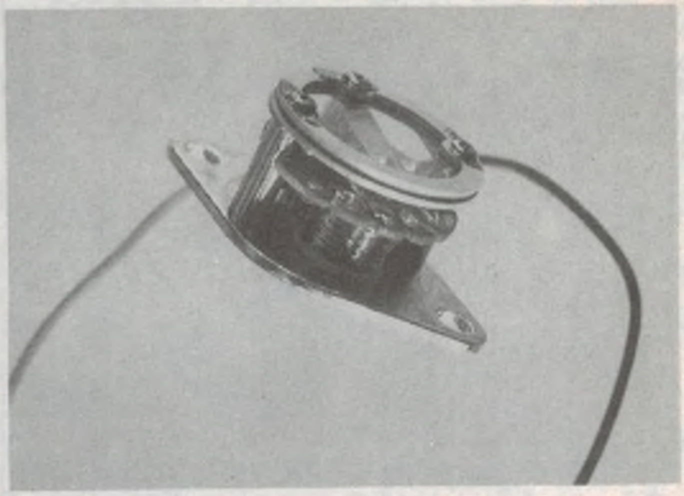


Fig.4: This photo shows the internals of the buzzer used in the prototype. A transistor oscillator is used to drive the coil, which attracts an armature connected to a diaphragm. When operated from a 9V supply, the buzzer will take around 50mA, so don't leave it connected for too long. Also watch the polarity of the supply to the buzzer.

student participation.

I provided each participant with a circuit diagram, a layout diagram, a work sheet requiring answers to be inserted and a pencil. The work sheet is shown in Fig.1, and is probably self explanatory. I commenced by showing the group an example of the project, and was delighted at the enthusiasm of the response. Next, after they had received each of the three pages, I asked them if any of the pages made sense to them. Of course none did, and they were obviously relieved that my expectations assumed this.

From then on, it was a matter of working through the answer sheet. I had previously prepared overhead projector transparencies of each of the handout pages, including one containing all the answers required on the work sheet. This way, everyone got the right answers sooner or later – most important when time is tight. The resistor colour code proved interesting to the group, as this was electronics coming to life. Young people seem to enjoy codes, and identifying a value from a code, regardless of what the value stands for, appeared to capture their imagination.

At no point, however, did I try and describe how the circuit worked. In fact, I steered well away from any electronics theory as my aim was to keep it practical. Rather, I concentrated on examining the relationship between the circuit diagram, the layout diagram and the bag of bits.

It is easy to forget that beginners have never heard of the term 'resistor' and have no idea of what one even looks like. To try and explain what it does is work for another time, and then only for a more dedicated group.

After about 45 minutes, it was becoming obvious that we had had enough talk – it was time for action. And that's where the fun really begins.

Building it up

The presumption that everyone has understood things so far will now prove false, and it is safe to assume that some will have grasped only about 20% of what has previously been described. In other words, be prepared for a lot of questions and requests for help.

I was fortunate to have the support of a number of parents, although many of these had no prior experience with electronics – but they had at least listened to the description and were thus able to provide considerable help.

It is now that you realise the potential for injury. For example, one 13 year old immediately put the solder in his mouth as he grappled with everything else. Others started to work with the PCB held over their uncovered legs. And the possibility of the soldering iron burning through its 240V lead is ever present. I had previously set up the work stations so that the soldering iron holder pointed the iron well away from the lead, and this, plus parental monitoring prevented any problems.

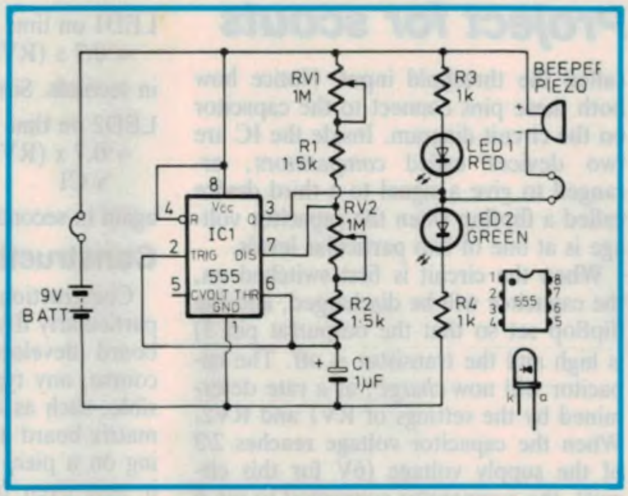
The first thing to describe is the soldering process. My previous remarks of losing the audience when they are faced with the equipment will prove correct at this point, and all you can bank on is that the adults will listen. I described the process briefly and then went around demonstrating soldering to each person individually. Even then, the resulting soldering efforts will range from minuscule blobs dropped onto the connection to piles of solder reminiscent of trowelling cement.

OK, once upon a time I couldn't solder either, so patience is the key!

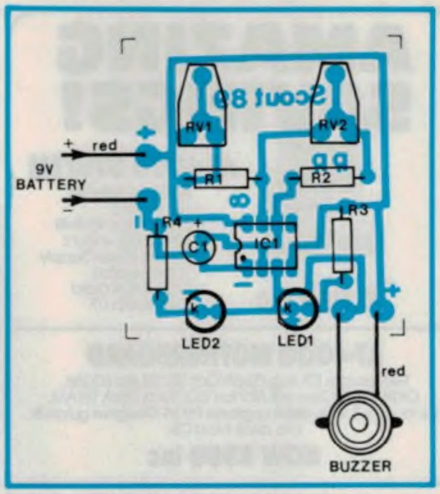
While I still had some control over the group, I instructed them to first mount and solder the potentiometers. Some confusion occurred with the unused hole, as the PCB design allows various types of trimpots to be fitted. Next I advised that the resistors be fitted.

The circuit contains four resistors, with two different values, and the layout is arranged to have the same value resistors mounted in a similar fashion. Those who are colour blind (and probably don't know it) will need help, although those not so afflicted will still get the resistors confused. The answer is to be in 10 different places at once, to try and supervise everyone as far as possible!

Of course, some will follow the layout diagram, which is purposely drawn as it might be for any project. The completed work sheet has most of the answers, particularly about the resistors, and the more competent will be able to complete the task without much help. As well, peer teaching will occur, as information transfer between young people can occur at a rate we adults seem



The circuit diagram. The circuit uses a 555 timer connected as an astable multivibrator (oscillator), and drives two LEDs and a buzzer. Only one LED is on a time, and the adjustments give a wide range of LED displays and sounds from the buzzer.



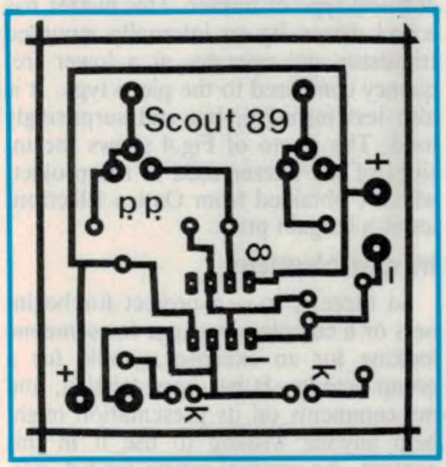
The layout diagram. Leave one wire from the buzzer so that it can be connected to the PCB only when a sound is required. The PCB allows various types of trimpots to be used, including a very rugged unit available from Oatley Electronics. Also watch the polarisation of the LEDs, the IC and the capacitor.

to forget. In fact, I found that very few got the component mounting wrong, and that most of the problems were caused by poor soldering, particularly shorts between adjacent pads.

Eventually some will get the project going, and the room will be filled with the squawking of buzzers. Others will not be so lucky, and with time running out, decisions need to be made on whether to try and faultfind them immediately. I eventually offered to take any project not working and to fix it at home. An easy trap to fall into is to spend too much time with one person, and to neglect others who may only need a few minutes attention.

The final result

To be honest, I ran out of time, as I had only allowed one and a half hours. In my planning, I assumed the actual construction would not take any more than half an hour, given the simplicity of the circuit. I hadn't allowed for problems such as the need to remove ICs mounted the wrong way round or to completely resolder some of the boards.



The PCB pattern for the learning project, reproduced here actual size for those who wish to trace it.

The whole event really requires at least two hours, perhaps even two and half hours. Even so, 16 projects were completed, much to their builders' delight. The remaining eight projects are now on my workbench, most of which will only take a few minutes to fix.

But one thing I am certain of – the night was a huge success. The project was very popular, and seemed to have all the ingredients young people want in an electronic device – lights, sound and adjustments. It required a lot of preparatory work, including having the workroom set up ready to go, and all handouts, pencils and kits organised for immediate distribution. However, the fact that the project was a winner and that most of them were successfully constructed is sufficient reward in itself and makes the work required seem incidental. Try it with a group – you will enjoy yourself.

The project

The actual project is shown photographed in Fig.2. The circuit diagram, the layout diagram and the PCB pattern are also included, ready for anyone to use either as already described, or perhaps to build anyway.

The project – I called it the 'Dual Flasher' – can create a range of sounds from a grasshopper to a Morse code type sound. Great for an alarm, or just for fun. The two flashing LEDs, which can be adjusted to give all sorts of displays, make the project useful wherever flashing lights are called for.

The more adventurous might wear it to a party or a disco. It could be attached to a bike or a car as a Clayton's alarm, or anywhere just crying out for flashing lights. You can adjust the lights to give a wide range of sequences, so if you get tired of one, adjust it to another.

How it works

The circuit is based on the 555 timer IC, connected to operate as an oscillator. This means the output, at pin 3, changes state at a rate determined by the setting of the variable resistors RV1 and RV2. The output produces two output voltages only – ground or 9V. When the output is at ground, LED1 (the red one) turns on. The current that can flow through it is limited by R3, to a value of around 7mA. When the output is at 9V, LED2 will turn on, while LED1 will turn off as it will now have 9V at both its terminals. The buzzer is connected across LED1, and will sound only when this LED is on.

The rate at which the LEDs flash and the ON time of each is set by the variable resistors RV1 and RV2. The fixed value resistors R3 and R4 are for protection of the IC, and limit the current flowing through the IC when the pots are set to zero. The oscillator works like this:

Inside the 555 timer, as shown in Fig.3, connected between the discharge pin (pin 7) and ground (pin 1) is a transistor. If this transistor is on, it will discharge capacitor C1, via RV2 and R2. If the transistor is off, the capacitor will charge from the 9V supply through RV1, R1, RV2 and R2. So the rest of circuitry inside the 555 needs to control the transistor.

There are two pins used to sense the voltage across the capacitor – pin 2, called the trigger input, and pin 6,

Project for scouts

called the threshold input. Notice how both these pins connect to the capacitor on the circuit diagram. Inside the IC are two devices called *comparators*, arranged to give a signal to a third device called a flipflop when the capacitor voltage is at one of two particular levels.

When the circuit is first switched on, the capacitor will be discharged, and the flipflop set so that the output(at pin 3) is high and the transistor is off. The capacitor will now *charge*, at a rate determined by the settings of RV1 and RV2. When the capacitor voltage reaches 2/3 of the supply voltage (6V for this circuit), the comparator connected to pin 6 will send a signal to the flipflop. This will turn on the transistor, send the output low and turn on LED1.

The capacitor will now *discharge* at a rate determined by the setting of RV2. When the capacitor voltage falls to 1/3 of the supply voltage (3V), the comparator connected to pin 2 will send another signal to the flipflop. This will set the output high, lighting LED2 and turning off the transistor. And so the cycle will continue, for as long as power is supplied to the circuit.

The time LED2 is on is determined by the settings of both RV1 and RV2, while LED1 is controlled only by RV2. To get both LEDs to flash equally, RV1 needs to be set to its minimum value, allowing RV2 to give equal charge and discharge times. The actual 'on' times for the LEDs can be calculated using the following equations:

PARTS LIST

1 PCB 50mm x 50mm
1 9V battery
1 Matching snap lead
1 6V or 9V mechanical or piezo buzzer

Resistors

All 1/4W, 5%: 2 x 1k, 2 x 1.5k

Trimpots

2 1M vertical or horizontal mount

Capacitors

1 1uF electrolytic

Semiconductors

1 5mm Red LED
1 5mm Green LED
1 555 timer IC

LED1 on time
= 0.7 x (RV2 + R2) x C1
in seconds. Similarly,

LED2 on time
= 0.7 x (RV1 + RV2 + R1 + R2) x C1
again in seconds.

Construction

Construction is very straightforward, particularly if you use the printed circuit board developed for the project. Of course, any type of construction is possible, such as on a piece of Veroboard, matrix board or even point to point wiring on a piece of cardboard. With care it may even be possible to get everything into a matchbox or a Tic Tac box!

It is important to check that the LEDs, the IC and the capacitor are mounted the right way around on the PCB. Look for the polarising indicators on these components – that is, the flat side on the LED, the notch on the IC and the negative sign on the capacitor. Also, make sure that the resistor values are correct; 1.5k (brown, green, red) for R1 and R2 and 1k (brown, black, red) for R3 and R4.

The variable resistors are both 1M trimpots, and the design of the PCB will take various physical types. I used a type available from Oatley Electronics that mounted horizontally, selected because it had a knob to turn the wiper. However, the more readily available vertical mount types can also be used.

The 9V battery should be connected using a battery 'snap' lead, as this then functions as the on-off switch. Also, don't solder the buzzer permanently to the PCB unless you want the sound function at all times.

The buzzer can be a piezo device, but the best one for good sounds is the mechanical type of buzzer. This buzzer has a coil driven by an internally mounted transistor and operates at a lower frequency compared to the piezo type. It is also less intrusive, but still surprisingly loud. The photo of Fig.4 shows the insides of the buzzer used in the project, which I obtained from Oatley Electronics at a bargain price.

In conclusion

So there it is – a project for beginners or a complete package for someone looking for an exercise suitable for a group activity. It has been trialled, and my comments on its presentation might help anyone wishing to use it in this context. An unusual article for *EA* perhaps, but one that I hope will prove useful and entertaining.

Construction Project:

Low cost, portable battery fluoro lamp

In response to reader requests, we present here an incredibly simple, high efficiency portable fluorescent lamp project. The circuit uses disposals type components and may just be the answer for that next camping trip. The project was developed by an *EA* reader, and we have added an extra section that describes an alternative transformer. All up, this has to be the simplest inverter circuit you'll ever see – and it really works!

by NORM BUSH

As mentioned in the introduction, this project is from a reader in response to other readers requesting information about the repair of portable fluorescent lights. The contributor claims limited expertise in electronics, but judging from the circuit and the final result it seems he is being rather modest. The light output is bright, the current consumption consistent with an efficiency of 70%, and best of all, the circuit is ridiculously simple. The prototype was supplied in two versions: a complete unit in a case made by the contributor and the electronics only.

Although supplied, we have not included details of the construction of the case, as most readers would not have access to the metal cutting and bending machinery required. However, for our usual charge of $5, we will supply photocopies of the case drawings and instructions provided by the developer of this simple but effective unit.

During testing of the unit we found that a toroidal transformer would work as a replacement to the pot core type transformer used in the prototype. In fact, we found that the efficiency was slightly higher, and that a simple addition to the circuit would allow a brightness control to be added. These modifications are described at the end of the article, but we stress that the original circuit is the brainchild of the contributor and our additional material simply builds on this circuit. (P.P.)

Having recently read in *EA* (November 1989) that some readers are experiencing difficulties in repairing portable fluorescent lights, I decided to offer this project for publication. I have been experimenting with various forms of 12V DC fluorescent lights for many years and have developed a number of designs culminating in this project.

There are a range of commercial designs available, usually powered by a pack of D cells, but the running costs can be quite high with this type of cell. In recent times, gel pack batteries have become more popular and I use a 12V, 4.5Ah or 6.5Ah gel battery in the fluorescent light unit I take when camping.

To allow recharging of the internal gel cell, I also fitted a socket and a three-position switch that selects 'lamp on', 'off' or 'charge'. This allows the light to be powered by an external 12V source, such as a car battery.

The unit can be operated by voltages from 6V to 14V, and alkaline or NiCad batteries can be used. However, the current consumption of 500mA will only give around 8 hours of use. Certainly, rechargeable batteries are a more economical proposition!

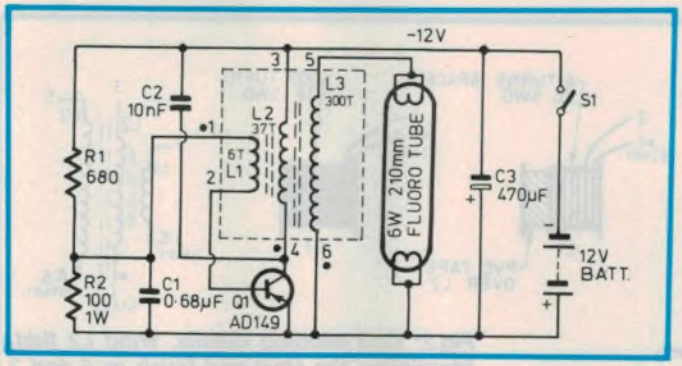
I have fully tested the unit on a number of camping trips and it has proven its reliability in all kinds of conditions.

The project

The main feature of this project is its simplicity. The PCB is simple enough to make with a Dalo pen, and most of the work is associated with the hardware, such as the case and reflector. In principle, the inverter circuit consists of a transistor oscillator that drives a pot core transformer which effectively steps the voltage from 12V DC to a much higher AC voltage. Although a conventional transformer might work, they tend to be noisier and heavier than a pot core.

When the lamp is first switched on, the initial high voltage (around 250V peak to peak) causes the tube to fire.

We will supply photocopies of the constructional details for the case if required. See Reader Services (last page) for details.



The heart of the circuit is the oscillator in which C1 and R1 establish the frequency of operation. Step up is provided by L2:L3.

Once the tube is on, the output settles down to about 125V peak to peak, which is sufficient to keep the tube alight. In fact, at first switch-on, the tube will glow dimly and you may hear the pot core oscillating. Once the tube lights, the oscillations will change pitch as everything settles down. You may also find that a new tube takes several seconds to stabilise, although this will vary between brands of tubes.

The pot core transformer is often available as a disposals item. The prototype uses one from Sheridan Electronics, although a bobbin will need to be purchased from Dick Smith Electronics or Jaycar. Alternatively, an FX2242 pot core transformer can be purchased, (most parts suppliers sell these) although they are more expensive. (*See also comments at the end of this article concerning the use of a toroid*).

As shown in the accompanying diagrams and photos, the PCB holds all the components except the transistor, which is mounted on an aluminium heatsink. The PCB is also supported by the heatsink, and the reflector for the lamp can then be attached to the heatsink.

The secret to the operation of the circuit is the type of transistor: a germanium PNP power device, type AD149 or equivalent. A silicon transistor does not work properly, and I gave up trying with these. (*P.P.: We suspect this is due to the current gain varying with collector current, a characteristic of a silicon transistor. A germanium transistor will retain its current gain (Ic/Ib) with increasing collector currents*).

Because the collector (case) of the transistor is connected via the transformer to the supply rail, either the transistor or the heatsink needs to be isolated from the common rail. I found it simpler to insulate the heatsink from the metalwork of the case, but the transistor can be insulated from the heatsink using either a mylar or mica insulating washer if required.

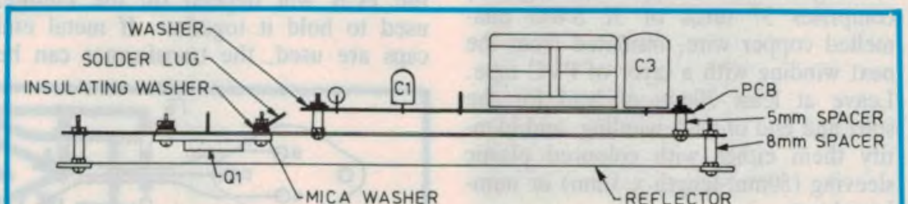
Circuit details

The circuit is essentially a blocking oscillator, whose frequency is controlled by R1 and C1. R2 and R1 provide initial forward bias, and the increasing current flowing in L2 supplies more forward bias to the base of Q1 via inductive feedback to L1. Once saturation is reached, the inductive feedback reverses, turning off Q1 and charging C1 in the reverse (positive) direction. The transistor won't resume conduction until this capacitor has discharged, after which the cycle recommences. Note that because a PNP transistor is used, the common rail is positive.

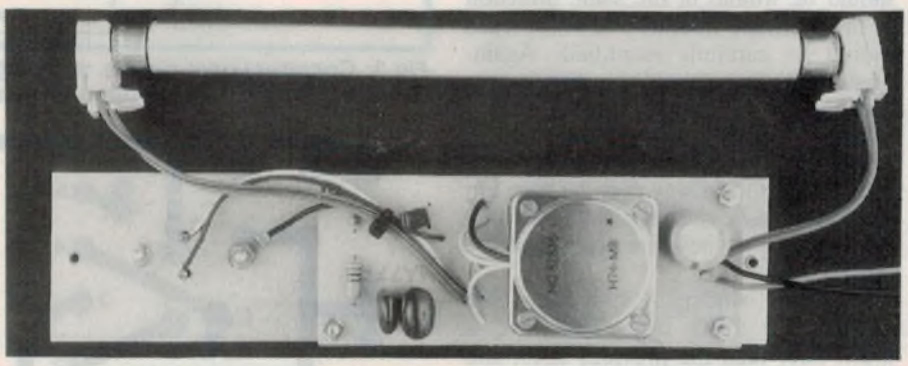
The brightness of the light is controlled by the frequency of the oscillator. Increasing the frequency will increase light output – and, of course, current consumption. Varying either C1 or R1 will allow a setting that gives the required compromise of light output versus current consumption. For the values shown, the frequency is approximately 10kHz, requiring a circuit current of around 550mA (for a 12V supply), with a fairly bright light output. The transistor will get quite warm, and it should be mounted on the heatsink when testing the circuit.

During development, it was found that in one instance a current of 1 amp flowed, possibly due to the characteristics of the transformer. The solution was to add a 1 ohm, 1W resistor in series with the emitter of the transistor. This had no effect on the brightness, and could even be worth adding anyway.

The light will operate at voltages as low as two or three volts, and almost normal light output occurs at seven volts. Because the current consumption is now only around 250mA, the circuit could be powered from a pack of six NiCads.



The layout diagram. The transistor is mounted on a heatsink, connected by three wires to the PCB. The prototype used two capacitors for C1: a 0.22uF and 0.47uF rather than a single 0.68uF.



This photo shows the printed circuit board and all components. The board is attached to the aluminium heatsink spaced with 5mm spacers. In the prototype, the transistor was not insulated from the heatsink, rather the heatsink itself was insulated from the case.

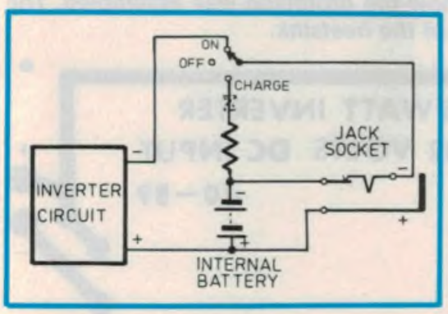


Fig.1: How to connect a telephone jack socket and three-way switch to operate from internal or external power source.

Fluoro lamp

Capacitor C3 is a filter, and stabilises the circuit against variations in supply voltage. Although an ammeter will show a constant value, the current is actually a series of spikes, and if the output impedance of the voltage source is relatively high, problems can occur due to the resulting changes in supply voltage.

As shown in Fig.1, a three way switch and a socket can be added to allow the unit to be powered from an external source, such as the cigarette lighter in a car. Alternatively, you might wish to only ever power the circuit this way, as the batteries make the unit larger and, of course, heavier. If required, the internal batteries could also be recharged by an external source. A telephone type jack socket is required, wired so that the internal battery is switched out of circuit when the plug is inserted. The value of the resistor will depend on the type of internal battery and the value of the external voltage. A diode (shown dotted) could be added to prevent the internal battery discharging through the charge source.

Construction

The main task is winding the transformer, as the rest of the circuit is simply a matter of loading components onto the PCB. Fig.2 shows details of winding the coil. The first winding (L2) comprises 37 turns of 32 SWG enamelled copper wire, insulated from the next winding with a layer of PVC tape. Leave at least 70mm of lead for the start and end of each winding, and identify them either with coloured plastic sleeving (50mm length x 1mm) or numbered tags.

The next winding (L1) requires six turns of 26 SWG wire, evenly spaced over the previous winding. This winding should be wound in the same direction as the first, and its start and finish leads should be carefully identified. Again, plastic sleeving should be fitted over these leads, preferably with different colours to those previously used. A layer of PVC tape should now be applied over L1, in such a way that the tape anchors the plastic sleeving. Note also that all wires exit at the same point from the bobbin.

The third winding (L3) requires 300 turns of 26 SWG wire. This wire is much finer than the previous sizes, and the winding can be 'pile' wound (i.e., fairly randomly), as long as it is distributed evenly over the bobbin. After fitting sleeving to the leads, a final layer

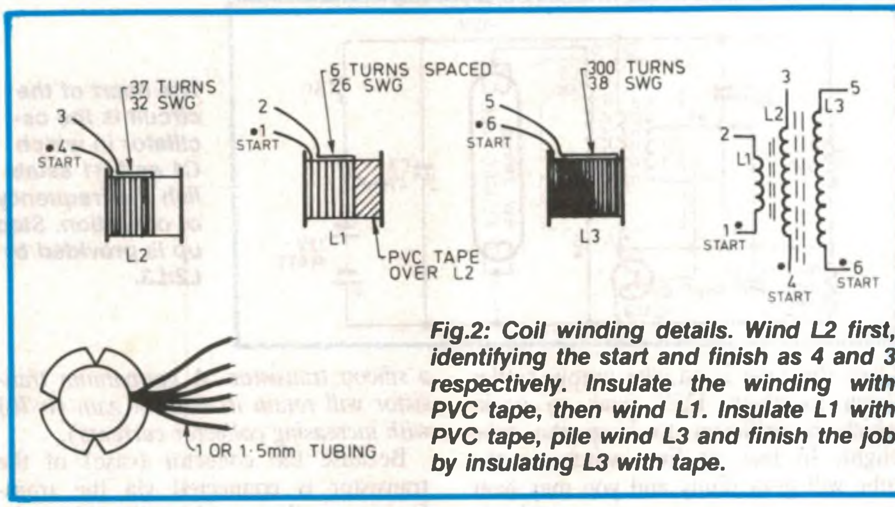


Fig.2: Coil winding details. Wind L2 first, identifying the start and finish as 4 and 3 respectively. Insulate the winding with PVC tape, then wind L1. Insulate L1 with PVC tape, pile wind L3 and finish the job by insulating L3 with tape.

of PVC tape should be applied.

Once the winding is complete, each lead should be tinned. Most enamelled copper wire can be soldered without removal of the enamel insulation, although care is required not to burn the sleeving.

It then remains to assemble the transformer and mount it on the PCB. The transformer core used in the prototype came with two end caps to hold the ferrite cups together. Alternatively, a single *brass* screw and nut can be used to secure the two halves if the cores have a hole through the centre. Be careful when tightening the screw, though, as the ferrite can shatter very easily.

How the transformer is attached to the PCB will depend on the method used to hold it together. If metal end caps are used, the transformer can be glued to the PCB, or even attached with double sided adhesive tape. Once attached, the leads can be soldered to the PCB, using the layout diagram as a guide.

The transistor should be fitted to a heatsink made from a piece of heavy gauge aluminium (measuring 50mm x 212mm in the prototype). As shown in the photos, the transistor is mounted at one end of the heatsink (on the underside) and the PCB attached to the other end. If the transistor is not insulated from the heatsink, the heatsink itself will need to be insulated from other metalwork such as the case.

Three wires connect the transistor to the PCB, as shown in the layout diagram. Note that the base terminal is the left hand pin towards the top of the transistor and that the case is the collec-

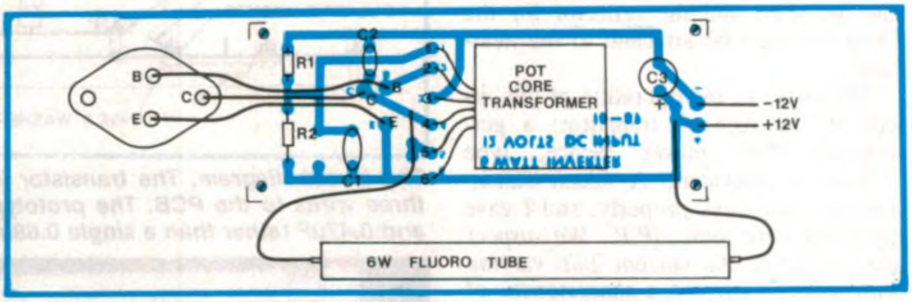
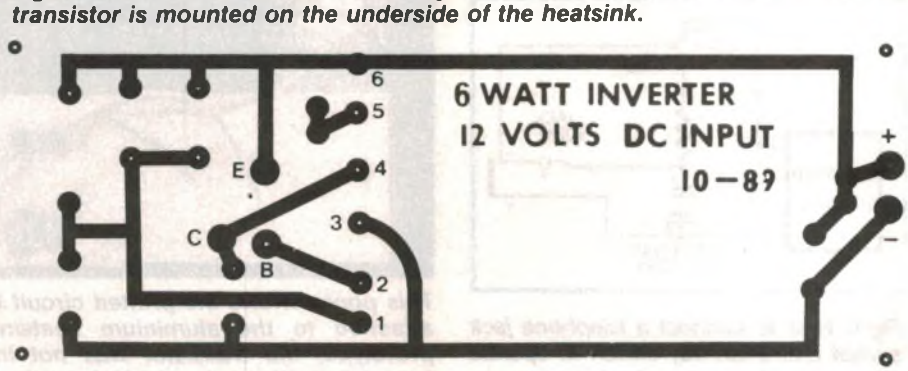


Fig.3: Constructional details, showing how the prototype was assembled. The transistor is mounted on the underside of the heatsink.



The PCB pattern, which is simple enough to make with a Dalo pen.

tor.

The PCB can be attached to the heatsink with screws, spaced with 5mm (or so) spacers. Naturally the wires to the lamp sockets and battery will need to be fitted before the PCB is mounted on the heatsink. Use lead lengths of around 300mm for the wires connecting the lamp sockets, and tin the ends that connect to the sockets.

Some sockets use a phosphor bronze clip rather than a screw terminal for connection. Only one wire is necessary per socket, as the heaters inside the tube are not used. However, two wires to each end will ensure a good connection.

Testing

Once the unit is complete electrically, it is ready to test.

NOTE: It is most important not to operate the unit without the tube, as the transistor will be damaged and probably cause the transformer to burn out!

Having said that, fit a 6W fluorescent tube and apply a voltage of around 12V to the unit. Be sure the polarity of the applied voltage is correct; that is positive to the common rail.

You will probably hear a whistling

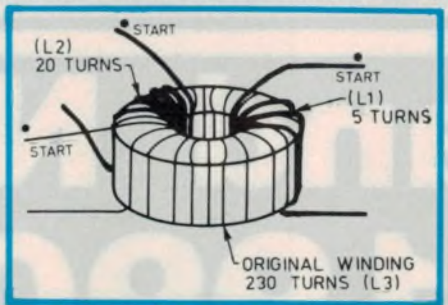


Fig.4: A toroid using the turns ratios shown can be used for 12V operation.

sound from the transformer, as the tube starts to light. Once the tube is on, the oscillations should be virtually inaudible. Note that a new tube may take a few seconds to stabilise.

If the unit doesn't work, check the phasing of L1. Otherwise, you may have the transistor connected with the base and emitter terminals reversed. The circuit is very simple, and should not be hard to get working.

Once working, check the current consumption, which shouldn't exceed 570mA (for a 12V supply). As already described, if the current is greater than this value, a 1 ohm, 1W resistor can be added in series with the emitter lead. Also, changing the value of C1 will affect both the light output and the current consumption.

Once the unit is working correctly, finish the assembly as shown in Fig.3. How the unit is mounted in a case will depend on individual choice, but here are a few ideas...

Building a case

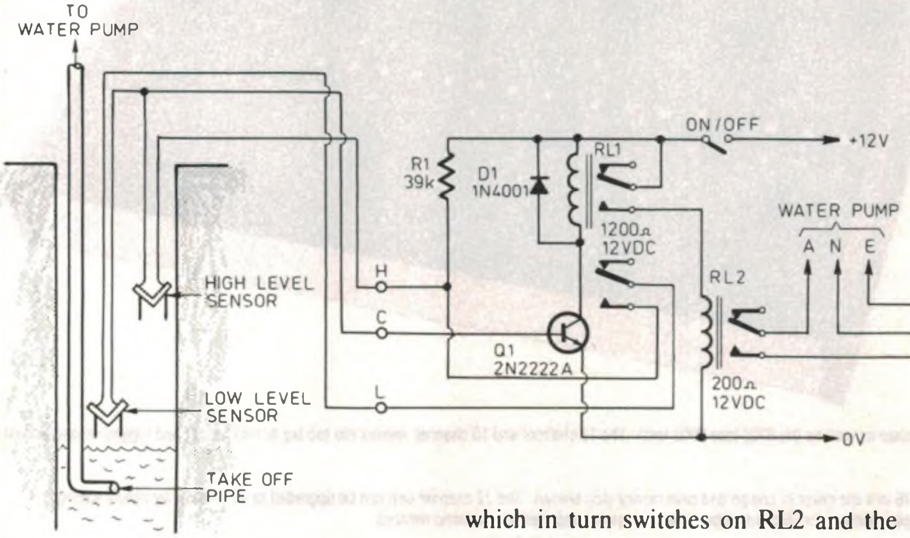
The lead picture shows the case constructed for the prototype. The case was built from 'Marviplate' and held together with pop rivets. Alternatively, the case could be made from ordinary tinplate and covered with adhesive vinyl. The reflector in the prototype was made from stainless steel, although any shiny metal will do. A piece of acrylic plastic or perspex can be used as a cover for the lamp, but avoid using glass – it breaks!

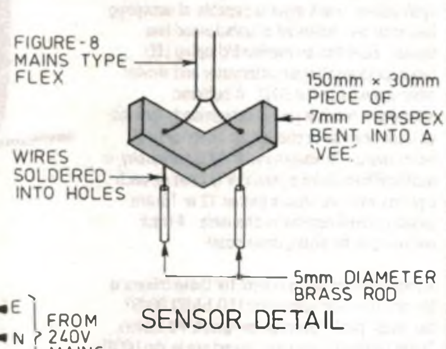
The size of the case will depend on the choice of batteries (if any are to be used). If you only want a light for the car, the electronics could be fitted inside a perspex tube, or a rectangular box with a plastic cover. You may want to try and waterproof the case, although this will make access to the internals more difficult in the case of breakdown.

Whatever your choice of case, at least you now have a simple circuit that can be readily repaired if necessary.

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.





Simple level control for well water

This circuit was designed to replenish a water tank from a subterranean well. Because of the irregular water levels in the well, previously one would have to stand by the water pump switch and turn off the pump before the water level in the well fell below the take-off level – to avoid repriming the pump, which is driven by a 240-volt motor.

With the low-level sensor submerged in the well at the required shut-off level and the high-level sensor set at the start level, Q1 conducts as soon as the water level rises to a point where it touches the contacts of the high level sensor. Once Q1 conducts, it activates RL1 which in turn switches on RL2 and the pump motor.

The second set of contacts on RL1 effectively latches on the transistor, by connecting the low level sensor to bias resistor R1. This keeps the pump motor energised until the water level falls to a point just below the low level sensor, where the bias is removed from Q1. This turns off Q1, RL1, RL2 and the pump motor.

Once the water level rises again to bridge the high level sensor contacts, Q1 again conducts and the cycle begins again.

For the sensors I used a piece of 7mm thick perspex, 150mm long by 30mm wide and bent into a 'V' shape as shown to accelerate water run-off. The actual contacts are two short lengths of 5mm diameter brass rod, drilled at one end and with the wires soldered into the holes. The joints were then sealed with super glue, which was also used where the wires pass through the holes in the perspex.

The leads to the sensors were run in figure-8 mains flex, not for insulation but simply to support the weight of the sensors. The sensors carry less than a milliamp at 12V DC, and are quite safe to touch.

For the power I used a small 12V DC supply.

Quite possibly the same circuit could be used for an automatic bilge pump controller for boats. By reversing the connections to the sensors it could also be used as a low-high controller to maintain the level of fluid in a tank.

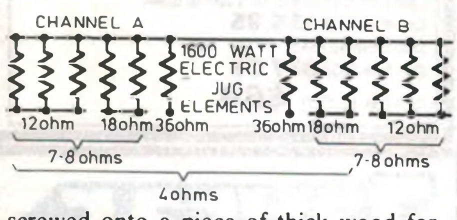
S.J. Pollard,
Marrickville, NSW **$35**

Inexpensive high power dummy load

Audio amplifiers under test sometimes need a dummy speaker load. For small amplifiers, this simply means connecting a few wire wound resistors or a loudspeaker. However, for more powerful amplifiers (100 watts and above), commercial resistive loads are quite expensive and loudspeakers are too loud.

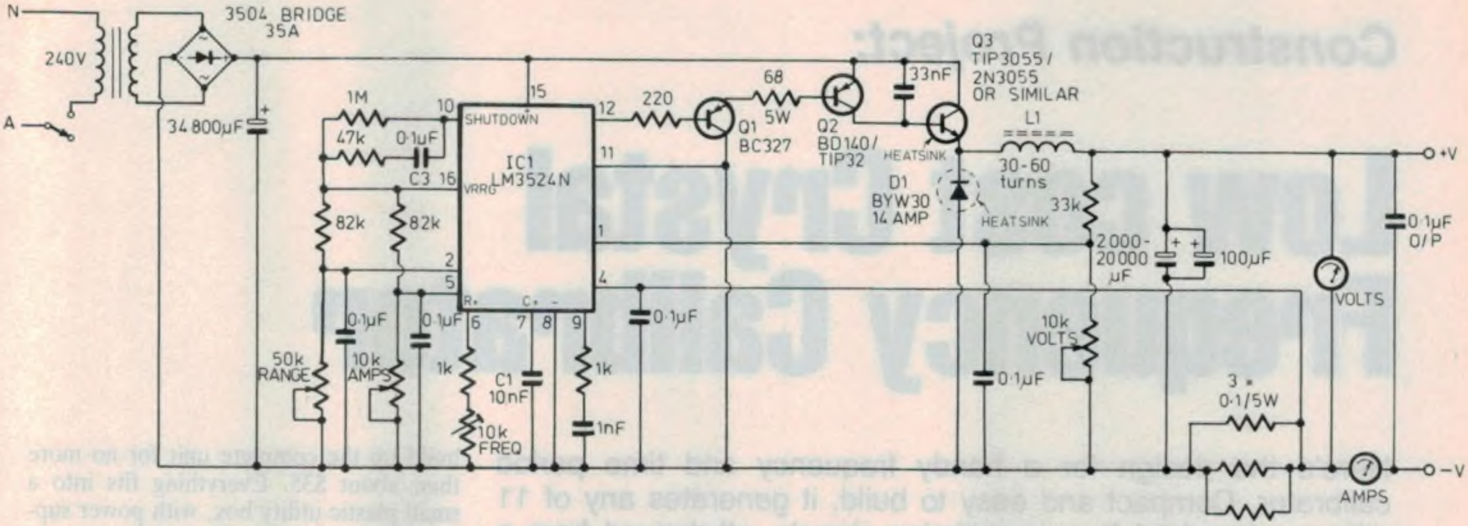
When testing high power guitar and PA amplifiers, I like to burn them in (sometimes literally) by feeding in a sinewave level to bring the output to just under clipping point. This goes on for a few hours continuously at maximum permitted load! If the amplifier passes this test unscathed, then it will survive normal usage.

The following simple circuit costs around $15 and will dissipate over 300 watts per channel. It consists of household 1600-watt jug elements, available at any supermarket, wired together in combinations for various convenient resistances. One element has an average resistance of 36 ohms, so five elements in parallel gives around 7-8 ohms and nine elements gives 4 ohms. Note the balanced combinations for stereo amplifiers.



The elements ends should be bent and screwed onto a piece of thick wood for stability. Thick connecting wire should be used, as there are some large currents flowing. You may be able to hear the elements "singing" faintly at high power! Be careful – while these elements don't glow in the dark they do get very hot, so put the dummy load in a clear area.

Tom Stewart Camp Hill, Qld **$25**



High current switchmode PSU

One day I found the need for an adjustable voltage/current regulated PSU with a fairly high output current. A conventional regulator wasn't the answer, as the heat generated when draining high currents at low voltages would be immense and a huge heatsink would be needed to remove it. A switchmode regulator seemed the way to go.

IC1 is basically an oscillator (set by an external resistor and a capacitor (with a pair of comparators changing the pulse width of the output. When the output of the chip is high, Q1, 2 and 3 are turned on hard. Q3 is slowed down by the capacitor. Current flows through the inductor, into the capacitor and through the load.

When the transistors are turned off, the magnetic field in the coil collapses and releases the current through the load and the now forward biased D1 back into the coil. When no current is flowing through the coil, the current is released from the capacitor at the voltage to which it was charged until the next cycle begins. The longer the pulse from the chip, the higher the output voltage or current.

The pulse width is controlled by the output of the two internal comparators. One input from each is connected to a constant reference voltage, taken from the internal regulator output and divided. When there is a difference in the inputs of either comparator, the pulse width is modified to compensate for the change and match the two again. To slow down the switch-on current surge, a delay circuit has been added. When the unit is switched on, C3 is a short circuit to the shutdown input, holding the output low until charged. This was taken from the PSU in 'Electronic Test Gear'.

The input and output filter capacitors should be large, but not so large that they blow up the circuit when they are charging! The current rating of the regulator can be increased by adding more output transistors in parallel, each with a suitable emitter resistor. The output frequency can be varied to suit the core you are using by the 'Frequency' trimmer. The range control varies the 'sensitivity' of the voltage and current controls.

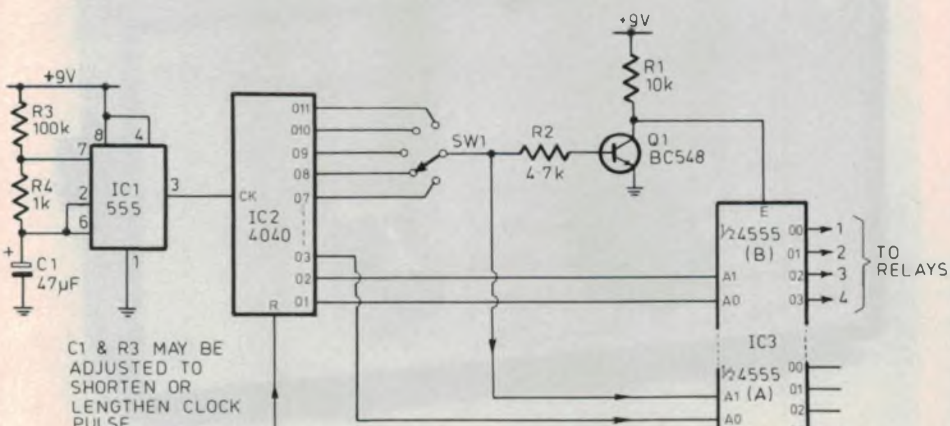
Voltage and current metering is essential if you change the output levels frequently. When I had no current meter on mine I accidentally turned the current up too high and Q3 shorted, fusing the strands of wire in the load cable together!

My supply cost me a total of $35. The transformer was bought from an industrial salvage yard for $2 and gives a good 200W continuous power output. I used 34,800uF filter capacitors which cost $5 each from Pre-Pak some time ago, as they were 'ex-computer'. I bought the rest from Atkins Carlyle.

Christopher Lockwood,
Perth, WA

$45

Seed bed mist timer



I had the requirement for a timer that would release a short mist of water over a seed box every few minutes, just to keep the soil damp. So I came up with this circuit.

The 555 timer sends a pulse to the clock pin of the 4040, a 12-stage binary counter. When the pin selected by switch 1 goes high, the 'B' side of the 4555 is enabled via the BC548 transistor, acting as an inverter.

When this occurs, relay 1 will activate, followed by relay 2 at the next location and so on, until all 4 relays have been activated. The very next location will activate output 3 of the 'A' side of the 4555, resetting the 4040 chip and starting the cycle again.

David Kadow,
Plympton, SA

$30

Construction Project:

Low cost Crystal Frequency Calibrator

Here's the design for a handy frequency and time period calibrator. Compact and easy to build, it generates any of 11 different standard frequency/timing signals, all derived from a low cost internal crystal. It's just the shot for quickly checking the calibration of scopes, timers and frequency meters – and also the tuning scales of older radio receivers.

by JIM ROWE

A reliable source of known frequencies and timing reference signals can be very handy around the workshop, whether you're a servicing technician, a radio amateur or a hobbyist.

When your scope tells you that a string of pulses are occurring every 100 microseconds, for example, how confident can you be that it isn't every 80 microseconds – or even every 140 microseconds? Often we take scope timebase markings for granted, not checking them for years. Yet they can easily drift out of calibration, due to component ageing, and could well be out by this kind of ratio.

The same kind of problem can occur with timers and frequency meters – not so much those of the digital kind, which are usually provided with their own internal crystal reference, but certainly those of the older analog variety which rely on R-C timing circuits. These can again drift quite significantly in calibration, and become misleading.

In both of the above cases a very quick way to check instrument calibration is to provide them with a source of known reference signals, and see whether you get the expected reading. And if not, the same signals will let you quickly adjust the instrument back into calibration.

If you get involved in building, repairing or renovating radio receivers of the simpler and/or older variety, there's also a need to calibrate or check the calibration of tuning dials. Here again a source of known reference signals is very handy, letting you quickly establish basic calibration and then if necessary fill in the fine details.

The simple calibrator unit described here is designed for just these kinds of situations. It provides a source of any of 11 different reference signals, ranging from 10MHz down to 5kHz and all derived from a single internal quartz crystal.

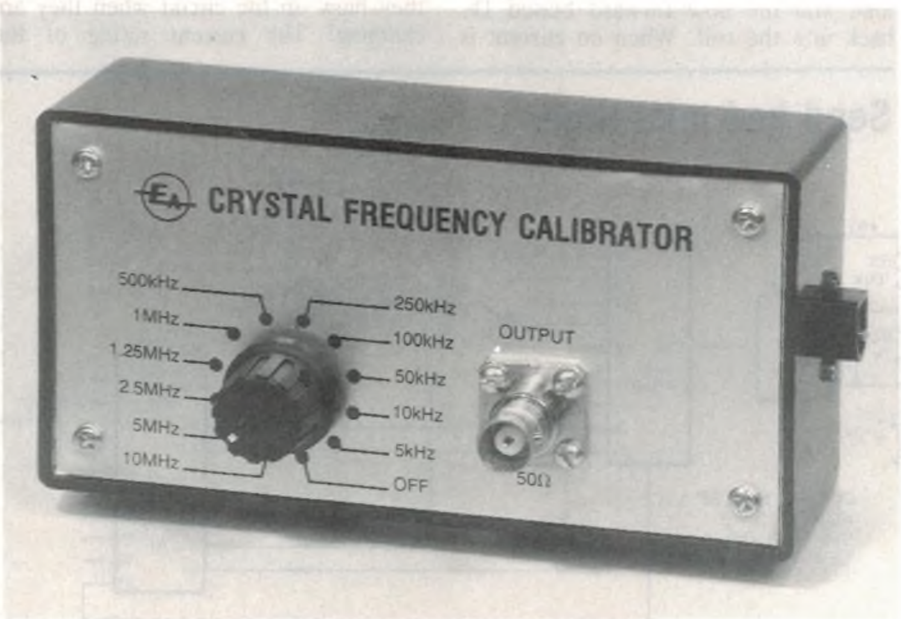
All of the signals are rectangular 'digital' signals. This makes them not only well suited for convenient calibration of scopes and times, with well-defined timing edges, but also means that they have good strong harmonic content for calibration of receivers well up into the VHF region.

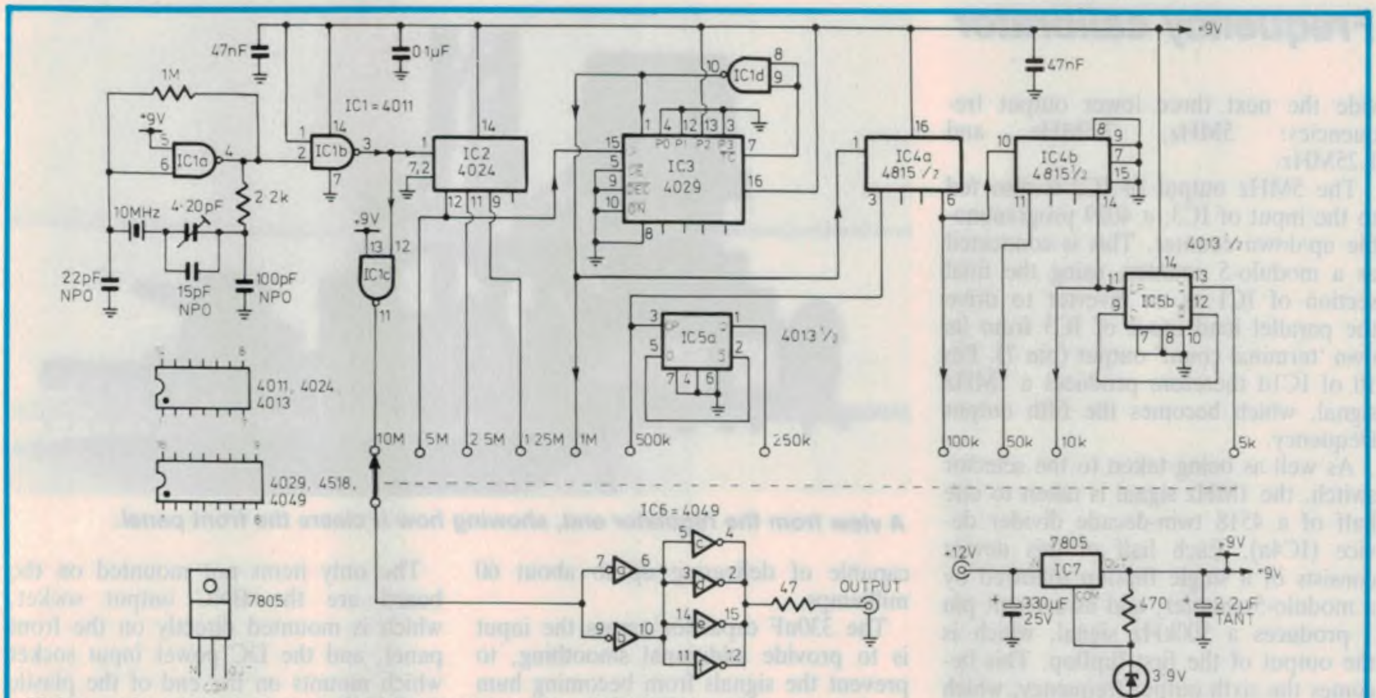
Best of all, you should be able to build up the complete unit for no more than about $35. Everything fits into a small plastic utility box, with power supplied by an external 12V battery or power supply – which may well be of the 'plug pack' variety.

How it works

Like other, earlier frequency calibrator units, the basic scheme used here is to have a crystal oscillator followed by a chain of frequency dividers, to divide down the crystal oscillator frequency and derive the various useful sub-multiples.

In the old days of discrete frequency divider circuits, the design philosophy would have been to have the minimum possible number of divider stages, with some fairly fancy switching to produce division by the ratios necessary to produce the desired frequencies. However thanks to IC technology the cost of frequency division as such has fallen considerably, while fancy multi-pole switches have now become quite expensive – assuming you can find them at all.





Using only seven low-cost ICs, it generates any of 11 frequencies.

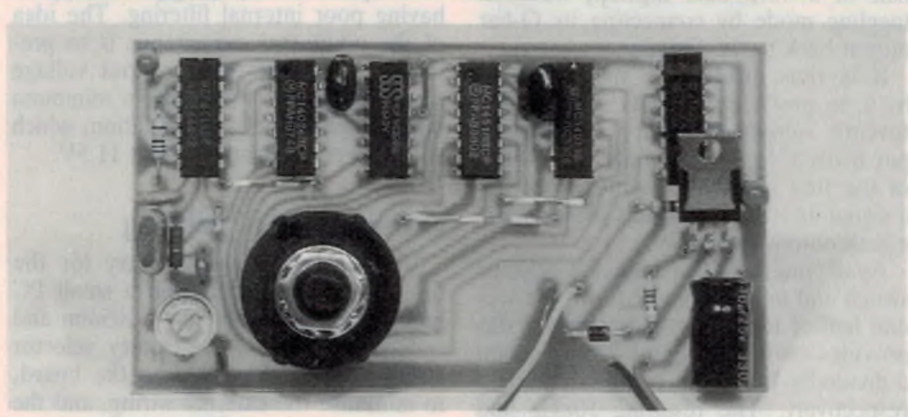
So the approach taken here has been rather different. I have tried to come up with a circuit which would provide the widest and most useful range of frequencies, while at the same time using a simple, low cost and readily available selector switch: a single pole, 12-position rotary type. No great effort was made to minimise the total number of IC's used, because these are all common CMOS types and readily available at low cost.

Despite this the final circuit still uses only six CMOS chips, plus a three-terminal regulator chip in the power supply.

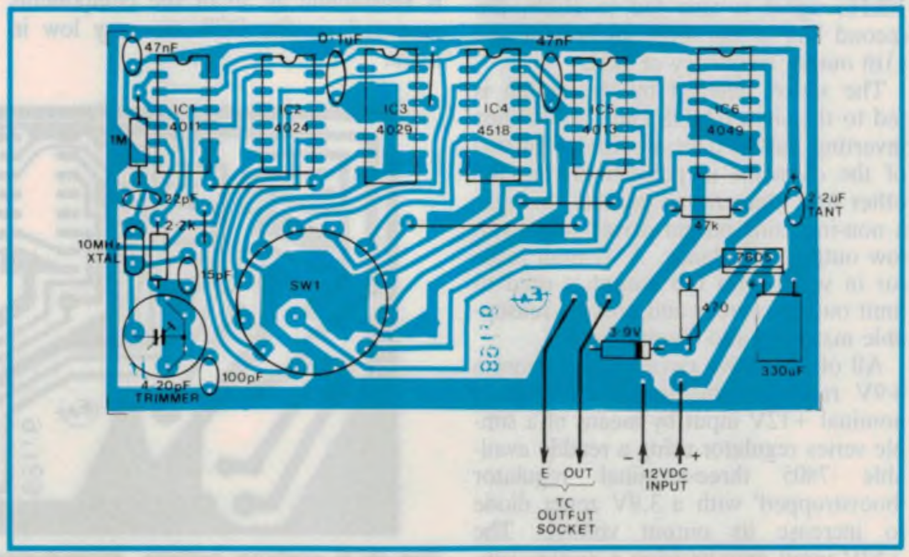
The 10MHz crystal master oscillator uses one section of a 4011 quad NAND gate device IC1, connected in a standard single-inverter configuration but with an R-C phase shift circuit (2.2k/100pF) to ensure reliable starting and provide additional isolation of the crystal from variations in the output impedance of the gate with temperature and supply voltage. A 4-20pF trimmer is provided to allow 'fine tuning' the oscillator frequency against a known standard.

A second section of the 4011 (IC1b) serves as a buffer for the oscillator output, isolating the latter against loading variations. A third section (IC1c) then provides further buffering for the 10MHz output which is fed to the selector switch, as the highest available output frequency.

The output of IC1b also feeds IC2, a 4024 binary divider device used to pro-



A closeup of the component side of the PCB, showing where everything goes.



This parts placement diagram should also guide you in wiring up the PCB. Note that the regulator is bent over, to clear the front panel.

vide the next three lower output frequencies: 5MHz, 2.5MHz and 1.25MHz.

The 5MHz output of IC2 is also fed to the input of IC3, a 4029 programmable up/down counter. This is connected as a modulo-5 counter, using the final section of IC1 as an inverter to drive the parallel load input of IC3 from its own 'terminal count' output (pin 7). Pin 10 of IC1d therefore produces a 1MHz signal, which becomes the fifth output frequency.

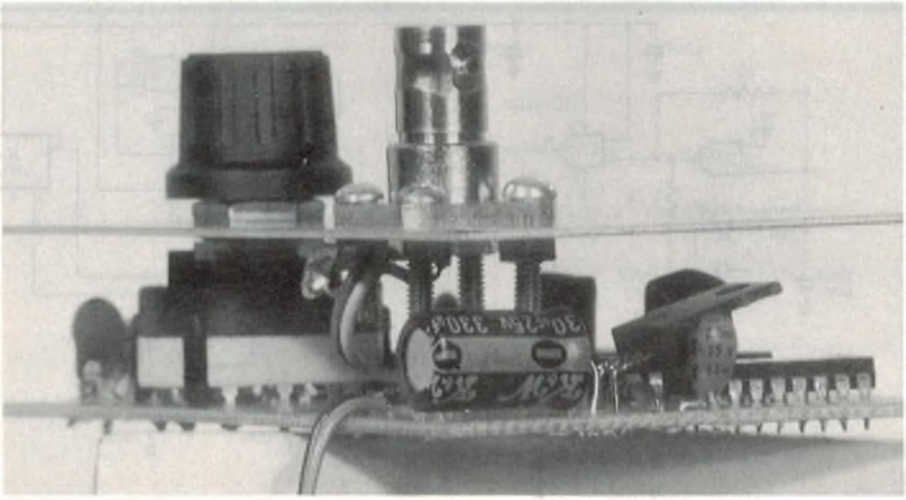
As well as being taken to the selector switch, the 1MHz signal is taken to one half of a 4518 twin-decade divider device (IC4a). Each half of this device consists of a single flipflop followed by a modulo-5 counter, and as a result pin 3 produces a 500kHz signal, which is the output of the first flipflop. This becomes the sixth output frequency, which is also fed to the input of IC5a – one half of a 4013 dual flipflop, wired in toggling mode by connecting its Q-bar output back to the D input.

IC5a thus divides the 500kHz signal by 2, to produce a 250kHz signal – the seventh output frequency. Meanwhile pin 6 of IC4a, representing the output of the first modulo-5 counter, provides a signal at 100kHz and this provides the eighth output frequency.

Again this is fed to both the selector switch and to the input of IC4b, the second half of the 4518. And as before this provides both a divide-by-2 output and a divide-by-10 output, at pins 11 and 14 respectively. The resulting 50kHz and 10kHz signals form the ninth and 10th output frequencies. And finally the 10kHz signal is also fed to IC5b, the second half of the 4013, to provide the 11th output frequency of 5kHz.

The signal selected by the switch is fed to the sixth CMOS chip, a 4049 hex inverting buffer. This is wired with two of the elements in parallel driving the other four elements in parallel, to form a non-inverting output driver stage with low output impedance. A 47-ohm resistor in series with the output is used to limit output current and provide reasonable matching into 50-ohm loads.

All of the active circuitry runs from a +9V rail, and this is derived from a nominal +12V input by means of a simple series regulator using a readily available 7805 three-terminal regulator 'bootstrapped' with a 3.9V zener diode to increase its output voltage. The +12V input may be from a battery supply, or from any DC 'plug-pack' supply capable of delivering up to about 60 milliamps.



A view from the regulator end, showing how it clears the front panel.

The 330uF capacitor across the input is to provide additional smoothing, to prevent the signals from becoming hum modulated at high output currents and when powered by plug-pack supplies having poor internal filtering. The idea of the additional capacitance is to prevent the 'troughs' in the input voltage from falling below the 7805's minimum input voltage level for regulation, which will here correspond to about 11.5V.

Construction, testing

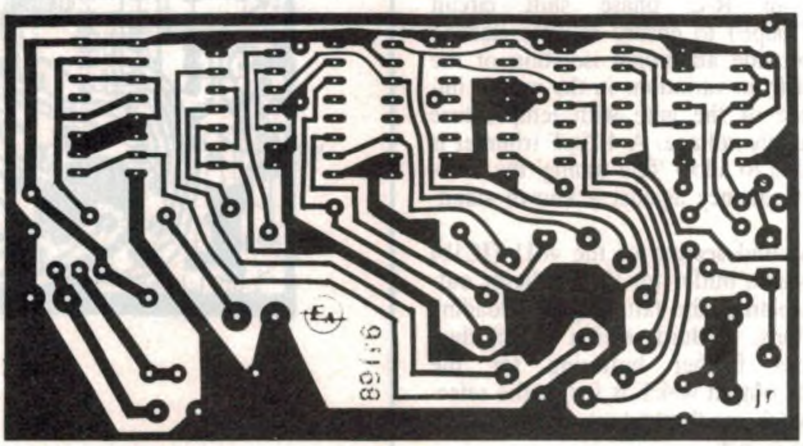
Virtually all of the circuitry for the frequency reference fits on a small PC board, measuring only 58 x 105mm and coded 89fr6. Even the rotary selector switch mounts directly onto the board, to minimise the external wiring, and the switch itself is actually used to support the PCB assembly inside the case. This is reasonable as all of the components mounted on the PCB are very low in mass.

The only items not mounted on the board are the BNC output socket, which is mounted directly on the front panel, and the DC power input socket which mounts on the end of the plastic case.

Incidentally the case itself measures 131 x 68 x 40mm, and is the type often called 'UB-3'.

Wiring up the board should be quite straightforward, as there is both a photograph and an overlay diagram to guide you. Note that there are a total of five small links, which are best run in insulated hookup wire. Do this by carefully cutting them to about 10mm longer than the length between the holes provided, and then stripping back about 5mm at each end to bend at 90° and take through the holes for soldering.

I suggest that you fit the links first, after checking the board for any obvious shorts or other problems. Then fit the four resistors, the fixed capacitors, the zener diode and the crystal. Take care with the polarity of the zener and the two polarised capacitors, and note



The PCB etching pattern, reproduced actual size for those who etch their own.

that although the 330uF electro is a 'radial' PCB-mounting type, here it is actually mounted horizontally to clear the front panel.

Next you can add the trimmer capacitor. As there are a number of different types available, with different mounting pin arrangements, I have provided the board with holes to allow mounting of at least two main types.

At this stage it's a good idea to fit the two small lengths of two-wire cable used to connect to the signal output and DC input sockets. I used two pieces cut from a length of 'ribbon' cable, about 100mm long – cutting off the excess later.

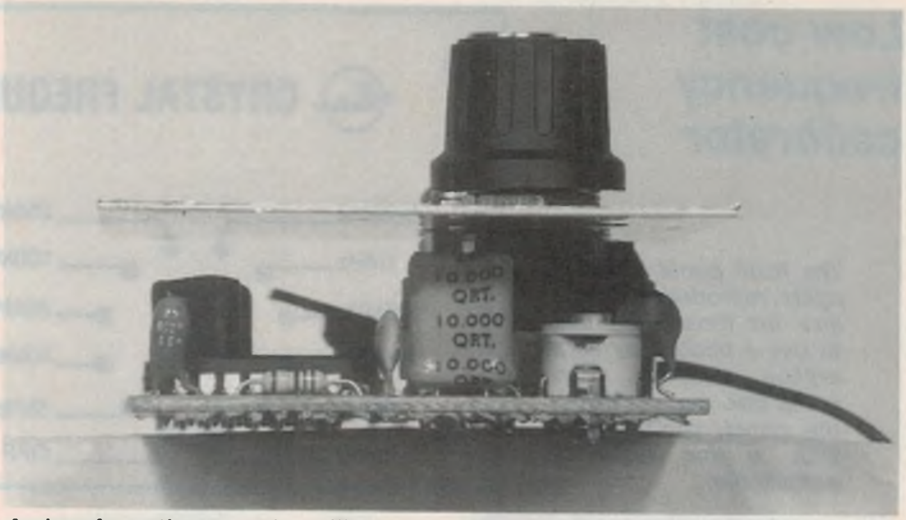
The selector switch is added next, taking care to mount it so that the contact corresponding to the 'fully anti-clockwise' position of the switch is immediately below the inner rotor contact.

Now fit the CMOS chips IC1 – IC6, taking care that these all have their 'notch' ends nearest the adjacent long edge of the PCB. It would also be wise to take the usual precautions when handling and soldering in CMOS devices, making sure that you have not developed a static charge and that your iron is securely earthed – along with the copper pattern of the PCB itself.

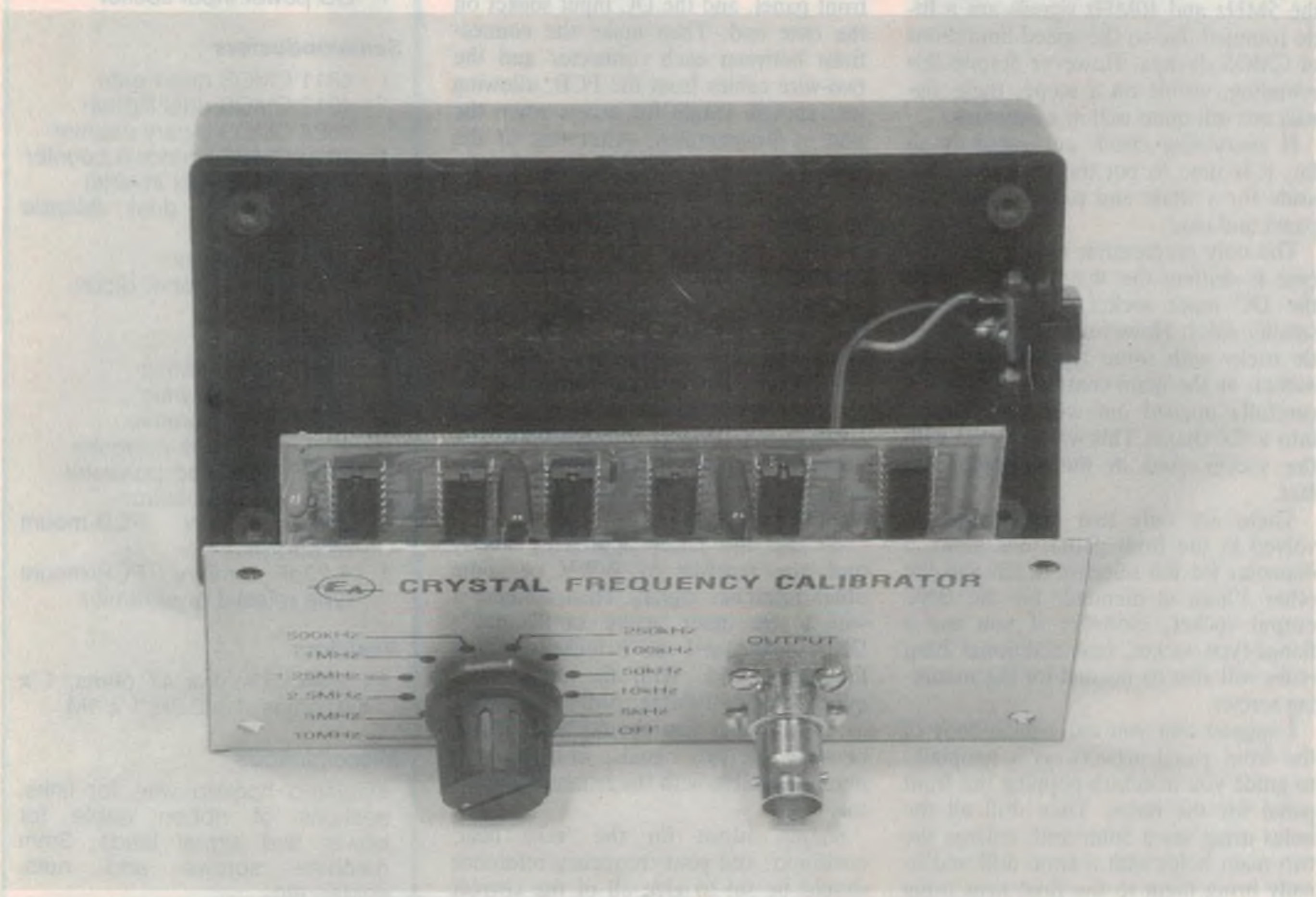
Finally fit the 7805 voltage regulator chip, after carefully bending all three of its leads by about 77°, so that when mounted it tilts over IC6. This is to ensure that it clears the back of the front panel, when the unit is assembled. As an additional precaution to prevent shorts, the heatsink tab of the regulator may be wrapped in insulation tape.

The PCB assembly is now complete, and if you wish it can be powered up and tested before fitting to the front panel and case. Apply +12V to the power input leads, with the correct polarity as shown, and check that with no load connected to the output, the current drawn from the supply is around 20-25mA.

If all seems well so far, connect the

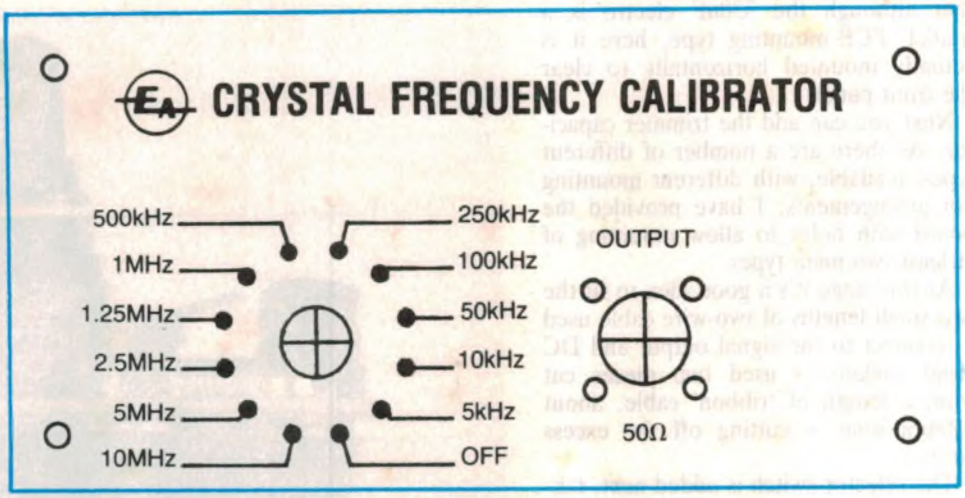


A view from the crystal oscillator end, showing the crystal and trimmer. The switch supports the PCB, and attaches it to the front panel.



How the unit goes together. The DC input socket is the only item mounted directly in the case.

Low cost frequency calibrator



The front panel artwork, again reproduced actual size for those who like to use a photocopy as a drilling template. You could also use a copy as the panel, protecting it with a thin layer of acetate film.

output leads to a scope and/or digital counter to monitor that the circuit is producing output. There should be a healthy and reasonably rectangular output for each position of the selector switch except the 'fully clockwise' position, which connects the input of the output stage to ground for zero output.

Did you notice that I wrote 'reasonably rectangular' in that last paragraph? That's because although all of the lower frequency outputs are quite rectangular, the 5MHz and 10MHz signals are a little rounded due to the speed limitations of CMOS devices. However despite this rounding, visible on a scope, these signals are still quite rich in harmonics.

If everything check out correctly so far, it is time to put the PCB assembly aside for a while and prepare the front panel and case.

The only preparation required for the case is drilling the mounting holes for the DC input socket, on one of the smaller sides. However this can be a little tricky with some types of moulded socket, as the main centre hole must be carefully opened out with needle files into a 'D' shape. This was the case with the socket used in the prototype, in fact.

There are only two main holes involved in the front panel, one 9mm in diameter for the selector switch and the other 12mm in diameter for the BNC output socket. However if you use a flange-type socket, four additional 3mm holes will also be needed for the mounting screws.

I suggest that you use a photocopy of the front panel artwork as a template, to guide you in centre-popping the front panel for the holes. Then drill all the holes using say a 3mm drill, enlarge the two main holes with a 6mm drill and finally bring them to the final sizes using a tapered hand reamer.

Once the holes are de-burred you can carefully stick on the front dress panel, which can be made from the artwork using Dynamark (formerly Scotchcal) photo-sensitive sheet. Then cut the holes in the dress panel to match those in the main panel, using a sharp scalpel or hobby knife blade – with movements down into the holes, so that you don't tear the thin material.

The final steps in assembly are to mount the BNC output socket on the front panel, and the DC input socket on the case end. Then make the connections between each connector and the two-wire cables from the PCB, allowing just enough length for access when the unit is disassembled. After this fit the selector switch to the front panel, with the PCB squared up to match, and fit its control knob. The whole assembly can then be slipped into the case, to complete the job.

You may wish to adjust the oscillator trimmer, to bring the oscillator frequency as close as possible to 10MHz. This can be done using either a known-accurate frequency counter, or by using a short-wave receiver to listen for a beat between the output and reference signals from a standard-frequency transmission such as WWV.

To use the latter approach, simply tune the receiver to WWV or some other reference signal. Then connect a wire to the inner 'active' of the unit's BNC socket, and coil it loosely around the aerial lead. With the output frequency set to 10MHz, 5MHz or 1MHz as appropriate, you should hear a beat between the two signals, with the beat note adjustable with the trimmer capacitor.

Simply adjust for the 'zero beat' condition, and your frequency reference should be set to give all of the correct frequencies as marked.

PARTS LIST

1 PC board, 105 x 57mm, code 89fr6
1 Plastic utility case, 131 x 68 x 40mm
1 Single pole 12 position rotary switch, PCB mount type
1 Knob to suit switch
1 10MHz quartz crystal
1 BNC socket, panel mounting
1 DC power input socket

Semiconductors

1 4011 CMOS quad gate
1 4013 CMOS dual flipflop
1 4024 CMOS binary counter
1 4029 CMOS up/down counter
1 4049 CMOS hex inverter
1 4518 CMOS dual decade counter
1 7805 5V regulator
1 3.9V 400mW zener diode

Capacitors

1 15pF NPO ceramic
1 22pF NPO ceramic
1 100pF NPO ceramic
2 47nF metallised polyester
1 0.1uF metallised polyester
1 2.2uF TAG tantalum
1 330uF 25VW PCB-mount electrolytic
1 4-20pF trimmer, PCB-mount type (plastic or ceramic)

Resistors

All 1/4W, 5%: 1 x 47 ohms, 1 x 470 ohms, 1 x 2.2k, 1 x 1M

Miscellaneous

Insulated hookup wire for links, sections of ribbon cable for power and signal leads, 3mm machine screws and nuts, solder, etc.

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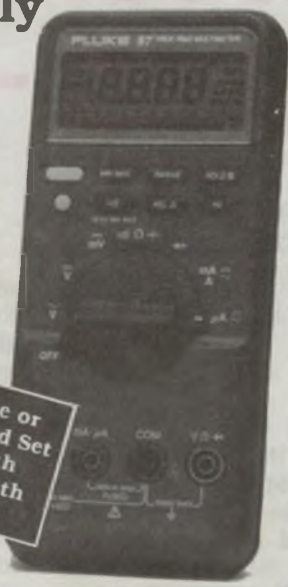

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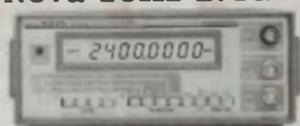

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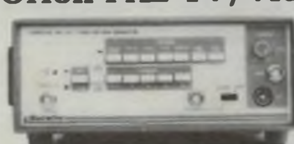

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Construction Project:

Simple FM receiver for the 6m band - 2

In this second article describing our new low cost, expandable NBFM receiver for the 50 – 54MHz amateur band, the author discusses constructing and commissioning. With most of the parts mounted on a single PCB, the receiver is easy to build and get going.

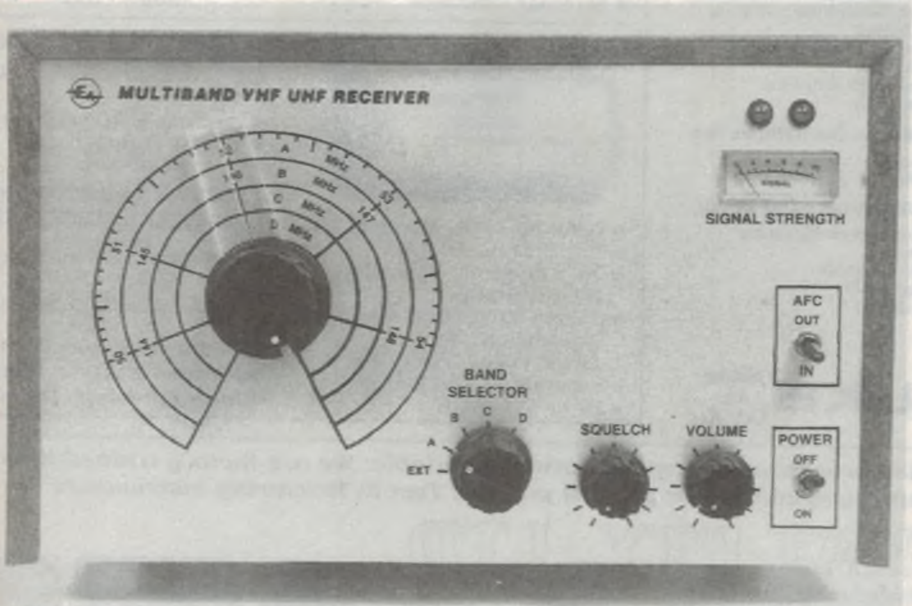
by DEWALD DE LANGE

The winding of inductor/transformers L1 through L3 will probably be viewed as the one of the more cumbersome parts of the construction. However, you'll find it's quite easy once you've tried it.

These inductors require 5mm slug-tuned coil formers with type F29 ferrite cores. The former unit is actually assembled from three separate parts, namely former, base and aluminium can (Dick Smith Electronics or Altronics resellers). All of the windings are wound with 0.5mm (25 SWG) enamelled wire.

Start with the easiest one, namely L3. Clean the enamel of one end of the wire and solder that to the base pin that will be connected to pin 21 of IC3 (see PCB component layout). Notice that L3 can only fit into the board one way. Wind 10 closewound turns clockwise on the former. For the correct number of turns, the two end wires should 'pass' each other. Solder the other end to the coil pin corresponding to pin 22 of IC3. Insert the inductor into the board. Cover it with the aluminium housing, whose lugs are soldered to the ground plane on the top side of the PCB.

As L3 determines the local oscillator frequency, the slightest movement of the ferrite core would detune the receiver. It is therefore necessary to secure it firmly with either the customary strip of rubber band between the core and the former, or by smearing some silicone grease to the inside thread of the former.



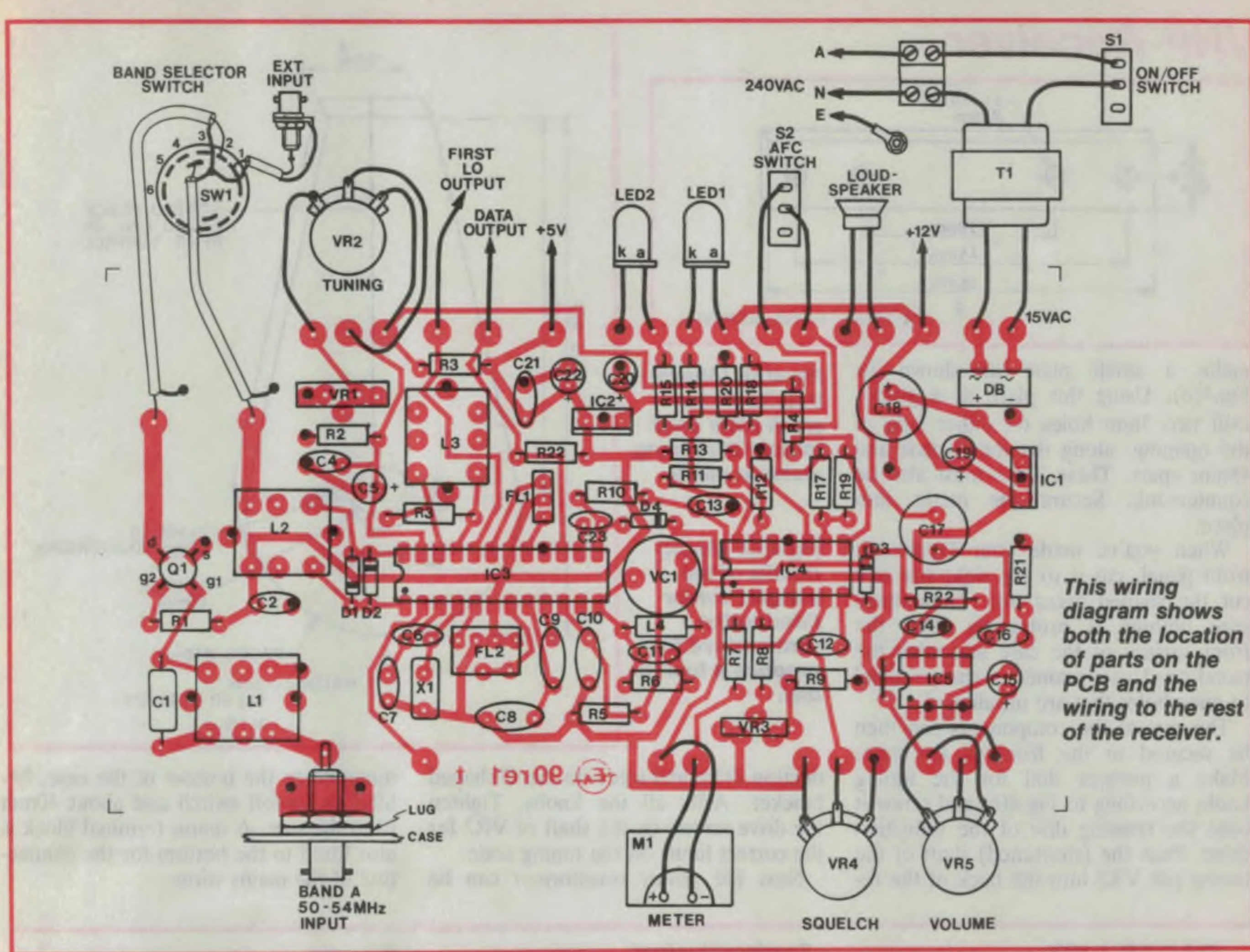
For transformers L1 and L2, start with 11 and 13 closewound turns respectively. Looking at the PCB layout diagram, these windings will be connected to the leftmost pins for L1 and to the rightmost pins for L2. Solder the start of the winding to its pin, leaving the other end free for the time being.

Then wind the second coil loosely over the first, spreading it out. Two turns are required for L1 and 3.5 turns for L2. The latter number of turns is obtained by starting with the top-left pin on the layout diagram and going clockwise three and half times to end up with the lower-left pin. All the ends can then be soldered.

Unless you purchase a kit, you may have difficulty finding some of the components. The MC3362 is a fairly new product, sold by VSI Electronics. The MOSFET BF981 is available from Radiospares or Farnell. You'll have to scrounge around for a 10.245MHz crystal (or have one especially cut at a price). Try Dick Smith Electronics for the 455kHz ceramic filter and IRH Components for the 10.7MHz filter – both of these are made by Murata.

MOSFET Q1 is soldered underneath the PCB (track side). To fit the body of the transistor, drill a hole with a diameter of 5mm through the board. The lead configuration of Q1 can be identified by the longer drain lead, or by the wider protrusion at the base of the source lead. All the leads have to be cut shorter to fit onto the board. Solder as quickly as possible, to prevent damage to the transistor.

With these trickier components completed, solder the other components in, making sure that ICs and electrolytic capacitors are inserted the right way round. C23 and R22, marked as optional, should only be inserted if digital FSK output is required, as the switching action of the comparator (pins 14 and 15 of IC3) causes some ripple on the



This wiring diagram shows both the location of parts on the PCB and the wiring to the rest of the receiver.

audio output at pin 13 (apparently via the first local oscillator).

The next major step is the preparation of the receiver housing. We used an instrument case with a large front face, to fit in the tuning dial with its multiple frequency bands.

You can use the printed front panel to make a Dynamark (Scotchcal) cover (the November 1981 issue of *EA* gives details on how the process works). Holes and screws into the case, that will be covered by the cladding, have to be finished first.

Using the front panel artwork as a guide, mark the exact positions for all the components on the front surface of the case. Drill holes where appropriate, including holes for the locating pins of the rotary switch and the pots.

A reduction drive will be added to the shaft of the tuning pot. A hole of about 20mm in diameter is required in the centre of the tuning dial, to let the rotating disc of the reduction drive through. After drilling a starting hole, use a reamer or metal punch to reach this diameter.

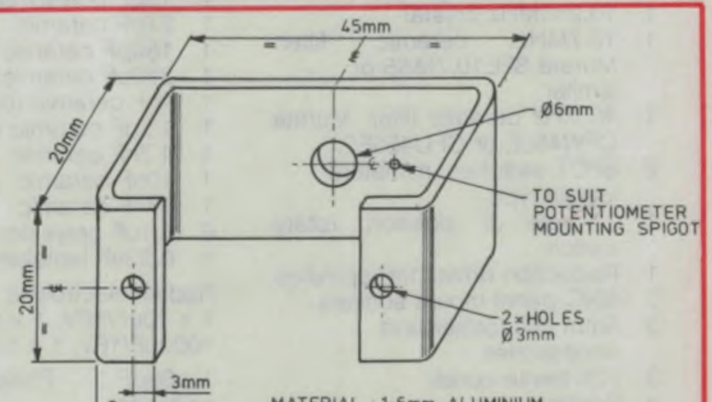
Put the case aside for a moment, to make the bracket that will hold the tuning pot itself in position. This is made from a 20mm wide and 1.6mm thick aluminium strip, bent in the form of a 'rectangular C', according to Fig.4(a).

Using the reduction drive as a guide, drill two holes of 3mm diameter into the case for the securing screws. These must be countersunk, as they will be covered by the stick-on panel.

The reduction drive and bracket can now be secured into place. Insert three 15mm countersunk screws through the holes in the case. Slip 4mm thick spacers (such as large nuts) over the screws. Insert the reduction drive and then the C-bracket. Then tighten the lot with 3mm nuts.

Finally, a rectangular hole has to be drilled and filed into the case for the meter. To hold the meter into place,

Fig.4(a): Details of the bracket used to support the tuning pot. The bracket attaches via the same screws used for the vernier drive.



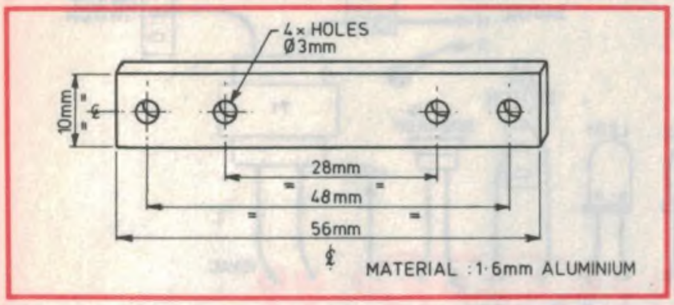


Fig.4(b): (Above) Details of the small plate used to hold the tuning meter in place.

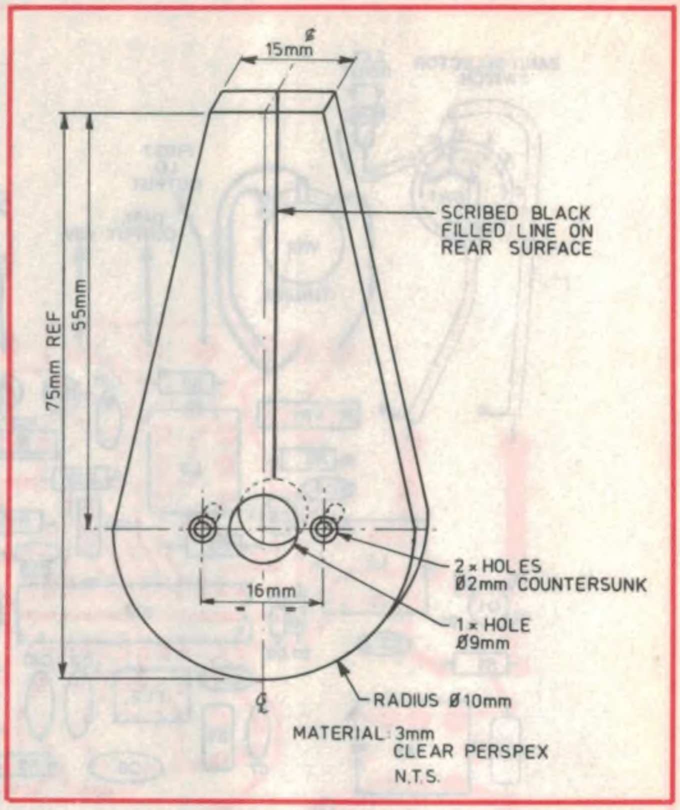


Fig.4(c): (Right) Details of the perspex cursor fitted to the vernier drive to produce a tuning dial.

make a small plate as shown in Fig.4(b). Using this plate as a guide, drill two 3mm holes on either side of the opening, along the longer axis and 48mm apart. These holes must also be countersunk. Secure the meter into place.

When you've made your Dynamark front panel, cut it to the right size and cut the shaded areas out. Then make sure nothing is protruding from the front surface of the case and stick the panel on. Use a reamer or sharp scalpel to open holes that are misaligned.

The rest of the components can then be secured to the front of the case. Make a perspex dial for the tuning knob, according to Fig.4(c) and screw it onto the rotating disc of the reduction drive. Push the (shortened) shaft of the tuning pot VR2 into the back of the reduction drive and screw to the C-shaped bracket. Affix all the knobs. Tighten the drive screws on the shaft of VR2 for the correct limits on the tuning scale.

Next the power transformer can be mounted to the bottom of the case, behind the on/off switch and about 40mm from the side. A mains terminal block is also fitted to the bottom for the connection of the mains wires.

PARTS LIST

- 1 Double-sided PCB 139 x 79mm, code 90re1
- 1 K & W instrument case 255(D) x 153(H) x 155(W)
- 1 Front panel, 154 x 250mm, or Dynamark photosensitive sheet
- 1 15V 1A transformer (2155 type)
- 1 100mm loudspeaker
- 1 250uA signal strength meter, 34 x 19mm edge type
- 1 10.245MHz crystal
- 1 10.7MHz ceramic filter: Murata SFE10.7MA5 or similar
- 1 455kHz ceramic filter: Murata CFW455E or CFU455E2
- 2 SPDT switches, miniature toggle type
- 1 2 pole 6 position rotary switch
- 1 Reduction drive, 1/4″ spindles
- 2 BNC panel-mount sockets
- 3 5mm coil former and accessories
- 3 F29 ferrite cores
- 4 Knobs

Semiconductors

- 1 MC3362 FM receiver
- 1 LM324 quad op amp
- 1 LM386 audio power amp
- 1 7812 12V 1A regulator
- 1 7805 5V/1A regulator
- 1 BF981 dual-gate MOSFET
- 2 5mm LEDs with mounting bezels
- 4 1N4148 diode or similar
- 1 WO4 diode bridge

Capacitors

- 1 10pF polystyrene
- 1 15pF polystyrene
- 1 27pF ceramic
- 1 150pF ceramic
- 1 270pF ceramic
- 1 1nF ceramic (optional)
- 1 1.5nF ceramic or polyester
- 1 4.7nF ceramic
- 1 10nF ceramic
- 1 47nF ceramic
- 6 0.1uF polyester or ceramic
- 1 0.33uF tantalum

Radial electrolytic: 2 x 1uF/50V, 1 x 10uF/16V, 1 x 100uF/16V, 1 x 1000uF/16V, 1 x 1000uF/25V

1 60pF Philips trimmer capacitor

Resistors

5% carbon film 1/4W: 1 x 10 ohm, 2 x 470 ohm, 2 x 1k, 1 x 3.9k, 1 x 10k (optional), 4 x 15k, 2 x 22k, 1 x 39k, 1 x 68k, 2 x 100k, 1 x 150k, 1 x 330k

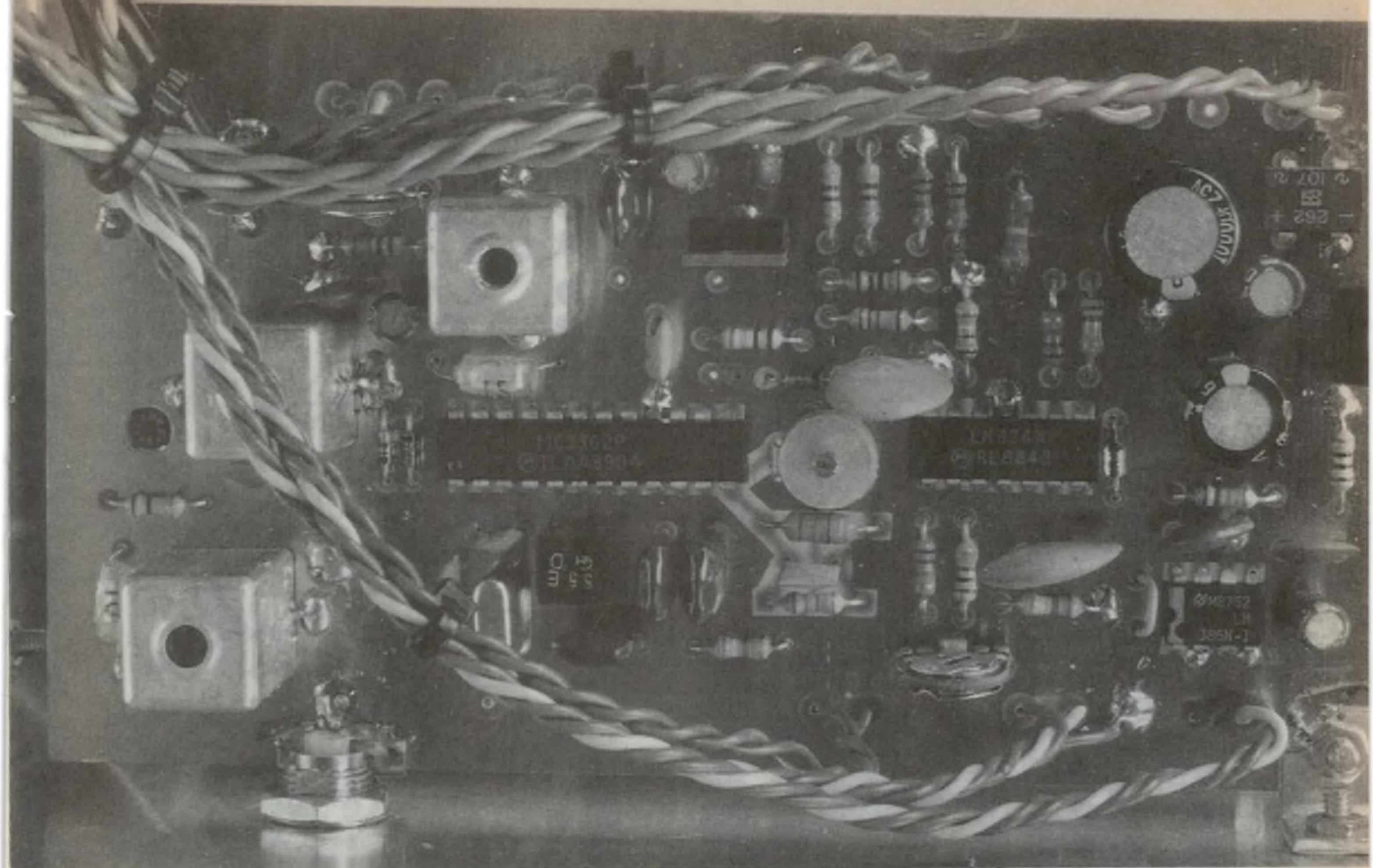
2% metal film 1/4W: 1 x 3.9k, 1 x 6.8k, 1 x 22k

Vertical trimpots: 1 x 1k, 1 x 50k

Single linear pots: 2 x 10k, 1 x 100k

Miscellaneous

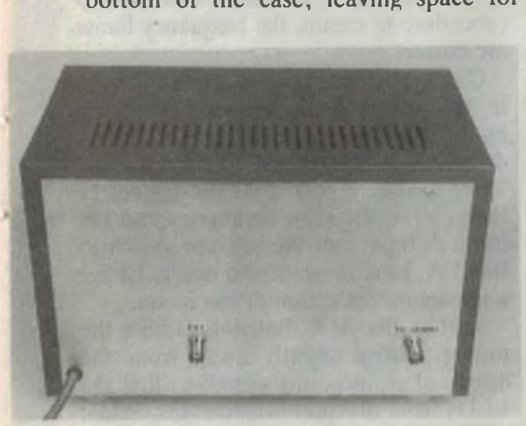
Mains cord and plug, mains terminal block, 5 or 6mm grommet, hook-up wire and coaxial cable, 2 x M2 by 4mm and 4 x M3 by 12mm countersunk head screws with nuts, 7 x M3 by 12mm panhead screws and nuts, 2 x 4mm thick spacers, 20 x 65mm Perspex sheet, 20 x 103mm and 10 x 56mm x 1.6mm thick aluminium sheet, a lug, 0.5mm enamelled wire, PCB pins



A close-up view of the receiver PCB, showing most of the parts clearly.

Drill a hole in the back corner and fit a grommet for the mains cable. Complete the mains connections, with the active lead going via the power switch and the earth lead screwed to the chassis with a lug.

The wiring between the PC board and the other components can now be made. The board will be mounted on the opposite side of the case from the transformer, to prevent magnetic interference reaching the LO coil L3. Make the wires long enough to run along the bottom of the case, leaving space for other boards that might be added in future. Use cable ties to keep the wires together.



At present, with only the one band fitted, the rear panel isn't too exciting!

Co-axial cables (preferably the thinner type, e.g., RG174) are used for connections to the band selector switch.

The board is finally installed by soldering it to the Band A input BNC connector. This connector is fitted to the back of the case, about 89mm from the side and 37mm from the bottom. A lug, fitted with the connector, is soldered to the patch of copper track underneath the board and the centre pin of the connector to a PCB pin on the RF input. Secure the board further with a small right angle bracket near the top edge of the board.

For the EXT input, fit another BNC connector to the back of the case, about 35mm from the other side (next to the transformer) and 37mm from the bottom. Run a coaxial cable between it and the first position of selector switch SW1.

Screw the loudspeaker to the (transformer) side of the case, behind the slots already provided.

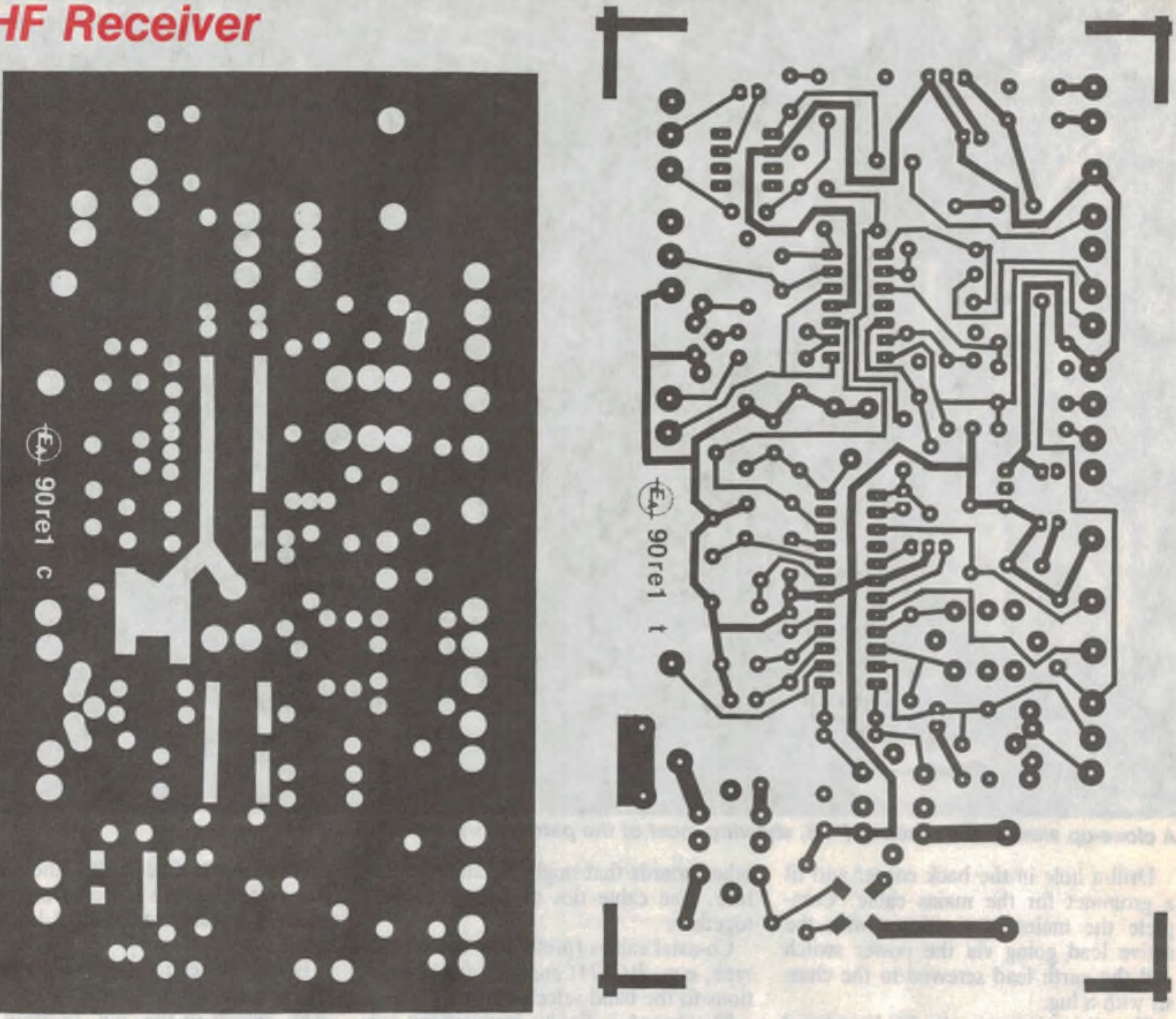
Commissioning

Before switching on, make sure the soldering is complete, especially the connections to the ground plane, on top of the board. Check that the wires to the pots, etc., are soldered in the right order, according to the PCB layout diagram.

Before switching the receiver on, turn the volume control down and leave the AFC switch in the 'out' position. With power applied, one or both LEDs should be lit. There may not necessarily be any sound from the loudspeaker. It would be a good idea to check the supply voltages of 12V and 5V at the output of IC1 and IC2 respectively, before proceeding.

To set the receiver up, you will need a low level (10 to 500uV) RF source at 50, 52 and 54MHz with some frequency modulation on it. If you have an oscilloscope, you may find it helpful to monitor the audio output of the MC3362 at pin 13.

Start with no signal applied to any input and the selector switch at EXT. Set meter M1 to its zero position by adjusting VR3. Adjust the tuning control to make sure you are in fact not tuned to any signal and that the meter has been set to the lowest reading. The meter should remain at zero over most of the band, with a few positive deflections possible here and there. If this doesn't happen, check the circuitry



The patterns for both sides of the receiver PCB, reproduced here actual size.

around IC4a, including the polarity of the wires to the meter.

Leave the tuning control on any frequency at which the meter reads zero and adjust VC1 for equal brightness of the two LEDs or about 2.25V at pin 13 of IC3. If you can obtain the latter voltage, but the LEDs aren't lit to the same extend, check the circuitry around IC4d.

With the squelch control turned fully anti-clockwise and the volume control turned up slightly, you should hear noise on the speaker. If not, check the path between pin 13 of IC3 and pin 5 of IC5, using the DC voltages in Fig.2 as a guide.

Apply a 54MHz signal to the EXT input (the selector switch still on EXT), turn the tuning knob to 54MHz and adjust L3 until the applied signal can be heard.

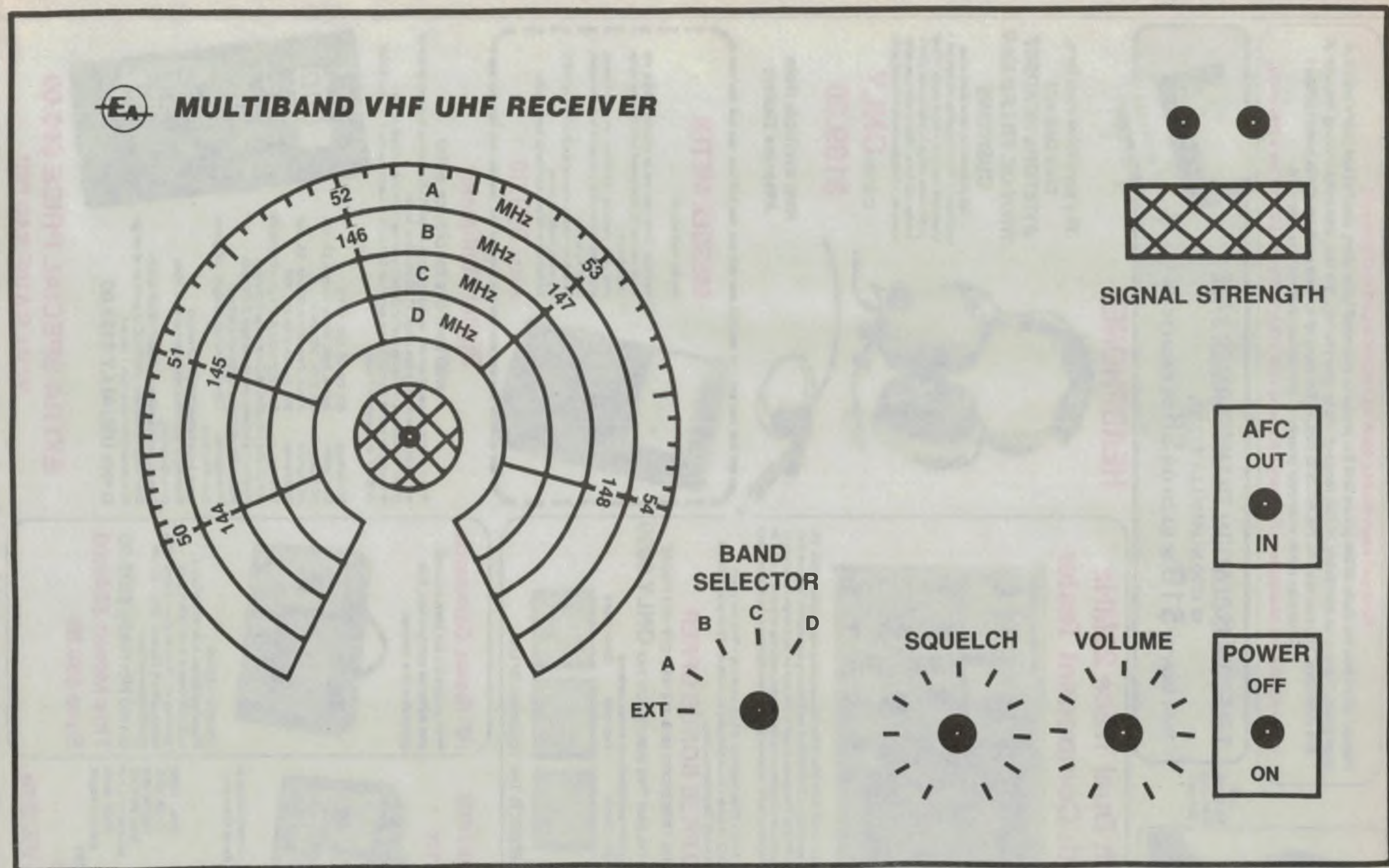
If you have difficulty finding the signal, you could try to measure the frequency of the first LO, knowing that it should be 10.7MHz below 54MHz, i.e., 43.3MHz. The LO output at pin 20 is too small to be of use, so you'll have to probe the 50mV (p-p) signals at pins 21 or 22. Take into account that the input capacitance of the average 10X probe would lower the LO frequency by about 7MHz. A low capacitance probe is therefor preferable (such as the active probe described in *EA* Sept. 1989). Alternatively you could bring a dip meter close to L3 and listen for an interfering signal.

You can also ensure that the second LO is operating, by probing pin 2 of IC3. A signal of 0.2mV (p-p) and close to 10.245MHz should be present. If the oscillator isn't operating, try reducing the value of capacitor C7. If the frequency is significantly off target, C6 can be changed in accordance with the specified load capacitance of the crystal.

Change the RF input signal to 50MHz, set the tuning dial to 50MHz and adjust VR1 to receive this frequency. Repeat the L3 and VR1 set-up procedure to ensure the frequency limits are correct.

Change the frequency to 52MHz, tune to the signal (with the proper tuning knob) and adjust inductor L2 for a peak deflection of meter M1. This setting is fairly coarse. Apply a smaller signal (1 to 40uV) at the same frequency into the Band A input, set the selector switch to Band A, tune in again and adjust L1 for a maximum deflection of the meter.

To test the AFC function, adjust the tuning control slightly away from the centre of an incoming signal, so that the LEDs have unequal brightnesses. When AFC is switched on, the LEDs should become equally lit again, indicating that the receiver is tuning automatically.



For those who would like to duplicate the front panel of the prototype, here is the artwork – again reproduced actual size. Note that the two cross-hatched areas indicate where metal is removed; this also applies to the filled-in smaller circles, which represent mounting holes.

Jack O'Donnell Managing Director

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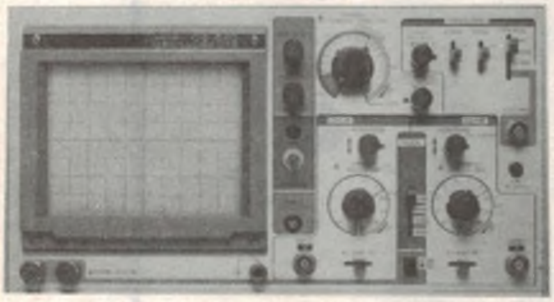

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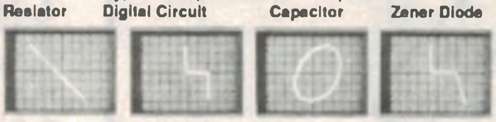

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Input impedance: 10M on all ranges

Nornmal mode noise rejection: 46dB at 60Hz (1k unbalanced)

Common mode noise rejection: 100dB at 60Hz

Overloads protection: 1000V DC or peak on all ranges

Response time: less than 1 second.

Q 1085 USUALLY $139.00

EXTRA SPECIAL PRICE $90.00 YOU SAVE $49.00!

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(See EA Dec'87)

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Fully built and tested
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S 5350 was $135.00 *SPECIAL ONLY $99.00* SAVE $36.00

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Won't scratch or damage - uses ordinary tap water and creates millions of super-penetrating bubbles. Hospital tests show that Ultrasonic cleaning produces better results safer than conventional methods.

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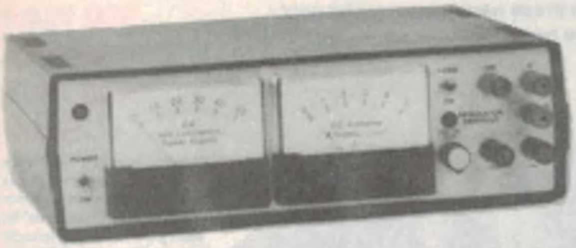

K 3300
$195.00
TOP VALUE

3 - 50 Volts at up to 5 Amps
(Ea May' 85)

Specs: 1 Output Voltage - 3.50 Volts
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- Floating outputs isolated from ground
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Employs Dual Meters - no switching from one to the other.

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Up to now similar lamps sold for $1000 & more

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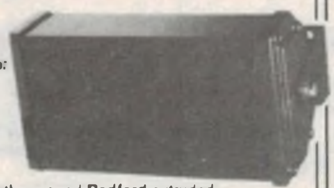
VIFA 2 Way 100 Watt Weatherproof Speaker



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1 GHz Frequency Counter

Measuring Mode: Frequency Measurements CHANNEL A
Range: 10Hz to 10MHz direct counter, 10MHz to 100MHz prescaled by 10
Resolution: Direct counter: 1, 10, 100Hz switch selectable, prescaled: 10, 100, 1000Hz switch selectable **Gate Time:** 0.01S, 0.1S, 1.0S, switch selectable **Accuracy:** +/- 1 count +/- time base error x frequency
CHANNEL B Range: 100MHz to 1GHz **Resolution:** 100HZ to 1kHz switch selectable **Gate Time:** 0.027S, 0.27S, 2.7S switch selectable
Period Measurements (Channel A) Range: 10Hz to 2.5MHz
Resolution: 10-7S, 10-8S, 10-9S switch selectable
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See our 1989 Catalogue Page 62 for full specifications of this top quality counter, now at even greater value for one month only.

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Specifications DC Voltage Ranges: 5 (200mV, 2V, 20V, 200V, 1000V) **Accuracy:** 0.5% + 1 Digit **Input Impedance:** 100M Ohm on 200mV range 10M Ohm on other ranges **Overload Protection:** 1100V DC max. (50 sec) or DC, AC Peak Max **Resolution:** 100uV **AC Voltage Ranges:** 4 (2V, 20V, 200V, 750V) **Accuracy:** +/- (0.75% + 0.5 dgr) 40Hz to 500Hz **Input Impedance:** 10M Ohm **Overload Protection:** 1100V DC max. (60 sec) or, DC, AC Peak Max **Resolution:** 1mV **DC Current Accuracy:** 20mA = +/- (1% + .5 dgr) 10A = +/- (2% + .5 dgr) 40Hz to 500Hz **Overload Protection:** 20mA = 0.2A 250V Fuse. 10A = 12A max. (60 sec) **Resolution:** 1uA

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(See SC Feb '90)

This NEW dual tracking power supply is a must for your workbench. The two rails track exactly with each other on any voltage and precise voltage is obtained with the multi-turn rotary control. It also has a clear display and meter movement, a dropout indicator and load ON/OFF switch. Housed in a medium sized instrument case with a silver anodised and pre-punched and screened front panel.

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NEW IN '90

K 3375 **$149**

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(See EA July '89)

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Construction Project:

The 'Super Vulture' car security alarm

by BRANCO JUSTIC

Super is the operative word here! Here's a car alarm with UHF remote on-off, two on-board detectors, blinker indication of arm and disarm, battery backup, and inputs for other sensors. It combines a number of already presented and proven projects to give a combination that equals the best commercial models – but at a fraction of the price. A complete kit will be available for only $119.90.

Over the last 12 months, we have presented several projects that could be described as component parts of a complete high class car alarm system. These are the UHF Remote Control (April '89), the Hazard Light Flasher (August '89) and the Vulture Car Alarm (November '89). All of these projects have proven to be very popular in their own right, particularly the multipurpose UHF Remote Control.

However, many readers have requested information on how to combine these individual projects into one complete unit. This article describes what's required, and we believe the resulting car alarm will prove to be the best and most fully featured unit so far presented in an electronics magazine.

The features

Before we start, here's a summary of the features of the 'Super Vulture'. The UHF remote control key has 19122 combinations for high security, and the visual indication for remote arming and disarming is provided by the car's blinker lights in which a preset number of blinks shows ON (two blinks for the values given in the circuit) and another preset number for OFF (four).

The alarm module has a fully adjustable voltage drop sensor, a fully adjustable vibration sensor and provision to connect bonnet and boot protection switches. As well, the alarm module includes optional battery backup (with on-board charger) and a heavy duty relay that flashes the blinkers when the alarm is triggered.

A dash-mounted light is driven by the alarm module, which flashes when the alarm is armed, and remains on if the alarm is triggered. Because the alarm will reset itself after a preset delay, indication that the alarm has triggered, then reset is provided by the dash light remaining on, meaning it 'remembers' the event.

The alarm module also has provision for future expansion, and we plan to describe a high quality crystal controlled ultrasonic movement detector in a future issue.

The three individual projects that make up this unit were designed to be self-standing, multipurpose projects, allowing them to be interfaced with other existing systems and alarms. Because they are now being combined, some minor modifications are required to allow them to form this most effective unit. Each of the projects were fully described when presented, and here we only discuss the modifications and interconnections required to give the complete alarm.

UHF remote key

This project was presented in April 1989, and included two relays referred to as the 'switch' relay and the 'indicator' relay. Because both the Vulture alarm module and the hazard light flasher units are operated with logic signals, these relays are no longer necessary. Also, to allow the hazard light flasher to double up as an alarm ON-OFF indicator, several timing resistor values have been changed, as listed further on. With the values shown, the blinker indication for ON will give two flashes and OFF will be shown with four flashes. Finally a 330 ohm 1/2W resistor is fitted in place of diode D4, to serve as a load for Q5 instead of the relay, allowing a logic 0 to appear when Q5 is off.

The required changes to the UHF receiver module are as follows:

(1) Delete diode D4 and the two relays (RL1 and RL2).

(2) Fit a 330 ohm, 1/2 watt resistor in place of diode D4.

(3) Replace R25 and R27 (both previously 10k) with 100k resistors.

(4) Replace R24 (was a 1k) with a 100k resistor, and replace R26 (previously 10k) with a 22k resistor.

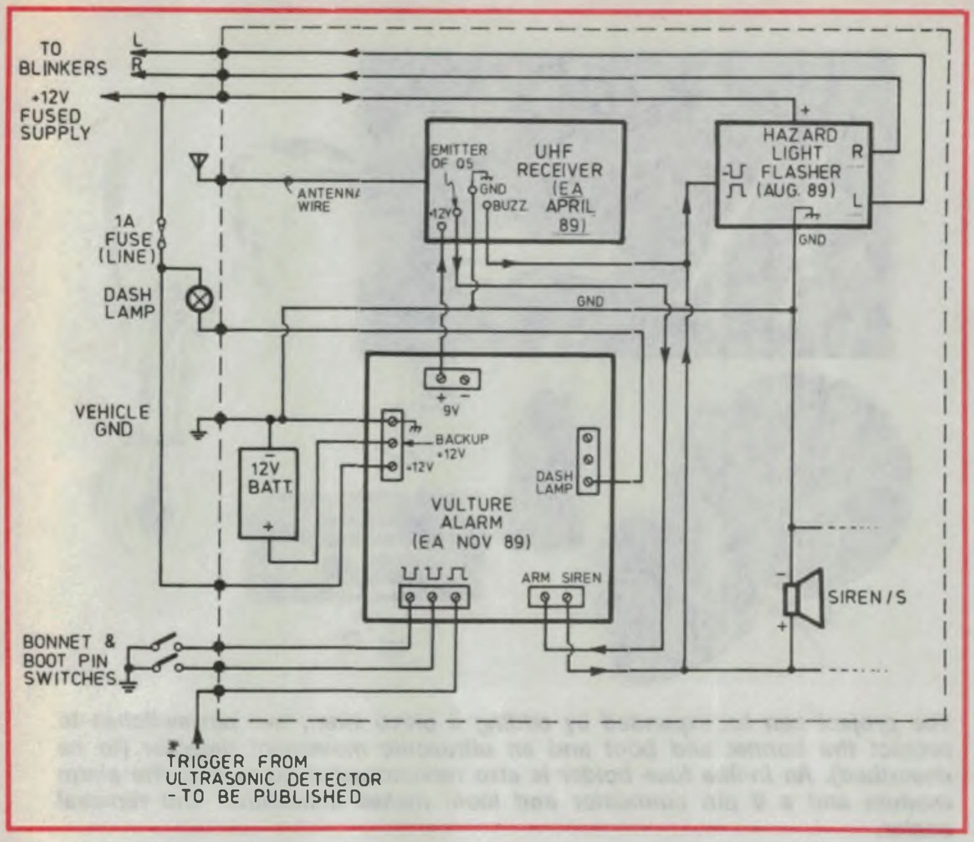
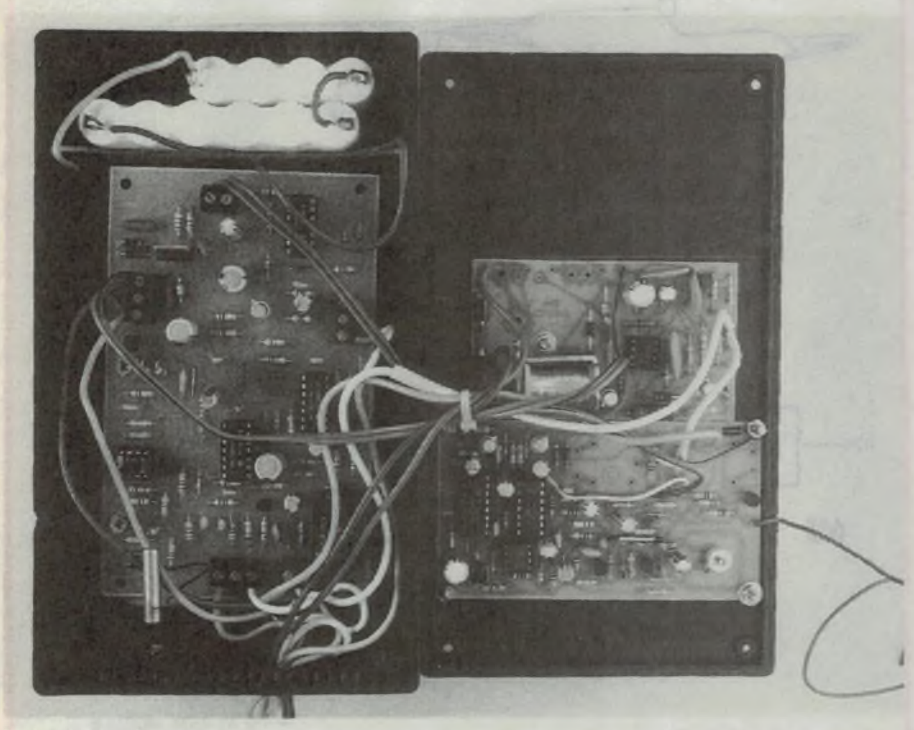


Fig.1: The block diagram of the Super Vulture car alarm, showing how each module interconnects. All of these modules are fitted into the jiffy box as shown in the photos.



This photo shows how we fitted the three PCBs into the box when constructing the prototype. Two are mounted on the lid, and the Vulture alarm module is attached to the bottom of the box. The optional battery pack is contained by a partition at one end of the box. For the purposes of the photo, the Vulture PCB has been raised from its normal position at the bottom of the box.

Hazard light flasher

This unit was presented in August 1989, and the only modification required is to delete the siren relay RL2. The blinkers are still operated by RL1 as described in the original article.

Vulture alarm module

This project appeared in November 1989, and requires two simple changes. The first modification is to increase the time taken to arm the alarm, as after it is turned on by the UHF remote key, the blinkers will flash to indicate that the alarm is now arming itself. If the alarm was to become armed before the blinkers finished flashing, the resulting variations in the 12V supply would trigger the alarm. The arm time has been increased to 10 seconds by changing R26 to 1M.

Because the alarm can now be disarmed by remote control, the alarm module should be wired to give instant triggering upon entry by linking points Z and Y. The required modifications are:

(1) Change the value of R26 (was 100k) to 1M.

(2) Fit a link from point Z to Y rather than from Z to X.

Construction

A complete kit of parts for this project will be available from Oatley Electronics, who also provide a backup service for repair and fault finding. The kit will contain the components listed in the parts list, as well as instructions. Note that the metal brackets, screws, nuts and hookup wire listed in the parts list are not included. The siren, backup battery and pin switches are also not included in the kit, and will be available as separate items.

Individual kits for each of the three projects are also available, although the prices may be slightly higher than those listed when the projects were published.

If you buy a complete kit, that is all the modules together, each one of these can be constructed by referring to the original articles, but note the modifications for each described in this article. The best way to tackle the construction is to build each module as described and to test it before proceeding to the next module. That is, build the UHF remote control transmitter and receiver, then align, test and code them. (Ref: January 1989 for transmitter, April '89 for receiver). Then build the Hazard Flasher (August 89) followed by the Vulture alarm module (November '89).

If you already have one or more of the modules built, all that is required is

Vulture

to incorporate the changes referred to in this article. In this case, you will only need to purchase and construct the missing modules.

Once all modules are built and tested, they can be assembled and interconnected as shown in Fig.1. The prototype was assembled into a jiffy box measuring 60 x 113 x 195mm. The position of each of the PCBs is not critical, although the UHF receiver should be mounted on the lid, to keep it away from the metal of the car body. The antenna for the receiver is a length of insulated wire approximately 400mm long, arranged to hang outside the box.

As shown in the photographs of the unit, a backup battery was fitted to the prototype by inserting a partition into the jiffy box and sandwiching the NiCad battery pack with foam rubber. The partition can be metal, plastic or even thick cardboard.

Test the unit on the bench before installing it, following the test procedures described in the previous articles.

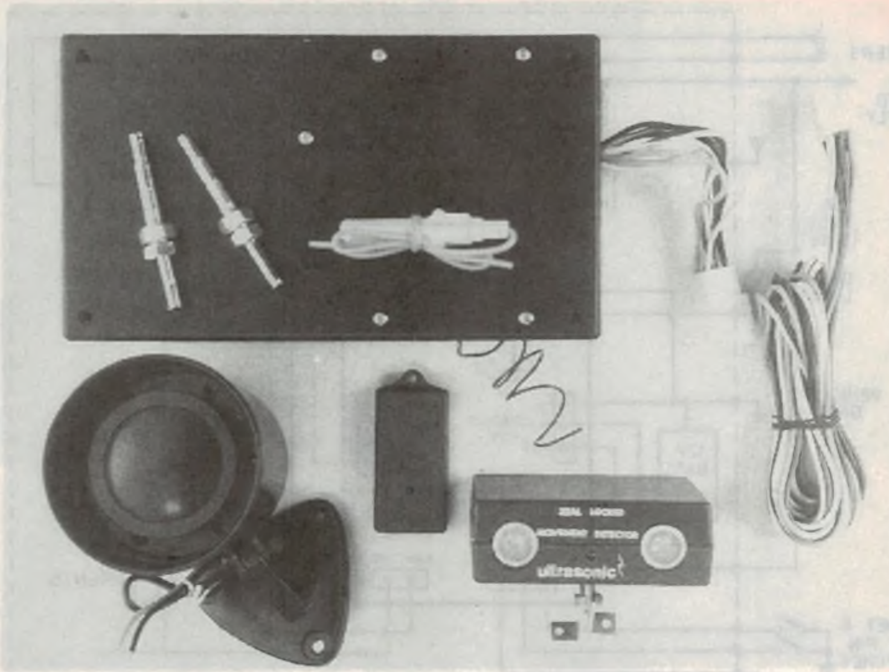
Installation

Installation of the unit, like any car alarm, is the most tedious part, and will vary considerably from one car to another. We recommend that you read the installation description presented in the article describing the Vulture alarm module, before proceeding to fit the unit to the car. To help you further, here are a few more hints that may be useful.

A handy tool to help identify wiring within the car is a 12V test lamp, made from a 12V lamp with two leads fitted with alligator clips as shown in Fig.2(a). A pin held by the alligator clips is useful for piercing through the insulation of a wire to enable it to be identified. For example, a blinker light supply wire can be found by attaching one lead of the test lamp to the car's metalwork and testing the wire by piercing its insulation with the pin held by the other lead.

The alarm system should, ideally, be protected with two fuses as shown in the connection diagram. The main fuse is the car's blinker fuse and the connection point is that side of the fuse that shows 0V when the fuse is removed. (Use the test lamp to identify). This fuse is used because the alarm operates the blinkers.

A second in-line fuse (1 amp or so) should be used to provide protection for the Vulture alarm module. This fuse is necessary as the blinker fuse will typically have a rating of 10A or more, and a fault in the alarm electronics would



The project can be expanded by adding a piezo siren, two pin switches to protect the bonnet and boot and an ultrasonic movement detector (to be described). An in-line fuse holder is also recommended to protect the alarm module and a 9 pin connector and loom makes installation and removal easier.

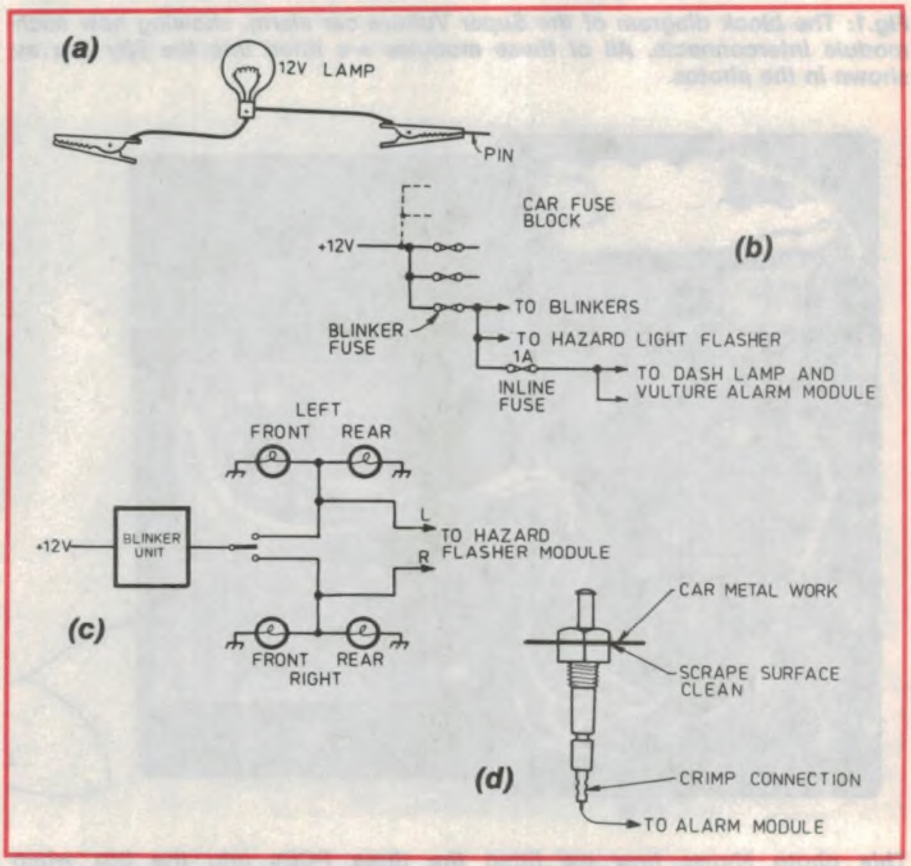


Fig.2: A useful test lamp can be made as shown in (a). The pin is used to pierce through the insulation of a wire for measurement purposes. The 12V supply is connected as shown in (b), and (c) shows how the blinkers are wired into the unit. If you use pin switches to protect the boot and bonnet, fit them as shown in (d).

Fig.3: Stick a photocopy of this warning to one or more windows of the car to let the world know the Vulture is on duty.

become very severe before it blew this fuse.

The car's blinker wiring needs to be identified so that the Hazard Flasher module can be connected to operate the blinker lights. First identify the colour coding used in the car for both the left and right blinker lights by looking in the boot and tracing the wires that go to the actual lights. These wires will most likely be contained in a loom running the full length of the car, and you may be able to find them at a point close to the alarm unit. The required connections are shown in Fig.2(c).

The connections can be done in a number of ways, and most automotive shops sell a crimp-type connector that allows a wire to be 'tapped' into an existing wire. These are not as good as cutting the wire and joining in the additional wire, but are easier to use. Make sure the connection is tight (soldered perhaps), as currents of several amps or more must be passed.

If you decide to add pin switches to protect the boot and bonnet, the diagram of Fig.2(d) should be referred to. Make sure the underside of the metalwork used to support the switch is scraped clean, to give a good connection from the switch to the car's ground. If your car has a boot light, the voltage drop sensor in the alarm will probably respond if the boot is opened, making a switch unnecessary.

To allow the alarm to be removed easily (when you sell your car perhaps), you could fit an automotive Molex-style connector to interface the alarm to the car's wiring. We used a 9-way plug and socket that included colour coded wires already connected. Make sure the wires are for automotive use; don't use hookup wire, as its insulation and current rating may not be suitable.

We have tested this alarm in two cars, and found it reliable and fairly easy to install. After all, most of the wiring shown in Fig.1 is between each module, and the external wiring is simply to the car's 12V supply, ground, the blinker lights, the dash mounted indicator and other optional sensors. Mounting the box containing the electronics was described in November 1989, and the same rules apply here.

And after installation, you should have an alarm system equal to any on the market. To complete the job, we have included a picture that can be used as a warning sticker, shown in Fig.3. Photocopy the picture and attach it to a window as another deterrent. You can't be too careful, these days!

PARTS LIST

1 UHF transmitter kit
1 UHF receiver kit (no relays)
1 12V lamp for dash mounting
1 Hazard Light flasher kit (one relay only)
1 Vulture car alarm kit (one relay only)
1 Plastic jiffy box, 60 x 113 x 195mm
Metal brackets, screws, nuts, hookup wire (not included in kit)

Resistors

All 1/4W, 5%: 1 x 22k, 3 x 100k, 1 x 1M
1 330 ohm 1/2 watt

Kits of parts for this project are available from:
Oatley Electronics
5 Lansdowne Parade,
Oatley West, NSW 2223.
Phone (02) 579 4985

Postal address (mail orders):

PO Box 89, Oatley West NSW 2223.

Complete kit as per parts list... $119.90
Large piezo siren.................. $25.50
7.2V NiCad battery packs........ $10.90
Pin switches (bonnet/boot) each. $1.10
Post & Packing charge............ $4.00

Basic Electronics - Part 3

Batteries

Anything electrical or electronic needs a voltage to make it work. Usually a DC voltage is required, but what do you do if all you have is an AC voltage? The choice is either a battery or some form of circuit that converts AC to DC. We look at batteries in some detail in this chapter, including some of the more unusual types that could be the power sources of the future.

by PETER PHILLIPS

Very few electronic or electrical circuits work without requiring a voltage source. (A mental teaser is to try and name a few). A voltage, as we've already described, is the electrical force that 'drives' electrons through the circuit, in which electrons flow from the negative terminal to the positive terminal. Don't forget though, that consistent with most books on electronics, we are regarding electron flow as being in the opposite direction to current flow and as Benjamin Franklin decreed in the 19th century, current therefore flows from positive to negative.

The direction of a current is generally not all that important, but it raises the interesting possibility of a current *changing* direction. A current that flows continually in the same direction is called a *direct current* (DC) and a current that periodically changes direction is an *alternating current* (AC). A current whose *value* periodically changes but without altering direction (that is, no change in polarity) is called a varying DC.

Because the direction of the current is determined by the voltage, a voltage that causes a direct current is known as a DC voltage. To produce an AC current requires an AC voltage and a varying DC current needs a varying DC voltage. The terms 'DC' and 'AC' seem to be out of context when it comes to talking about a voltage, but common usage has it this way.

We look first at that most popular of DC voltage sources: the battery. However the crunch comes when discussion commences on the alternating voltage. This is a big topic, and will need a chapter on its own. In future chapters we will also look at deriving a DC voltage from an AC voltage, as this is the most common way of powering an electronic circuit.

The electric cell

The 'voltaic' cell has its origins back in the 19th century, and the first electric battery is attributed to Alessandro Volta as far back as 1800. The term 'volt' is in recognition of Volta's work, as electrical energy really got under way with this development.

Volta's battery consisted of disks of zinc and copper separated by a piece of cardboard moistened with a salt or acid electrolyte solution. During operation of the cell, some of the zinc combined chemically with the electrolyte, leaving a negative charge on the zinc plate and producing a voltage between the zinc and copper plates. The voltaic cell, or *pile*, as it was called, caused a revolution at the time, as it allowed electric currents to be produced of a magnitude never before available.

Volta's cell illustrates the basic components of an electric cell: two dissimilar metals (anode and cathode) immersed in some form of electrolyte, or electrically conducting liquid. In fact, an interesting experiment, often conducted in school science classes is to use a

Modern dry cell 'batteries' come in many types, as well as sizes. Here is an array of 'D' size cells showing (left to right) three different grades of carbon-zinc cell, an alkaline cell and a NiCad rechargeable.

lemon as the electrolyte.

A problem with the basic voltaic cell is that gas forms around the anode, restricting further chemical action and causing a drop in output voltage. This effect is called *polarisation*, and can inhibit the output quite quickly. In 1868, Georges Leclanche produced the first practical cell, in that it overcame the problem of polarisation. The Leclanche cell contained a zinc cathode (negative terminal) and an anode (positive terminal) made up of a carbon rod, surrounded by a mixture of manganese dioxide and powdered carbon held together in a porous container. The whole thing was fitted into a glass jar filled with an electrolyte, in this case a solution of ammonium chloride. The manganese dioxide was the *depolarising* agent and absorbed the hydrogen generated during discharge.

This cell was then improved by Gassner in 1888, in which the electrolyte, carbon, manganese dioxide combination was formed into a paste, producing the first *dry* cell. This arrangement is still used today in the popular carbon-zinc cell. The terms 'wet' and 'dry' cell are used to differentiate between those cells whose electrolyte is a liquid to those using a paste. However, the paste still requires some moisture for the chemical action to occur.

Primary cells

In general terms, batteries can be grouped into one of two types, using either primary or secondary cells. A primary cell is one that cannot be recharged, and, (you guessed it), a secondary cell is one that can. Primary cells vary from the common zinc-carbon variety, through the longer lasting alkaline types, to the many miniature batteries currently available.

The fundamental part of a battery is the *cell*, and, for the carbon-zinc type, a single cell produces 1.5V. To be strictly correct, the so-called 1.5V torch battery is really a 1.5V torch *cell*. Carbon-zinc batteries capable of more than 1.5V contain a number of series connected cells, such as the 9V battery which contains six individual cells, connected positive to negative and all contained in the same case. In fact, it is common to connect batteries (or cells) in *series* to increase the total voltage, as shown in Fig.1(a).

The circuit diagram is also shown, in which the symbol for a battery is depicted as two cells separated by a row of dashes to indicate that a number of cells are being used in the battery. The symbol for a single cell is described more fully in Fig.2.

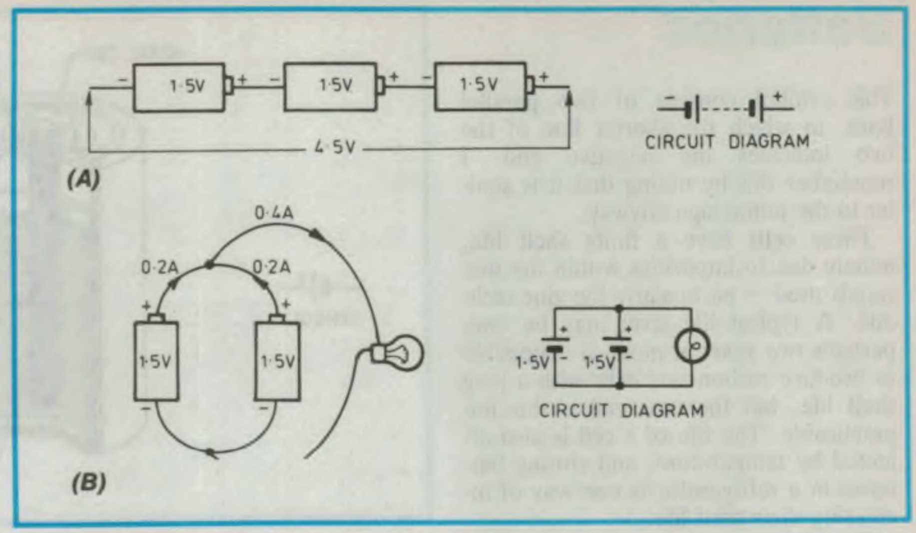


Fig.1: (a) Cells can be connected in series to give a higher output voltage. (b) To increase the current capability, cells can be connected in parallel. Cells should be matched to prevent one cell doing all the work, or even trying to charge another. The circuit diagrams show how these connections are drawn in schematic form.

The physical size of a cell determines its current capability, and some primary cells when new are able to deliver over an amp of current. If the current capability of a group of batteries (or cells) needs to be increased, they can be connected in *parallel*, as shown in Fig.1(b). However this can result in one cell trying to charge another if the cells are not perfectly matched, and some precautions are needed.

Carbon-zinc cells

The most common primary cell is the carbon-zinc cell, still made today with a construction based largely on the Gassner model. The construction of the carbon-zinc cell is shown in Fig.2, with the symbol used to denote a single cell.

TABLE 1

NAME	VOLTAGE	WET OR DRY	PRIMARY OR SECONDARY TYPE	NOTES
Carbon-zinc (Leclanche) cell	1.5	Dry	Primary	General purpose batteries; flashlight batteries; lowest price; short shelf life
Manganese-alkaline cell	1.5	Dry	Both types	Manganese dioxide and zinc in hydroxide; currents above 300 mA
Lead-acid cell	2.2	Wet	Secondary	Very low r, and high current ratings; 6-and 12-V batteries
Edison cell (NiFe cell)	1.4	Wet	Secondary	Nickel and iron in hydroxide; industrial uses
Mercury cell	1.35	Dry	Both types	Mercuric oxide and zinc in hydroxide; constant voltage, long shelf life; B batteries; miniature button cells for hearing aids and cameras
Nickel-cadmium cell	1.25	Dry	Secondary	Hydroxide electrolyte; constant voltage; reversible chemical reaction; used in rechargeable flashlights and portable power tools
Silver-oxide cell	1.5	Dry	Primary	Silver oxide and zinc in hydroxide; miniature button cells for hearing aids

H002247

Batteries

This symbol consists of two parallel lines, in which the shorter line of the two indicates the negative end. I remember this by noting that it is similar to the minus sign anyway.

These cells have a finite shelf life, mainly due to impurities within the materials used – particularly the zinc cathode. A typical life span may be one, perhaps two years at most. It is possible to produce carbon-zinc cells with a long shelf life, but the cost makes this impracticable. The life of a cell is also affected by temperature, and storing batteries in a refrigerator is one way of increasing their shelf life.

There are a wide variety of carbon-zinc batteries in use, ranging from the tiny AAA size up to large lantern batteries. Their construction has improved over the years, but the phenomenon of a leaky battery ruining the equipment it powers is still a potential hazard.

The larger the battery, the longer the shelf life and the greater the current capability. The smaller varieties often fail as a result of exceeding their shelf life, rather than exhaustion due to the load. Batteries in a remote control unit for a TV or video recorder are a typical example.

An improvement on the carbon-zinc cell is the *alkaline* cell, so called because the electrolyte is an alkaline solution, rather than an acid as in the carbon-zinc cell. In fact, the term alkaline cell is occasionally applied to some secondary cells (the NiCad and NiFe types) as their electrolyte is also an alkali.

The alkaline primary cell has much the same construction as the carbon-zinc cell, but with an electrolyte of potassium hydroxide. These cells are more expensive than the conventional types, but have an improved shelf life and performance characteristics.

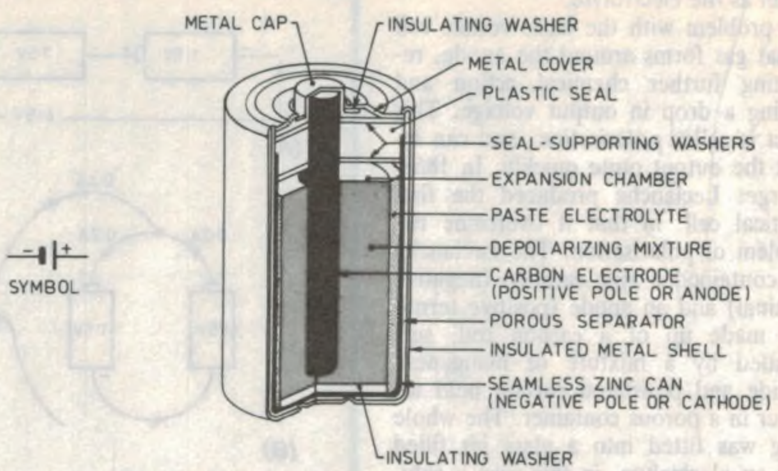


Fig.2: The construction of a typical zinc-carbon cell. The electrolyte is a paste, giving the term 'dry' cell. The original Leclanche cell had a liquid electrolyte, hence the term 'wet' cell. The symbol of a cell is also shown, in which the negative end is depicted with a small line similar to a negative sign.

Alkaline batteries come in various shapes and sizes including the 12V alkaline battery, used in a range of remote control transmitters and cigarette lighters. They are also packaged in the miniature button style for use in calculators and electronic games.

The zinc-chloride construction is another variation of the carbon-zinc cell, and has improved output at minimal cost increase. A zinc-chloride cell is claimed to have a performance around 75% of that of the alkaline cell, but at approximately half the cost.

Other types

The need for miniature batteries has increased dramatically in recent years, and cells with a high output compared to size are made with a number of chemical systems including lithium, silver oxide or mercury.

These cells are generally used in applications requiring very small currents, usually no more than a few milliamps. They are used in numerous applications such as backup power supplies in computer memory systems, watches, cameras and calculators. Some types are also available in packages suitable for direct soldering on the printed circuit board.

The internal construction of a mercury cell is shown in Fig.3. Note that the top of the cell is negative, unlike the usual arrangement, where the top terminal is positive and that the case (made of steel) is negative. Fig.3(a) shows the construction of a cylindrical type, and (b) shows the more common button type. The mercury cell has a very high capacity for size and a low internal resistance. The cell voltage is 1.35V, and a mercury *battery* is made by stacking cells in series and packaging the lot into one container.

The silver oxide cell is shown in Fig.4. This cell has an even higher capacity for size than the mercury cell, but comes with a higher price tag. It has a silver oxide cathode, a zinc anode (positive terminal) and a potassium hydroxide electrolyte. These cells are used wherever their small size justifies their high cost, such as in a hearing aid. They have an output voltage of 1.5V per cell, which is marginally higher than the mercury cell.

The lithium cell is often used in computers as a backup supply for the computer's internal time clock, or for battery RAM backup. Button types are also available for use in calculators and

Each type of dry cell comes in a variety of sizes. Here are alkaline cells (left to right) in the AAA, C, D, AA and miniature 9V sizes.

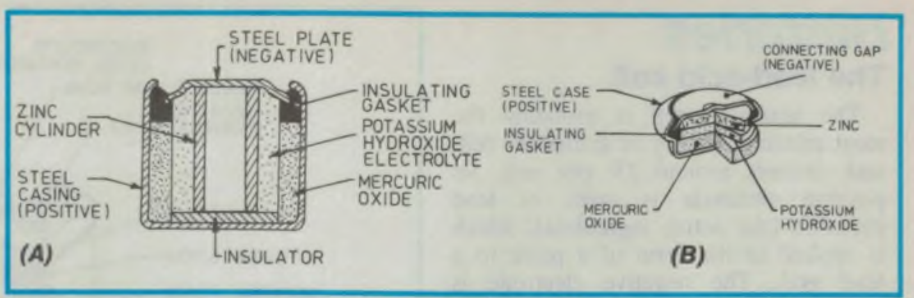


Fig.3: The mercury cell. (a) shows the construction of the cylindrical type, (b) the construction of the more commonly available button type. Note that the case is positive and the top terminal is negative. The electrolyte is an alkali (potassium hydroxide), mixed as a paste.

the like. Their main feature is longevity, and a ten year life span is typical. However, they can be expensive, some types costing $20 or more. Still, that's only $2 per year!

Internal resistance

An important point about primary cells is that they possess a fairly high internal resistance – depending on their size, age and type. The resistance increases with age and can sometimes cause erratic circuit behaviour, particularly when the circuit uses power in a pulse form, such as in a digital circuit. The average current may be small, but the individual bursts can be high enough to create severe voltage variations, often only visible on a cathode ray oscilloscope (CRO).

The internal resistance of a cell, or battery, is the limiting factor that determines the current able to flow when a short circuit is connected across the battery. If the internal resistance is zero, then assuming the short circuit itself has no resistance, an infinitely large current would, theoretically, be able to flow.

You cannot measure a cell's internal resistance with an ohmmeter, but it can be calculated from two other measurements able to be taken, as shown in Fig.5.

The first measurement is the open circuit, or no load voltage of the battery, as shown in Fig.5(a). The voltmeter, particularly if it is a digital type, will take very little current from the battery, and can be regarded as an open circuit. The next value required is the short circuit current, measured by connecting an ammeter across the battery, as in Fig.5(b). Because an ammeter has a very low resistance, the current that flows will be limited mainly by the internal resistance of the battery.

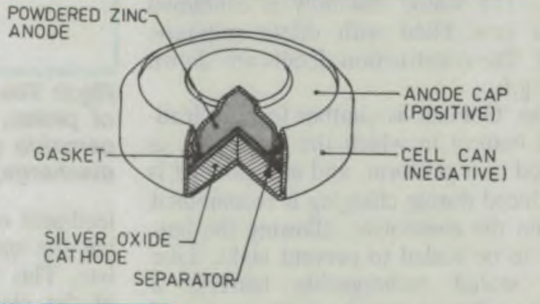
The value of the internal resistance (Rint) will, by Ohms law equal V/I. This is often a good way of determining the state of charge of a battery, but it has the disadvantage of using up considerable chemical energy during the short circuit test.

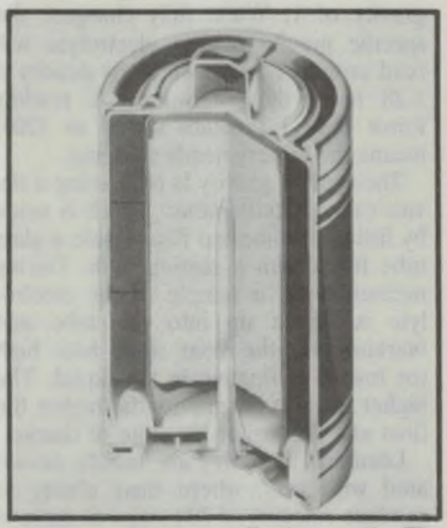
Rechargeable cells

Rechargeable batteries, (or secondary cells) have a chemical action that can be reversed by passing a current through the battery in the opposite direction. The two most common types are the lead-acid, (as in motor cars), and the nickel-cadmium chemical systems.

A third variety, using a nickel-iron chemical system (NiFe cell) is occasionally found. It was developed by Thomas Edison and was originally intended for

Fig.4: The silver-oxide button cell. The case is negative, unlike the mercury cell, but the electrolyte is also an alkali. These cells are relatively expensive, but feature a high output versus size.





Inside a modern alkaline cell. The central spike is the current collector for the zinc anode.

the Model T Ford. Unfortunately things didn't quite work out, but Edison is reported to have spent some US$1.2 million dollars in the 1920's in his search for the perfect battery. However, the NiFe cell has several advantages over the more popular lead-acid battery, including its higher efficiency and the fact that it can be left in an uncharged state for long periods of time. It also features a longer life, but has a lower output voltage that drops under load, usually to around 1.2V per cell. They are used mainly in industrial applications due to their long life span and general ruggedness.

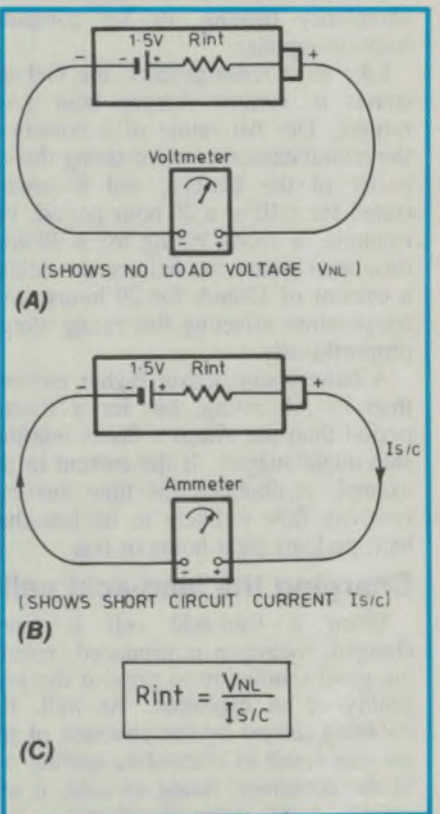


Fig.5: The internal resistance of a battery limits the available output current. Its value can be calculated by measuring the open circuit voltage as in (a), measuring its short circuit current as in (b) then using the equation shown in (c).

Batteries

The lead-acid cell

The lead-acid cell is probably the most common variety of secondary cell, and delivers around 2V per cell. Its positive electrode is made of lead peroxide (the active ingredient), which is applied in the form of a paste to a lead grid. The negative electrode is similar in shape, but is made of spongy lead. Each cell consists of a number of plates of both types, in which groups of positive and negative plates are interleaved and spaced by insulating separators. The whole assembly is contained in a case filled with dilute sulphuric acid. The construction details are shown in Fig.6.

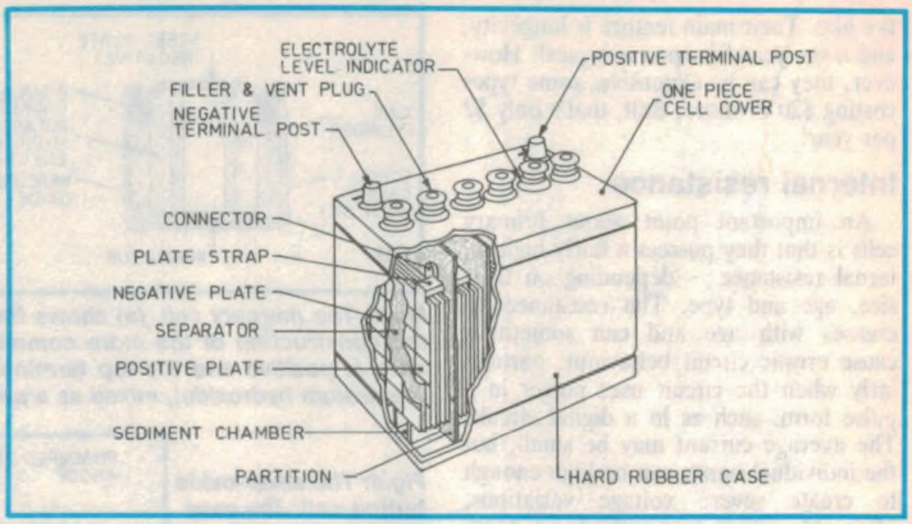


Fig.6: The construction of the lead-acid cell. A single cell contains a number of plates, in which the positive plates are a lead grid covered in a lead peroxide paste and the negative plates are made of spongy lead. During discharge, water and lead sulphate are formed, diluting the electrolyte.

The 'Gel cell' is another form of lead-acid battery in which the electrolyte is stored in a gel form, and any gas that is produced during charging is recombined within the electrolyte, allowing the battery to be sealed to prevent leaks. Like any sealed rechargeable battery, a safety valve is incorporated in case of accidents. The Gel cell provides an excellent power source for burglar alarms, emergency lighting, or for computer back-up supplies.

Like most rechargeables, the Gel cell comes in various Ampere-hour (Ah) ratings. The Ah rating of a battery is the manufacturer's way of rating the capacity of the battery, and is usually stated for a 10 or a 20 hour period. For example, a 2.6Ah rating for a 20-hour time span means the battery can deliver a current of 130mA for 20 hours, with temperature affecting this rating almost proportionally.

A battery can deliver higher currents than its Ah rating, but for a shorter period than the Amps x hours relationship might suggest. If the current in the example is doubled, the time this current can flow is likely to be less than half, perhaps eight hours or less.

Charging the lead-acid cell

When a lead-acid cell is being charged, hydrogen is produced, requiring good ventilation to prevent the possibility of an explosion. As well, the bubbling caused by the emission of the gas can result in electrolyte spilling out of the container. Being an acid, it will quickly burn holes in clothing, rust metal and stain flooring. In short, the right environment is essential! The Gel cell, being sealed, doesn't have these problems of course, but testing its state of charge is not as easy to do as in the conventional unsealed types.

The state of charge of an unsealed lead-acid cell is determined by measuring the *specific gravity* of the electrolyte. This refers to the relative density of the electrolyte compared to water, which is defined as having a specific gravity of 1. When fully charged, the specific gravity of the electrolyte will read around 1.28, meaning its density is 1.28 times that of water. A reading lower than 1.2 (often stated as 1200) means the battery needs charging.

The specific gravity is read using a device called a *hydrometer*, which is made by fitting a calibrated float inside a glass tube fitted with a suction bulb. During measurement, a sample of the electrolyte is drawn up into the tube and markings on the float show how high (or low) it is floating in the liquid. The higher the specific gravity the higher the float and the higher the state of charge.

Lead-acid batteries are mostly associated with cars, where their ability to produce currents of 200 amps or more is essential to operate the car's starter motor. The recharging system of the car maintains the battery, and various schemes are used to show that recharging is occurring. The most common indicating system is the ignition light, which glows when the current flowing out of the battery is greater than the charge current.

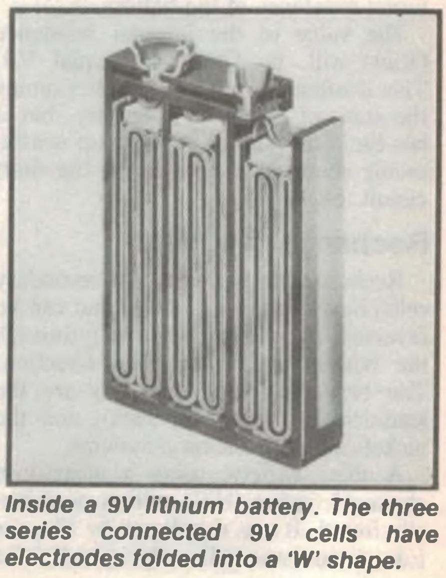
Another system uses a voltmeter to indicate the voltage of the battery. Under normal charge conditions, the voltage of a 12V car battery will show 13V or more. This voltage will quickly drop to around 12.5V after the charging source has been disconnected, and may drop to as low as 11V after a few days if the battery has not received a charge. However, the voltage of a lead-acid cell is not necessarily a good indication of the state of the charge, although it can give some idea of how the battery is responding.

A lead-acid cell is tested by measuring its output voltage under load. If the cell voltage drops considerably when a load is applied, the cell has developed a high internal resistance and needs replacing. Car batteries can also develop an internal open circuit, almost without warning, as many frustrated motorists know.

The NiCad cell

Nickel-cadmium (NiCad) rechargeable batteries are available in the same packages as zinc-carbon batteries, although they have a lower output voltage of 1.2V per cell, as compared to 1.5V per cell for the zinc-carbon types.

In the charged state, the positive elec-



Inside a 9V lithium battery. The three series connected 9V cells have electrodes folded into a 'W' shape.

trode is nickel hydroxide and the negative electrode is metallic cadmium. The electrolyte is potassium hydroxide, (an alkali) and the whole assembly is contained in a sealed case. The fact that it is sealed means it can be used in any position, making it suitable for use in portable equipment, and it is generally more cost effective than a primary cell.

The NiCad has a relatively low output resistance, and its output voltage remains virtually constant almost to the end. (When they die, however, they die!). A disadvantage is the so called 'memory effect' – meaning they 'remember' how many times they have been charged and recharged, with an eventual reduction in capacity.

NiCads need some care however, if the maximum life of the battery is to be realised. When charged with a 'float' or trickle charge it becomes nearly impossible to hurt them with overcharging, but their capacity is reduced if this is the only way they are ever charged.

The recommended way of charging most NiCads is to supply a charge current for 14 hours at a value equal to their 10 hour discharge rate. For example, a 1.2Ah rated NiCad cell is capable of sustaining a discharge current of 120mA for 10 hours. It should therefore be charged for 14 hours at 120mA, and thereafter left on trickle charge to make up for losses due to internal discharging. A more complete article on NiCads and a design for a NiCad charger and discharger were presented in *Electronics Australia* for July and September, 1989.

Some NiCads come with temperature sensors built into them, allowing fast charging in conjunction with a suitable charging circuit. Clearly, their replacement with the same type is essential. Fast charging a NiCad is sometimes used by model car enthusiasts, but the life of the battery is severely shortened, and the danger of internal heating causing explosion is always present.

Other cells

Other types of cells have been developed over the years, including the nuclear cell, the fuel cell and the solar cell. The nuclear cell is a device that generates electricity directly from nuclear energy, and consists of a radioactive source that emits high-speed electrons, a collector that captures and accumulates these electrons and an insulator through which the electrons pass to reach the collector. Nuclear batteries generate quite high voltages, and are used in spacecraft and other exotic applications.

The fuel cell, first conceived by William Grove in 1839 is an unusual cell in that it can operate continuously providing the active materials are supplied from an external source. The electrolyte remains chemically unchanged during operation, and these cells have been successfully used in spacecraft.

Fuel cells seem to be the ideal energy source of the future in that they have the potential for very high efficiency and can use basic fuels for their active materials, rather than highly refined metals. One type of fuel cell uses hydrogen and oxygen gas as the fuel and potassium hydroxide as the electrolyte. The gases enter the cell through porous electrodes and combine to form water. In the process, a voltage is generated between the two electrodes.

While it all sounds simple enough, fuel cells capable of useful power outputs are still under research, and a practical cell has still to be developed. Something to look forward to, perhaps.

The solar cell converts light energy to electrical energy, and they are now fairly commonly used in solar powered calculators. Solar batteries have the disadvantage of requiring a large surface area if useful output power is required, but solar powered electric cars, telephone boxes and battery chargers are examples using this form of energy.

When used as a battery charger, an array of solar cells capable of trickle charging a battery, usually lead-acid, is positioned to receive solar energy. A typical single solar cell can only produce around 0.4V, so quite a few are needed in the bank. Some parts suppliers stock solar cells with a current capability of 450mA, and connecting several together can give quite substantial power to drive motors, recharge batteries and do a range of useful tasks.

Summary

The battery has come a long way since its invention, but then it has had nearly 200 years of development time, and some might argue progress has been rather slow. Certainly Edison's dream of an electric car has yet to be realised and the perfect battery is by no means a reality yet. A problem with rechargeable batteries is that only around 80% of the energy required to charge them can be retrieved, making electric cars and the like relatively inefficient, compared to petrol, gas or diesel engines.

The summary shown in Table 1 lists most of the cells discussed in this chapter, with some comments to compare each type. In the next chapter we will examine AC voltage, in readiness to showing how a DC voltage can be produced from an AC supply. EA

Vintage Radio

by PETER LANKSHEAR

A 'Universal' battery eliminator

All of the very early, and many later vintage receivers were battery operated. They are much more interesting when operational, but batteries have always been inconvenient and expensive, and there is a long history of powering these radios from the mains. This article will describe a universal power supply suitable for operating a wide range of battery receivers.

Dedicated power supplies for individual receivers can be compact and simple, as illustrated in the April 1989 article on the STC 509 portable. However, a supply capable of powering a wide range of receivers is a much more complex project.

Although the basic principles of power supplies have not changed, vastly improved performances are possible with modern technology. Whereas battery eliminators of 60 years ago were barely adequate, today's power supplies can more than equal the performance of new batteries.

Specifications

The requirements of a large number of battery receivers dating from 1920 to 1960 were analysed. As Table 1 shows, there has been a remarkable variety of filament requirements, varying from 150mA at 1.4 volts for the later low consumption miniature receivers to as much as 3A at 6.3 volts for vibrator equipped domestic sets. And whereas low current filaments are very sensitive to hum, vibrator receivers demand very low impedance voltage sources.

To cater for all possibilities with individual or switched outlets would be quite impractical. Consequently, the filament supply has been made continuously variable from 1.2 to 9.0 volts and with a current capability sufficient for any conventional battery powered receiver.

High tension demands were less stringent. To cope with the ageing characteristics of dry cells, there was a wide tolerance of voltage variations. Generally, 'B' batteries were required to give maximum nominal voltages of 90V or 135V, with tappings in multiples of 22.5 volts and total current demands less than 25mA.

Most bias voltages were in the range –1.5V to –9.0V, with some early output valves requiring as much as –27 volts. The current drains on bias supplies were at the most a few milliamperes.

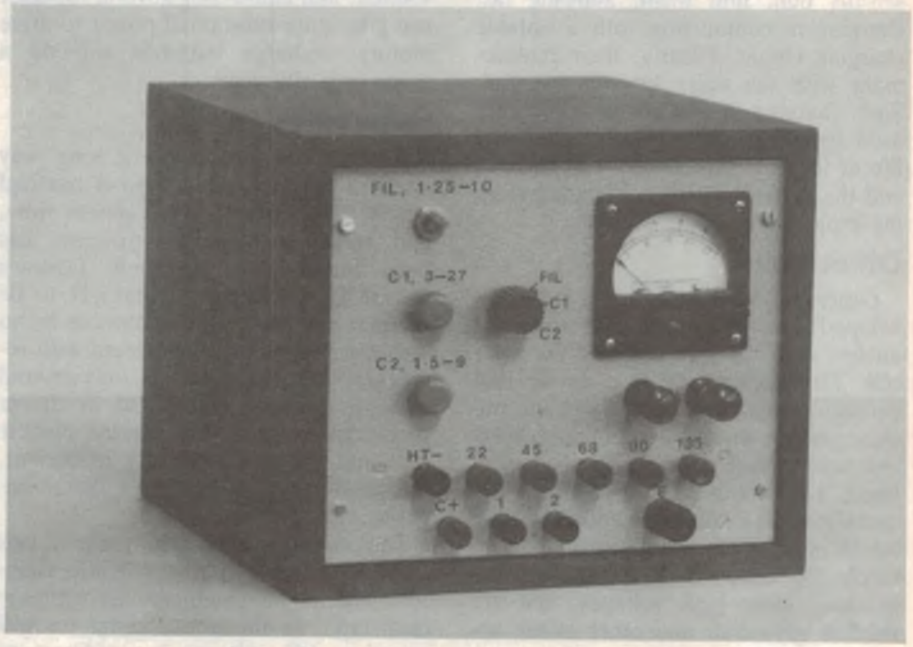
Specifications for the supply to be described are listed in Table 2. Hum level from the unregulated 135V terminal is only 75mV, or .055%. All other outputs are regulated (see circuit) and their hum levels are practically unmeasurable. The filament and bias outputs are short circuit proof, and the regulated HT outputs are capable of withstanding short duration heavy overloads.

The voltmeter is good insurance. Although the filament and bias voltage adjustment controls could be directly calibrated, this is an imprecise method and the cost of a meter is small compared to that of a set of rare valves which can be easily burnt out by an incorrect filament voltage.

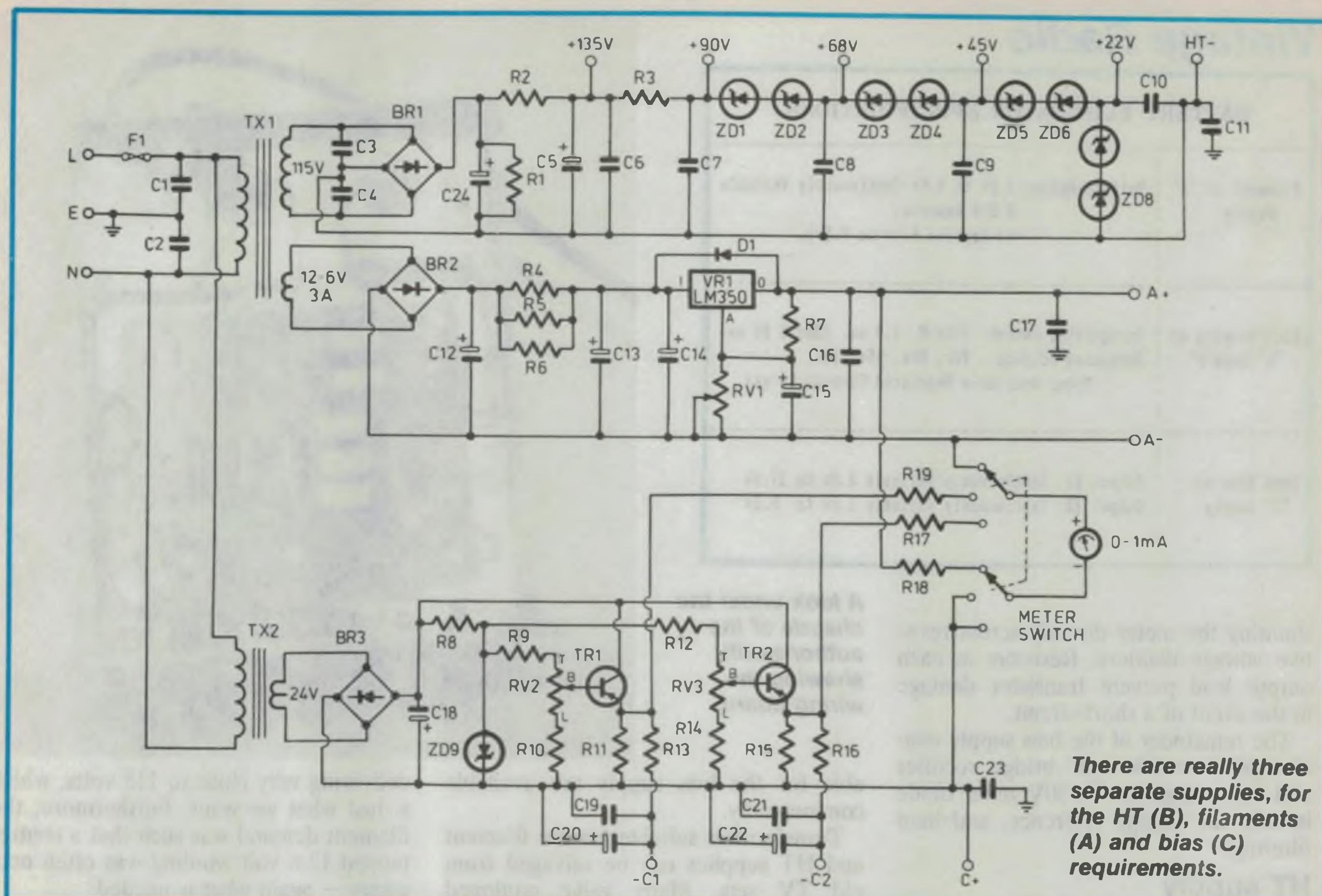
Filament supply

Rectified 12.6 volts AC is filtered by the three 2200uF capacitors and associated resistors. At full current output, the filter capacitors are subject to a considerable ripple current. To minimise heating, 35 volt working types are recommended.

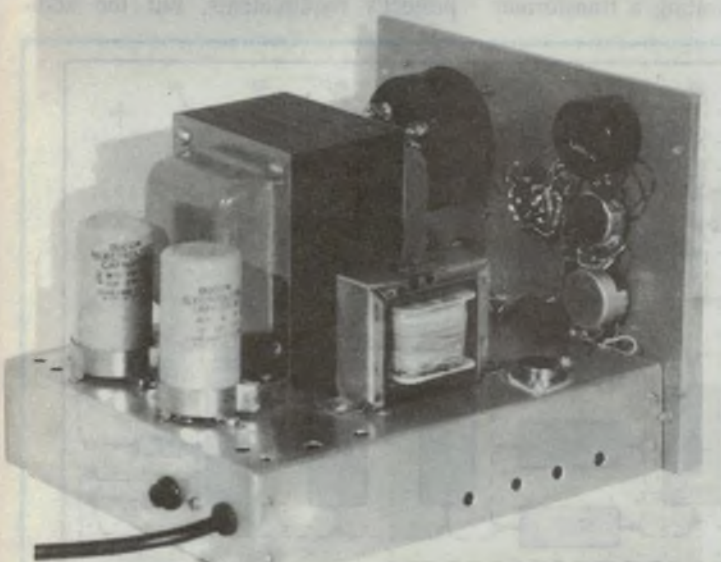
As well as contributing to the filtering, the three resistors R4, R5 and R6 help reduce the dissipation of the LM350 voltage regulator. Adjustable upwards from 1.2 volts, the LM350 variable regulator could almost have been custom designed for this purpose. Not only does it provide extremely good hum filtering, but it is also short circuit



The author's prototype eliminator, housed in a neat wooden case with an aluminium front panel. The meter is a surplus 0-1mA type.



There are really three separate supplies, for the HT (B), filaments (A) and bias (C) requirements.



Inside the author's eliminator, which is built on a traditional chassis.

and heat protected and requires only a minimum of external components.

Bias supply

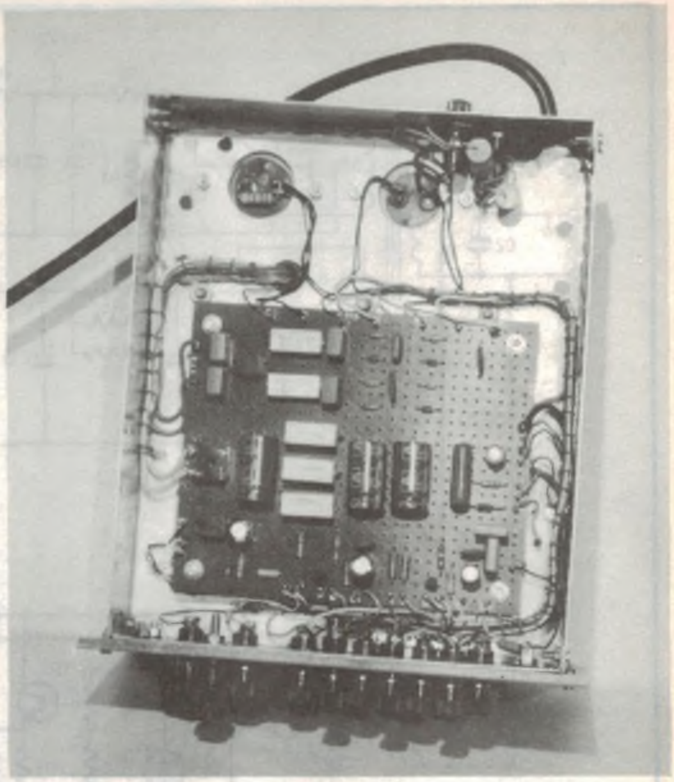
Two variable bias outlets cater for most receivers. Emitter follower regulating transistors are used, to minimis· errors which would be introduced by

BATTERY RADIO FILAMENT SUPPLY VOLTAGES

VOLTAGE	SOURCE	ERA	VALVE TYPES
1.1 to 1.4	SINGLE DRY CELL	1920 - 27 1938 - 50 1948 - 60	RCA WD11, WD12 & European equivalents Octal & Loctal Based 1.4v series. 1.4v 7 Pin Miniatures & Rimlock.
2.0	SINGLE LEAD/ACID OR TWO AIR CELLS	1920 - 30 1930 - 50	Early Eur an Types. American, European & Australian Standard Directly Heated Battery Range
3.3	DRY CELLS	1923 - 30	American '99,'20,'22. AWA 33.
4.0	TWO LEAD/ ACID CELLS	1920 - 30	European Standard.
5.0	6.0 VOLT LEAD/ACID	1920 - 30	Standard American Range of Triodes, Including '00A,'01A,112A,'71A.
6.0 & 6.3	6.0 VOLT LEAD/ACID	1926 - 30 1932 - 60	European. Wide International Range of 2.0 volt Directly & 6.3volt Indirectly Heated Valves Used in Vibrator Receivers. 1.4 volt Valves Also Used After 1938.
9.0	MAINS OR 9.0 VOLT DRY BATTERY	1947 - 60	1.4v Octal, Loctal, Miniature and Rimlock valves in Mains/ Battery Portable Receivers with Series Connected Filaments.

N.B. During the 1920's there were many non standard filament voltages. Some examples are;- 1.0. 1.25, 1.8, 2.6, 2.8, 3.5, 4.8, 4.9, 5.6.

BATTERY ELIMINATOR SPECIFICATIONS	
Filament or "A" Supply	Voltage Range; 1.2v to 9.5v Continuously Variable @ 2.0 Amperes. (3 Amperes 5.0v to 7.5v).
High Tension or "B" Supply"	Unregulated Output; 135v @ 5.0 ma. 128v @ 30 ma. Regulated Outputs; 90v, 68v, 45v, 22v. (Total Available Regulated Current 25 ma)
Grid Bias or "C" Supply	Output #1; Continuously Variable 3.0v to 27.0v Output #2; Continuously Variable 1.5v to 9.0v



A look under the chassis of the author's unit, showing the wiring board.

shunting the meter directly across resistive voltage dividers. Resistors in each output lead prevent transistor damage in the event of a short circuit.

The remainder of the bias supply consists of a transformer, bridge rectifier and filter capacitor. A 30V zener diode is used for voltage reference, and hum filtering.

HT supply

For the HT supply a bridge rectifier is connected to a filter comprising a pair of 100uF capacitors and a 510-ohm series resistor. Voltage at the second capacitor and first HT terminal is 135V, varying only a few percent with load current. Following the 1.2k resistor R3 is the 90 volt terminal, with a string of zener diodes operating at a standing current of about 35mA and feeding the remaining HT terminals at nominally 22.5 volt steps. The zener diodes are inexpensive regulators, very effective hum filters and stable voltage dividers.

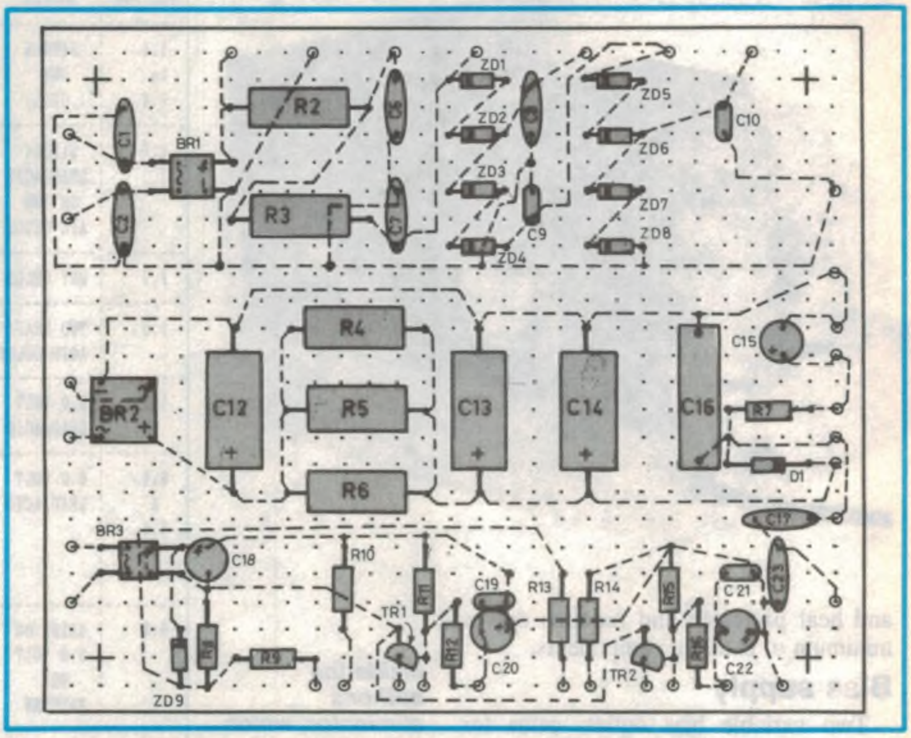
The three supplies have very different transformer requirements. Converted to RMS figures, the filament winding needs to be capable of supplying about 12V at 4.5 amperes, the HT winding 115V at up to 75mA and the bias supply winding 24V at about 60mA.

A custom made transformer would be ideal, and if you have access to winding facilities, a suitable core size would be 75 watts. However, most constructors are not so fortunate, and to have one wound commercially would be very expensive. Even to purchase a set of individual 'off the shelf' transformers for the three supplies would cost around $100.

Fortunately, inexpensive transformers of 24V or 25V at 5 watt rating and suitable for the bias supply are available commercially.

Transformers suitable for the filament and HT supplies can be salvaged from old TV sets. Many valve equipped monochrome TV receivers (including *EA* projects) used a voltage-doubling HT supply incorporating a transformer delivering very close to 115 volts, which is just what we want. Furthermore, the filament demand was such that a centre-tapped 12.6 volt winding was often necessary – again what is needed.

The current ratings of such a transformer are considerably in excess of this project's requirements, but the addi-



The author's unit has the minor components mounted on a 150 x 130 piece of 0.2" pitch Veroboard, and wired as shown. However some readers may wish to produce custom PC board for the job.

tional size is no real problem and operating a transformer at a fraction of its rated current results in less leakage field and induced hum in nearby audio transformers.

Although available from electronics suppliers, the 100uF 200VW chassis-mounted HT filter capacitors in the prototype were also salvaged from a discarded TV receiver. They were made in Australia about 20 years ago and still test 100%. Suitable capacitors were often made in multiple units.

Battery sets generally, and regenerative receivers in particular, are notorious for modulation hum when operated from AC mains. To minimise this, as well as having RF bypass capacitors for each terminal, the mains leads and the three supplies are bypassed to earth, and an earth terminal is provided for interconnection to the receiver's earth.

Construction

The construction and layout are not at all critical. Using a traditional 'inverted tray' chassis and front panel in a simple open backed veneered particle board housing, the prototype is quite compact, measuring 240 x 250 x 205mm overall.

The 2.0mm gauge aluminium alloy chassis is 230 x 190 x 50mm and is bolted to a 215 x 180mm front panel. On top are the transformers, HT capacitors and the filament supply's LM350T regulator IC.

Provided that there is good thermal contact with the chassis, additional heat sinking for the regulator is not essential. To assist heat dissipation, a few ventilation holes should be drilled in the sides and top of the chassis. The front panel of the prototype is made of 5.0mm alloy, but any heavy metal or switchboard Formica could also be used.

When making adjustments, I prefer to be able to keep an eye on temporary receiver connections and consequently, all controls and terminals have been mounted on the front panel. But the terminals could be rear mounted if desired. The type which double as banana plug sockets are handy for the HT and bias supplies, but heavier terminals have been used for the filament supply.

Small knobs have been used to reduce the possibility of inadvertently knocking and upsetting the variable bias controls. Battery valve filaments can be very delicate, and excess voltage can destroy them in a fraction of a second. A good insurance is not to use a knob for the filament control, but to slot the control shaft for screw driver adjustment.

The prototype meter is a standard 1mA moving coil type, with multiplying resistors mounted on unused tags on the range switch. Similar meters are readily available and inexpensive. Dick Smith Electronics stocks a very suitable 100uA universal panel meter with suitable scales and a shunt pack.

In the prototype supply small components are mounted on a 150 x 130mm piece of 0.2" pitch Veroboard, but if desired a PC board can be used.

To prevent heat damage, wire-wound resistor leads should be crimped to provide a couple of millimetres clearance between the bodies and the board. The capacitor bypassing the HT supply to earth is not on the component board, but is wired directly to the HT- terminal.

Limitations

No practical supply could cater for every possible situation, and consequently, there are a few minor limitations.

Vibrator radios fall into two categories: domestic, drawing up to about 3 amperes, and car radios requiring 6 volts at up to 8 amperes or 12 volts and drawing as much as 4 amperes. Domestic vibrator powered receivers are within the capacity of the eliminator's filament supply, but car radios are far beyond the capabilities of an unassisted LM350 regulator.

For 12.0-volt car receivers, an *EA* 'Powermate II' supply (October 1988) would be a much better proposition. Realistically, 6-volt vibrator car radios are best used in vintage cars with large batteries!

Another type of receiver which cannot be powered by this supply is the 32-volt farm radio, which was designed to be used with DC home lighting plants.

PARTS LIST

Resistors

R1	27k 1W
R2	510 ohms 5W
R3	1.2k 5W
R4, R5, R6	4.7 ohms 5W
R7	120 ohms 0.5W
R8	180 ohms 0.5W
R9	680 ohms 0.5W
R10	1.5k 0.5W
R11	2.7k 0.5W
R12	5.1k 0.5W
R13	2.2k 0.5W
R14	510 ohms 0.5W
R15	390 ohms 0.5W
R16	1.0k 0.5W
R17, R19	10k 0.5W*
R18	30k 0.5W (33k//330k)*

*For use with 1.0mA FSD meter

Variable Resistors

RV1	1k linear or wirewound
RV2	10k linear or wirewound
RV3	2.5k linear or wirewound

Capacitors

C1, C2	47nF 250VW AC polycarbonate**
C3, C4, C6, C7	47nF 250VW polyester
C5, C24	100uF 200VW electrolytic**
C8	47nF 200VW polyester
C9, C10, C19, C21	47nF 50VW disc ceramic
C11	0.47uF 200VW polyester**
C12, C13, C14	2200uF 35VW electrolytic
C15	10uF 16VW electrolytic
C16	1.0uF 50VW polyester
C17, C23	0.47uF 50VW polyester
C18, C20	100uF 35VW electrolytic
C22	100uF 16VW electrolytic

** Mounted externally to board

Semiconductors

BR1,BR3	1.0A/400V PIV silicon bridge
BR2	6.0A/100V PIV silicon bridge
D1	1.0A/50V PIV silicon diode
ZD1, ZD3, ZD4, ZD5, ZD7	12.0V/1.0W zener diode
ZD2, ZD6, ZD8	10.0V/1.0W zener diode
ZD9	30.0V/1.0W zener diode
VR1	LM350K 1.2-32V 3A TO3 adjustable regulator IC
TR1, TR2	BC557 or equivalent PNP transistor

Transformers

(All 240V primary)

TR1	110-115V 10 watts*
TR1A	12.6V 3.0A*
TR2	24-25V 5.0W

*Or transformer from old valve-type B&W TV receiver

Hardware

12 x insulated terminals; fuse carrier and 1A Slow-Blow fuse; 2 x small knobs; 1 x pointer knob; 1 x 4 pole, 3-position rotary switch; chassis, panel and case; screws, nuts, bolts etc.

Vintage Radio

Operating notes

The industry had no standardisation for interconnection of batteries. In some instances B– (HT–) and A– were connected together. Others joined B– to A+, and C+ could be connected to either A+ or A–!

Complete DC isolation of the eliminator's three supplies from each other and from earth has been necessary, and in each case they should be connected to a receiver in the same way as specified for batteries, not forgetting any interconnecting leads.

A few receivers used 180V HT for the output stage, but lack of a suitable transformer has prevented provision of this voltage. Very little practical loss of performance will result from operation at 135 volts, but bias for output stages should be reduced pro rata.

If you are fortunate enough to own a pre-1923 receiver using 5.0-volt, 1.0A-filament UV201 valves, use of this eliminator is not recommended.

The UX and UV201A valves made after 1922 had 0.25 ampere filaments and with one precaution, should not be a problem. These valves have thoriated tungsten filaments, operating at a high temperature. Their cold resistance is very low and if the receiver filament rheostats are fully advanced at switch on, the initial surge of current may shut down the LM350. The remedy is good practice anyway. Always back off the receiver controls before switching on.

If an additional bias output is required, add a duplicate 27V section to the bias supply, but remember that another metering switch position will be necessary.

A hum problem can arise with grid leak detectors. Audio gain from the detector grid to the output stage grid can be anything up to 1000 times, and shielding from the modern environment nil. Furthermore, interstage transformers are sensitive to hum induced from nearby mains transformers. Try to space the power supply a metre or so from this type of receiver.

Finally, some warnings. Set up and check the various voltages BEFORE connecting the receiver leads. And never re-arrange connections when the eliminator is operating. Remember too that the +135V terminal is connected to a 100uF capacitor, and can pack a lot of energy if shorted – or accidentally connected to yourself! EA

Information centre

Conducted by Peter Phillips

Some answers – for a change!

Remember the time when these columns were a clearing house for reader questions about EA projects? Lately we seem to have gone off the tracks a little, exploring all kinds of issues that have left little room for the basic function of this section. OK then, here's some answers to a few technical type questions, with a slight diversion into the realms of MIDI software.

One of the joys of electronics is rediscovery. Recently I was standing next to a fairly old radio propped up on a colleague's repair bench. In the midst of an in-depth discussion on the price of jellyfish, my nose began to twitch and my mind started recalling smells and memories from the past. I just couldn't resist it, so I bent over the radio and inhaled deeply. Ah! The aroma of lacquered coils, waxed paper capacitors (yes, they have a smell), of hot valves and old solder. I was instantly catapulted back to my youth, when radios were built on a metal chassis, voltages were called 'B plus' and inflation ran at 0.5%.

There is nothing like the smell of old electronics! They say the mind only remembers the good things, and my colleague stood astonished as I ignored his dissertation on glasnost and the Berlin Wall while I slobbered over his radio.

But what's this got to do with Information Centre? Not much, except that most of the questions being posed by readers this month bring back memories – some recent, some distant. And that's another joy, recalling the answer to a problem that years ago had me stumped, or of remembering events that now seem so long ago. The first letter takes me back to a time when digital logic was still a novelty and relays were the accepted technology.

Relay flipflop

Back in February 1989, a reader asked for a circuit that could cause a relay to latch on with a pulse of 12V and to unlatch on the second pulse. I responded by first stating that the circuit could be achieved with two relays, and continued by describing a logic circuit that used a 4013 D-type flipflop, interfaced to a relay. Great! says I to meself – another satisfied reader. Well, yes and no, it seems...

The circuit you supplied to my request worked well, but I would like to follow up the comment you made in the first paragraph of the reply on page 142 of February, 1989. The use of two relays to make a latching circuit with the on/off features of the circuit you published (also on page 142) would be extremely useful to me. Have you ever published such a circuit? (R.B. Scarborough, WA).

Oh dear! I will make these statements, won't I? Some 25 years ago I recall a friend demonstrating his implementation of a flipflop with relays, but I sure don't remember how he did it. So the best I can do is suggest the circuit of Fig.1, which although untested, seems to work on paper. The capacitor C across relay 2 (R2) is necessary to slow its operation, allowing one toggle per pulse of the pushbutton. I wonder if readers have a better circuit, or one that's been proven?

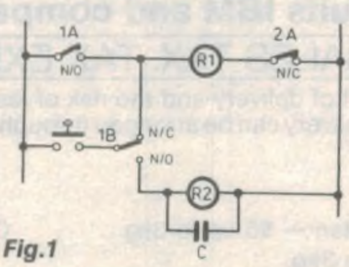


Fig.1

Frequency counter problem

The next letter concerns a problem being experienced with the venerable 200MHz frequency counter described in August 1978.

Through your Information Centre pages, I hope you will be able to assist me with a problem concerning my 200MHz, August 1978 frequency counter. When the unit is switched on, the readout is steady for a short period and gives the correct count, but then the display flashes on and off, with random figures on all ranges. (R.D., Yass NSW).

Having built one of these myself some 10 years ago from a DSE kit, I know the frequency counter quite well. Unfortunately I don't know whether R.D. is having difficulties with a newly constructed circuit, or with one that used to work and has since developed a fault. In the former case, the errata published for this project (October 1978) states that a 74LS73 may not work if used in the timebase. A 7473 should be used instead.

In the latter case, I would be suspicious of the power supply. I have known digital circuits to behave in the most peculiar ways simply as a result of noise on the 5V rail. Check the capacitors associated with the 7805 regulator, or better still, replace them anyway. A check with a 'scope should show a clean 5V rail, and that the supply voltage is in fact equal to 5V. If this is not the problem, try replacing the 74C926 display driver/counter ICs.

Or perhaps the crystal oscillator is not functioning correctly. It should be easy enough to check, as gating signals of 20Hz and 2Hz are present in the divider chain. Also, try replacing the various ICs, particularly the 74LS10 and 7404 devices associated with the display. If problems still persist, check for noise at the input of the 7490 counter, as this may cause random counting. If noise is present, the input amplifier stage should be suspected. There isn't much else in the circuit, except maybe a PCB problem.

My own counter has performed perfectly ever since I built it, so the design seems to have stood the test of time.

Large display

The following letter is from a school aged reader offering a possible solution to E.L. of Armidale, who wanted to build a giant numerical display (September 1989).

If a calculator with LED seven segment displays was interfaced to the giant display via some latches and buffers, it may solve the problem posed by E.L. The calculator could add scores and perform the clear function stipulated.

I have not had any formal training in electronics as my school does not offer electronics as a subject, so I don't know if this is a viable solution. (S.M., Lake Cargellico, NSW).

Good idea S.M., and thanks for sending it to us. A problem I see in implementing it is getting around the multiplexing used in most calculator display drivers. However, an early model desk top calculator may use a scheme sufficiently accessible for someone to break into and use.

Electrical connections

Readers may recall some discussion held in these columns in September 1989, concerning the best way to make connections in electrical supply cables. I have since received two more letters, one agreeing with my sentiments, another opposing them. I'll stay out of this one, as I have already given my opinions.

The first letter, unfortunately too long to reprint in its entirety, starts by saying that encouraging soldered joints as a means of reducing the risk of fire is bad advice. The correspondent continues by defining the requirements of a good connection and then gives his reasons for not using soldered joints:

If solder is part of the conductive path, then it is prone to temperature rise under fault conditions, causing it to melt, giving conduction to unwanted areas. The danger now is not only fire but electrocution.

A soldered section in a cable will be solid, with little flexibility. If subject to vibration, the connection can break due to fatigue, giving at best an open circuit, at worst sufficient heat to cause a fire. As well, the soldering process may carbonise the cable insulation or leave a residue of jointing flux. Either of these can introduce a long term chemical action with the cable. Soldered joints are not worth the trouble.

Concerning the reference made to the SAA wiring rules, I would like to correct some misinterpretations of the regulations quoted. First, the SAA does not allow soldered cables to be crimped. In fact, the SAA, although allowing soldered joints, regards this as an old practice; not recommended but accepted. The rules require soldering earth connections, but only to prevent corrosion and to provide mechanical strength, NOT to provide better conduction. But note also that the earth is not a current carrying conductor under normal circumstances. It has a smaller diameter than the cables it protects, and is expected to carry a large current for a short duration only, which should not result in a significant temperature change. The main earthing conductor should be joined with a wrapped joint soldered for protection.

Finally, the major contributors to electrical fires are overloaded circuits, arcing at switches or partially open joints, flexible pendant light cables attached to high wattage globes and ballasts or capacitors in older style fluorescent light fittings.

A correctly chosen terminal that is tensioned correctly will not become loose due to vibration. If this were the case, the terminals of irons, stoves, vacuum cleaners and other appliances would never stay in service. Correct choice and tension of the connection requires training and experience, not an ad hoc 'what do you think' attitude. (T.T., Albion Park NSW).

The next letter is in agreement with my comments detailed in the September issue. I should make one point clear, perhaps missed by the previous correspondent, that I (and the NSW Fire Brigade) believe the most reliable connection is achieved by first twisting the wires together for mechanical strength and *then* soldering them. One cannot rely on soldering only, as it has no inherent strength. Anyway, here's the next letter...

I agree with your opinion that fixed power connections should be soldered. Soldered connections are naturally superior to screwed connections, due to the greater intimacy of contact. The only advantage of screwed connections is the immediate convenience and future ease of disconnection.

Every screwed power connection I have known could later be tightened another half turn, even when it was known to have been screwed down originally. This surely means it was on its way to high resistance.

Your correspondent P.G. seems to be muddling a distinction between tinned and soldered connections. Otherwise, what does he mean by 'once a soldered joint becomes loose'? Of course tinned wires that are subsequently only screwed down will more likely work loose, but this is no argument against soldering wires onto screwed terminals.

There is no reason why the insulation should be damaged (perhaps P.G. is a messy solderer!) and the vibration problem is easily fixed by mechanical clamping. (B.S., Colac Vic)

If any readers want to contribute to this discussion, I will be glad to let it run for a bit, as electrical connections are an important issue. However, as I've stated before, I agree with the first writer that mains wiring is the province of the licensed electrician.

On the subject of licensing, those interested in gaining an Electrician's licence should contact (in NSW) the Building Licensing Board – phone (02) 959 1444. Many TAFE colleges offer courses in electrical wiring for those outside the trade, including engineers and others with some form of training in the electrical field. As I mentioned before, you don't have to be an electrician to gain the licence. However, it certainly helps.

Impedance matching

The next letter seeks advice on coupling a low impedance source into a high impedance input. I experienced a similar problem some years ago, when all I could get was distortion, from connecting the earphone socket of a radio to an amplifier. The correspondent's letter is too long to reprint fully, so I'll summarise the reason, then let the writer take it from there.

It seems the writer and his family make a number of phone calls to overseas relatives, via an FM phone. Unfortunately, the signal strength varies, meaning some conversation is a little hard to hear. The solution is to record the conversation using an FM receiver/-tape recorder combination for later replay. The problem is, to get the required combination requires interconnecting two appliances, a Technica FM radio to a Philips stereo tape recorder. The only way this can be achieved is to connect the headphone socket output of the Technica to the input of the Philips. Unfortunately, it doesn't work out...

How can I convert a low impedance signal to drive a 1M ohm input, without

Information Centre

sacrificing quality of reproduction? I've tried a couple of transistor circuits specially designed for using speakers as microphones, but the results were poor. I've checked through quite a few back issues of EA but cannot find a solution to this problem. (R.C., Wellington NZ).

The solution to this and similar problems is usually very simple. The distortion is probably due to the lack of a suitable load for the output signal from the Technica (radio) unit. When an output signal is taken from the earphone socket of any appliance, the internal speakers are disconnected, meaning the output circuit is operating into the replacement load. If this load is a set of earphones, all is well, as the impedance is comparable to that of the speakers they are replacing.

But if the load is a high impedance, such as the input to an amplifier, the output stage is not correctly loaded, giving the distortion referred to. The answer is to connect a low value resistor (15 to 33 ohms) between the output terminals. If the socket is stereo, two resistors are required.

Adding these resistors will not be a problem to the input being driven, as impedance matching is only usually necessary for an output. Naturally, if the input impedance of the amplifier was low, then it could not accept a signal source with a high impedance, but that is not the problem here.

So, R.C., add two resistors across the outputs (left channel to ground, right to ground) and you should be in business.

The only other possible source of trouble is that the signal from the earphone socket could be too large for the recorder's input stages, and driving them to overload. Here the remedy is to connect simple resistive voltage dividers across the recorder's inputs – say series 1M resistors from the radio, and 100k resistors to ground, with the junctions taken to the recorder inputs.

MIDI software update

Readers may recall our Universal MIDI output interface, presented in February 1988. This simple unit was designed to work from the parallel output port of a computer, hence the title 'universal'. Following this project, we were sent a sample copy of a program called Maestro, written by John Loftus. This program was for an IBM (or compatible) computer, and I reviewed it a year ago in these columns in March 1989.

Since then, I have received an updated version of this already sophisticated package, now called JEL Maestro Release 2.2. Included in the software is a new enhancement which the writer calls Pluto, along with many improvements and additions to the original program.

'Pluto' is described by the developer as an assistant that helps with the process of adding harmony to a given melody, by automatically adding parts 2, 3 and 4 of a four-part minimal harmonisation. The main program combines all the essential tools for dynamic musical expression, editing, screen-based music notation and a 16 channel real-time digital mixer, to control the volume of individual instruments. In other words, this is a most comprehensive package, which the author is selling along with a very professional manual for $65. Existing owners can update for $30.

The software is of excellent quality, which in combination with the MIDI interface gives a very inexpensive but sophisticated musical facility for an IBM type personal computer. You can contact the developer by writing to John Loftus, 10 Lorient Court, Petrie, Qld 4502, or by phone on (07) 285 5142.

PIR detector

The following letter is from a reader with a few questions about our Low Cost PIR detector described in May 1989:

I have recently assembled a DSE kit for the PIR detector (May 1989). It works very well as described in the article, although when installed across a driveway, it only responds if you walk past it fairly slowly. If you move a little faster it fails to detect the movement at all (don't tell the burglars!). Is the value of C8 (47nF) too high? These tests were conducted in the evening, without the interface unit connected, but powered by a 9V regulated supply.

Also, I and I'm sure other readers would like to see a little more information about the white filter with the lens. Is it placed in front of or behind the lens, and when should it be used? (I.M., Christchurch NZ)

Dealing with the problem first, I note that the kit is from DSE rather than from Oatley Electronics. I had quite a bit to do with the development of the original project, which used an RPY97, dual element PIR detector. Since then I have built others from kits supplied by Oatley Electronics and can assure readers that the response time and sensitivity are more than adequate to sense any fast or slow moving burglar.

My first suggestion is to confirm that the PIR detector supplied in the DSE kit is an RPY97. If not, it could be that the sensitivity of the supplied device differs from the original type. If so, check that the supplied lens is similar to that used in the prototype, by comparing it to the photos and diagrams in the article. If the lens and PIR detector are the same as those used in the prototype, the next step is to check that the detector is mounted at the focal point of the lens (ideally 18mm).

As you can see, I am convinced that the circuit gives the required gain, and that any problems are likely to be with the detector/lens combination. For example, I have been advised that touching the crystal glass window will affect the sensitivity. Apparently the glass will deteriorate over a period of time if touched, due to moisture from the offending finger.

The white filter is intended to be placed between the lens and the detector (position not important) and it is normally used if the detector is exposed to sunlight. The reason is to prevent saturation of the elements, due to the

NOTES & ERRATA

PLAYMASTER PRO SERIES ONE AMPLIFIER

(January 1990): Due to a typesetting quirk, the parts list on page 102 shows the main electrolytic filter capacitors with a value of 000uF. They should of course be 8000uF. Also note that the previously published circuit diagram shows C10 with a value of 390pF – this should be 470pF as indicated in the abovementioned parts list. (File: 1/SA/82)

'MASTER CONTROL' POWER SWITCH

(January 1990): In the layout diagram on page 155, the active (A) and neutral (N) connections to the Master Output socket are shown transposed. As a result, there is a risk of electric shock from appliances plugged into the socket, if they are either faulty or incorrectly wired. We therefore strongly recommend that the error be corrected. The wire from the junction of R3 and C5 on the PCB should connect to the 'N' terminal of the socket, while that from the junction of R2, D4, L1, C2 and R1 should connect to the 'A' terminal.

2m FM TRANSMITTER

(November 1989): The value of capacitor C23 shown in Fig.2b should be 2.2pF and not 22pF. The parts list contains the correct component values.

high amounts of infrared energy present in sunlight.

As described in the original article, the sensor operates by detecting the *difference* in infrared energy being received by both elements. However, if the total energy being received is sufficient to cause saturation, then the sensing element cannot respond to any more energy. Also, the white filter is recommended if the unit is used outside, to prevent false triggering as a result of cloud movement.

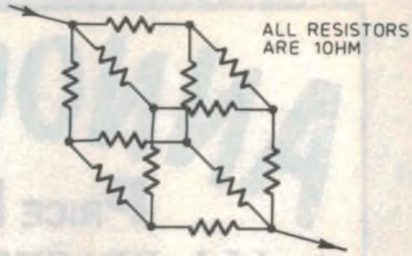
Another point to watch is the length of the leads used to couple the 9V supply to the module. If the length is excessive, the resulting variations in voltage drop across these leads can give problems – including false triggering and a possible loss of sensitivity if the voltage at the unit is much less than the recommended 9V.

Finally, I have been advised that Oatley Electronics has sourced a professionally made case for the PIR detector. The case has a swivel base and comes fitted with the lens. No more cutting squares in boxes to fit the lens! The kit price apparently remains unaltered, despite the inclusion of the new case.

What??

This month's question is from Mr Alan Fowler, (Balwyn, Vic.) a contributor with a keen sense of humour and an eye for revenge. He supplied the answer to his question, but tightly stapled so I couldn't peek until I'd figured out the solution. He wanted me (me!) to suffer as all others must have suffered with the now-renowned (infamous?) What?? question of October 1989. It's a tricky little question, and one that as Mr Fowler puts it, needs lateral thinking. The question posed is as follows:

Twelve one-ohm resistors are joined together to form the edges of a cube, as shown in Fig.2. Determine the value of the resistance between diagonally opposite corners.



I'll tell you how I went next month...

Answer to last month's What??

The answer to last months What?? concerning three series connected cells is a circuit current of 50mA and a voltage drop across each cell of 0V.

As shown in the diagram, the equivalent circuit has three series connected 1.5V cells, each with an internal resistance of 30 ohms, giving a total circuit voltage of 4.5V. The total resistance of the circuit is 90 ohms, resulting in a circuit current (I = E/R) of 4.5V/90 = 50mA. However, the voltage drop across each resistor will equal 1.5V, (E = IR: 50mA x 30 ohms = 1.5V).

As each resistor is *internal* to the cell, the voltage that will be measured across the outside terminals of each battery will be the cell voltage (1.5V) less the drop across its internal resistor (1.5V), giving zero volts. Try it with some real batteries, if you don't believe it!

Letters *Continued from page 5*

error, Peter. No matter how hard we try, the occasional error still slips through. Your letter plus the correction note will hopefully prevent any serious consequences.

Fisk Radiolas

In response to Mr Belgrave's letter regarding 'Fisk Radiolas' in the December 1989 issue, I have some information that may assist him.

I have a service manual for 1932 Fisk Radiolas, models Radiola 55B, Radiola 55E, Duoforte 55E and the Radiola Junior. For other readers interested, I also have many old valve books, TV magazines, shortwave magazines, circuit diagrams and other miscellaneous information I would be happy to supply for the cost of photocopying and postage. I also have 70-odd valves I would be happy to sell to anyone restoring a vintage radio.

I am at present, restoring a radio and need a circuit diagram for it. The following description may help. It is a five valver using the valves AK2, 6B5, 80, 6B7 and 6D6. It has the number 1100 on the back of the chassis, uses electrolytics, is dual wave and has the station markings on the dial. When I found it, there was no speaker and no cabinet. I would like to obtain an appropriate speaker and the valves AK2 and 6B5 as spares.

I have been a reader of your magazine since June 1986 and have looked forward to the next issue each month. Two small questions though: whatever happened to Frankly Frank, and, this month *EA* was in the local newagency seven days before I received it in the mail. Is this Australia Post's fault or your own?

Keep up the good work.
Ben Hobson.
PO Box 225,
Quirindi NSW 2343

Comment: Frankly Frank was discontinued to make way for more 'electronic' material, Ben, in response to many reader requests. The mails do seem to have slowed down lately, but we're taking steps to minimise the delays.

Sound history

This year is the centenary of the arrival in Australia of Professor Douglas Archibald, English educationalist and travelling showman, who introduced the improved Edison phonograph to the colonies.

Between 1890-1892, Archibald made cylinder recordings of many local dignitaries and theatrical personalities, including the Earl of Hopetoun (later our first Governor-General) and legendary actress, Nellie Stewart.

At his public demonstrations the Professor played a cylinder recording entitled 'A Message to the Governor of NSW,' (Lord Carrington), allegedly spoken by William Gladstone and also reproduced an 1889 recitation by Thomas Edison.

I am researching and documenting the exciting early days of our recorded sound history and would welcome information and assistance from *EA* readers on this topic.

My investigation includes tracing the activities of other pioneer promoters of the talking machine, who travelled the country, both educating and entertaining their audiences. I am particularly keen to find and study newspaper reports of the day, advertisements, posters, phonograph concert programmes, photographs, and original wax cylinders.

My findings will be included in an 'Australian National Discography' that I am preparing, which will list all known sound recordings by Australians, made at home and abroad, between 1890-1960. This publication will be the audio equivalent of the Australian National Bibliography (ANB).

Readers who can assist are invited to write to me at PO Box 83, Hall, ACT 2618.

Peter Burgis,
Hall, ACT.

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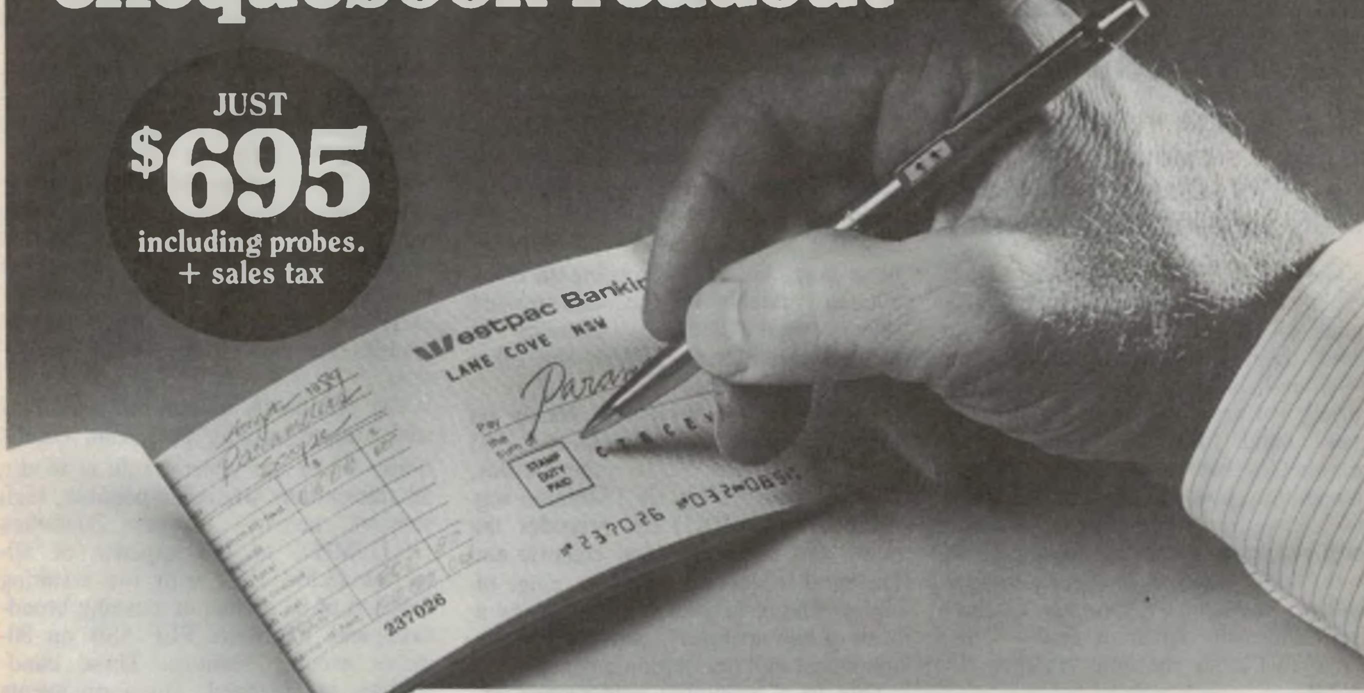

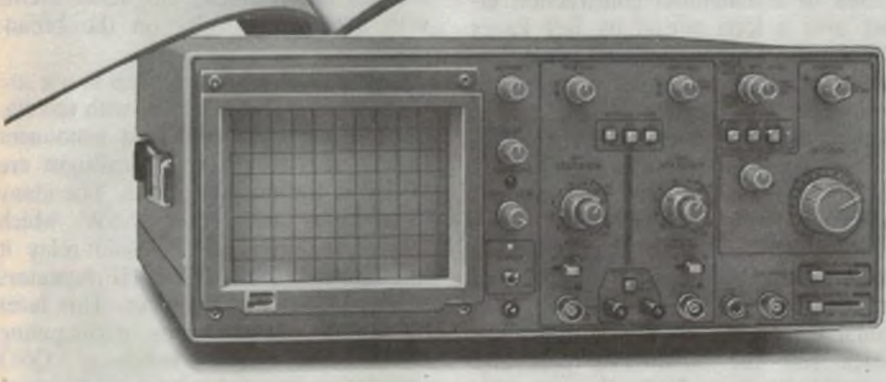

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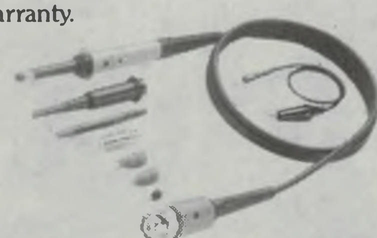

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Ham Talk

WIA broadcasts in NSW

As a change from biographies of pioneering radio amateurs, here's a rundown on the weekly news service broadcasts by the NSW Division of the Wireless Institute of Australia – kindly supplied by Julie Kentwell, VK2XBR.

The WIA's NSW Division transmits a weekly news broadcast on a very wide range of frequencies, covering many bands to enable reception anywhere in NSW and, indeed, Australia on a wide variety of receiver systems. Almost every band from 160 metres to 23 centimetres has at least one Institute transmitter covering the news: additional coverage is provided by relays on local repeaters scattered throughout the state. Some amateur TV repeaters (e.g, Sydney Amateur TV Group's VK2RTS and Gladesville Amateur Radio Club's VK2RTV) carry the news on their TV sound.

The purpose of these broadcasts is to allow all members, wherever situated, to keep track of Divisional events plus Federal and local club news. The general pattern of broadcasts is to begin with the headlines, as it were, then the Divisional news. A Federal office segment normally follows, supplied on tape from that office. Thereafter you can hear reports on propagation, courtesy of the Ionospheric Prediction Service: club news, in which local radio clubs anywhere in NSW can publicise their activities on the broadcasts at no cost to themselves: a summary of coming events: and finally, any news affecting amateur radio or relating to it. Such news may concern the passing-on of an amateur, details of trash-and-treasure sales, social functions, seminars or lectures, Divisional bargains and other functions or events.

Broadcasts are presented weekly on Sundays, commencing at 1045 and 1915 hours local time – in other words, 10.45am and 7.15pm. A 15-minute segment by Tim VK2ZTM precedes the news: this segment, titled Historic and Technical, covers an enormous range of topics. The news is then presented by a team of two operators, consisting of one announcer and one station engineer.

Due to a mammoth construction effort over a long period by Jeff Pages VK2BYY, the consoles are computer-controlled and very user-friendly to both operators, giving instant control over all facets of operations in the station's many transmitters, transceivers and receivers. The operators are all volunteers, who are rostered-on over a three-month period by the Broadcast Co-ordinator, and in the preparation of these rosters the Co-ordinator fits individual volunteers into times and duties which suit the volunteer's particular personal situations. Naturally enough, a full-call licensed amateur must be in attendance at each broadcast for the full range of bands to be used by the other team member may be unlicensed, which means that anyone interested in assisting with Divisional broadcasts once every month or two months, can try their hand at announcing or engineering.

Here's a view of the large display organised by the NSW Division of the WIA at the recent Games and Hobbies Expo at the Sydney Showground, as reported in our January issue.

The frequencies in general use are 1.845MHz AM, 3.595MHz AM, 7.146MHz AM, 10.125MHz SSB, 28.320MHz SSB, 52.120MHz SSB, 52.525MHz FM, 147.000MHz FM, 438.525MHz FM, 584.75MHz TV sound (through VK2RTS and VK2RTV) with, finally, 1281.75MHz FM for microwave enthusiasts. The AM HF transmitters are each 500 watts output: 10.125MHz power is 100W PEP. VHF and UHF use various amounts of power, as little as 10 watts, while the use of AM on HF enables reception on ordinary shortwave sets.

The HF bands in use are varied to suit sunspot activity and band conditions. While the general rule is to use all transmitters wherever possible, high sunspot activity favours 30-metres (10.125MHz) at the expense of 80-metres (3.595MHz) with the resulting deletion of 80 metres in morning broadcasts and 100 watts PEP SSB on 80-metre evening sessions. These band-shuffles are planned, long-term events with advance publicity on the broadcasts.

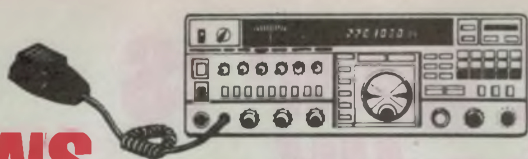
Callbacks on all frequencies in use are taken after each broadcast, with the station engineer and broadcast announcer sharing the workload. All callsigns are logged in the station's books. The many local clubs throughout NSW which receive the news on HF and relay it through their local VHF/UHF repeaters conduct their own callbacks. This facet of the broadcasts gives participating non-amateurs good 'hands-on' QSO experience on a wide variety of bands.

Like any really progressive outfit, the WIA NSW Division station expands and improves continually. It contains voice and digital repeaters on many bands as well as the broadcast facilities and will be installing television in the near future for use during broadcasts and special events such as JOTA.

The station is housed in a sturdy brick building and proudly boasts a 30-metre tower as one of its antenna masts, while the 5-acre bushland property on which it sits makes a perfect setting for the many Divisional activites which are held there.

Further information and enquiries can be directed to the Broadcast Co-ordinator, PO Box 1066, Parramatta 2124. He really is a very nice bloke and would welcome your enquiries.

Amateur Radio News



Another shot taken at the NSW Microwave Field Day reported in January, with the equipment display under temporary shelter. Visible in the foreground are Vic Barker VK2BTV and Dick Norman VK2BDN, with Ray Biddle VK2ZDB just visible behind Vic.

No licence fee for US amateurs

Although both the US Congress and Senate had proposed the imposition of licence fees for radio amateurs, as part of measures to reduce the federal deficit, this has now been abandoned.

A fee of between US$30 and $35 had been proposed, which would have been payable whenever an application for renewal, upgrading or even change of address was made to the FCC. However US amateurs viewed the proposed fees as a tax on volunteers, as they provide public-service communications without compensation of any kind. Congress finally agreed that a fee schedule was inappropriate, as amateurs do not operate their radio stations for profit.

According to David Sumner, executive vice president of the ARRL, "We faced an uphill battle in Congress against a wave of red ink, and a general feeling that user fees aren't a bad way for the government to increase its revenues. Fortunately, enough key people in Congress recognised that the services performed by radio amateurs are far more valuable than the fees that would have been collected."

ARRL representatives apparently worked for four months to educate Congress on amateurs' important public-service responsibilities and entitlement to an exemption.

Tent pole aerial for 146MHz

From Tom House, ZL2BTI/VK2BTH comes details of a simple system he has used for making use of a four-section aluminium tentpole as an antenna for 146MHz, when operating at a campsite.

Tom found his tentpole to be about 1346mm (53") long, making it roughly a 3/4 wavelength at 2m. When in place supporting the tent, it formed a vertical with a maximum lobe slightly above the horizontal – just right for working hill-top repeaters.

The radiation resistance turns out to be around 100 ohms at the bottom of the pole, so that matching to 50 ohm co-ax can be achieved with a 1/4-wave length of 75 ohm co-ax connected between the main cable and the base of the pole. The required length turns out to be 282mm (19"). As the tentpole has a diameter of around 19mm or more, its Q is fairly low, giving a low SWR over the complete 2m band.

Tom has found that using only 100mW of power from his handheld rig, with this tentpole antenna at sea level, he could easily access the repeater at Nelson, NZ from a campsite 40 miles away.

New test gear is built in the UK

In the last few months a new range of very competitively priced test instruments has become available here, designed and built in Britain. The 'Black Star' range includes frequency counters and counter/timers, digital multimeters, function generators, a portable battery-operated scope and an RS-232C analog/digital I/O multiplexer.

by JIM ROWE

Mention 'low-end test instruments' nowadays, and most of us think automatically of Japan, Taiwan and Korea – right? Especially if you're also talking about instruments that offer good value for money. About the *last* country you'd expect to find producing this kind of gear is Britain (although perhaps Australia would be even further down the list!).

But believe it or not, that's exactly the source of the latest range of test instruments to hit our shores. The Black Star company is based in St Ives, Huntington, in Cambridgeshire, and proclaims proudly in its literature that all of its instruments are designed and manufactured in Britain.

We're not talking about up-market, highly sophisticated test gear with matching price tags, either. These are down to earth, general purpose test instruments for the service workshop, small development lab and serious hobbyist: counters, DMMs, function generators, a colour-bar generator, a compact battery-powered scope and an I/O multiplexer for PC's. And the price tags are *very competitive* with those on similar instruments from Asian climes.

How does $320 plus tax sound for a 3-1/2 digit true RMS reading bench type DMM, for example? Or $379 plus tax for a 2MHz function generator? Or $460 plus tax for a 1GHz counter? You get the idea, I hope...

The Black Star range is distributed in Australia by Obiat, and a few weeks ago Obiat's MD Len Altman asked if we'd be interested in checking out a couple of instruments from the range. Needless to say we were; in fact we were intrigued to find out whether there was a catch.

In due course, then, two instruments arrived: the 3210 true RMS reading DMM, and the 'Apollo 100X' – an 8-digit 100MHz counter/timer with temperature-compensated crystal oscillator (TCXO) timebase. Quoted price for the 3210 is $320 plus tax, while the 100X sells for $935 plus tax. We examined them both with great interest, and set about putting them through their paces.

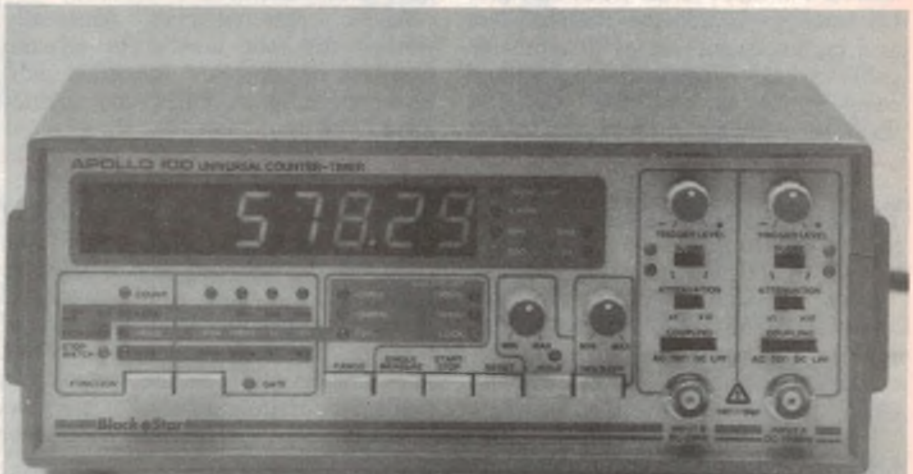
One of the first things we noticed, when we looked closely, was that the cases are based on a very neat modular construction. Although the case of the 3210 measures 75mm in height overall, while the corresponding dimension of the Apollo 100 is 100mm, they're both based on the same moulded case top and bottom sections. The difference is that for the Apollo 100, there is an additional moulded spacer section on each side.

The design of the spacer pieces, as well as the execution of the moulding, is such that you have to look really closely to detect how it has been done. A very neat and elegant system, and from the pictures shown in the catalog, the same scheme has been used for all of the instruments in the range. The only things that change are the front and rear panels, and whether or not the spacers are used to provide additional height.

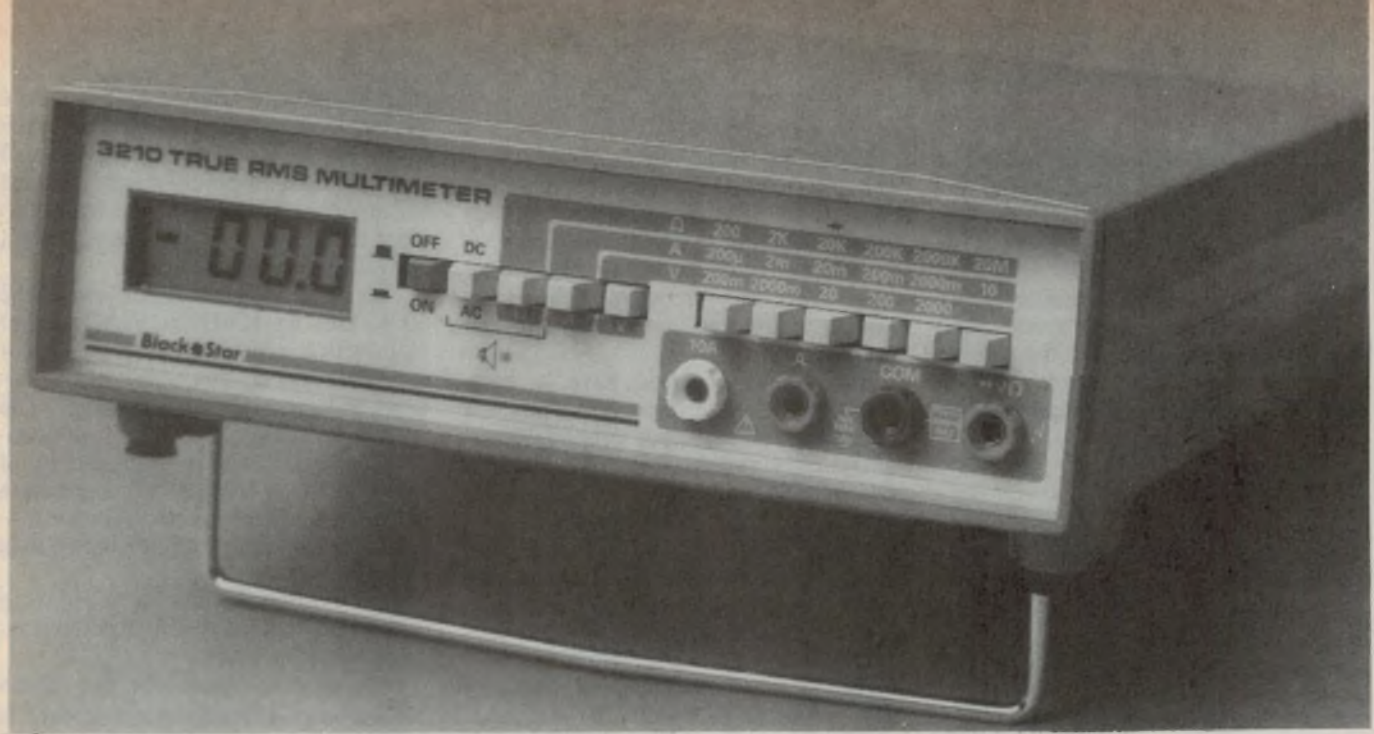
This modular system must reduce the cost of the instrument cases, for a start – and nowadays the case is frequently a major component of overall cost. In fact at times the case can cost rather more than the electronics inside!

To be honest, we couldn't find any other obvious cost-cutting measures. The construction both inside and out seems to be both well designed and solidly executed. There's no obvious evidence of automated assembly, either; the PC boards use through-hole technology with standard leaded components, rather than SMT.

Nor are there any really obvious 'cut corners', in the way of missing features or facilities you'd normally expect to find in other instruments of the same class. Perhaps the only exception would be the fact that the 3210 DMM runs only from internal alkaline cells,



The Apollo 100X Universal Counter/Timer, which operates at up to 100MHz and features a TCXO type timebase. It provides many functions.



The 3210 DVM is a 3.5 digit bench-style instrument operating from six alkaline 'C' cells. It offers true-RMS readings on all AC ranges, with current measurements to 10A.

whereas other similar instruments tend to provide for mains operation and perhaps also for recharging of NiCad cells. But then these instruments also tend to be rather more expensive!

Essentially, our impression is that judging from these examples, Black Star is simply working very efficiently and keeping both its overheads and the unit cost of its instruments down, to the point where it can sell them at a really competitive price. In short, they're using the same techniques used by our friends in Taiwan and Korea, and formerly by firms in Japan.

So much for general observations. Now let's look at the two instruments concerned, in a little more detail.

The 3210 DMM

The 3210 digital multimeter is a compact bench-type instrument, measuring 219 x 240 x 75mm and weighing a modest 1.2kg including batteries (six alkaline 'C' cells). It is fitted with four rubber feet for mounting flat on a shelf, with a swing-down tilting bail for benchtop operation. The display is a 3.5-digit liquid-crystal type with digits 12.5mm high, and indication of polarity, overrange and low battery voltage.

The instrument is based on the widely-used 7136 VLSI DMM chip. Battery life is typically better than 7000 hours, for predominantly DC voltage measurements.

As is common with many similar instruments, the 3210 is manual ranging. There are six range selection pushbuttons, in addition to the five main function/mode buttons. The four input sockets are of the lightly-recessed banana jack type, with a common, an active input for volts/ohms, an active input for the lower five current ranges and a separate input for the highest 10A range.

There are five DC voltage ranges, with nominal full-scale readings of 200mV, 2V, 20V, 200V and 2kV respectively. Accuracy on all five ranges is quoted as +/-(0.1% of reading + 1 digit). Input impedance is fixed at 10M on all ranges; normal mode 50/60Hz rejection is greater than 60dB, and common mode rejection greater than 100dB at the same frequencies.

For DC current measurement there are six ranges, with nominal full-scale readings of 200uA, 2mA, 20mA, 200mA, 2A and 10A respectively. Accuracy on the four lower ranges is +/-(0.15% of rdg + 1 digit), falling to +/-(0.3% of rdg + 1d) on the 2A range and +/-(2% rdg + 3d) on the 10A range. Maximum voltage drop on the 2A range is 1V, while for the other range it is 200mV. All ranges except the 10A range are protected by a 2A fuse.

For AC voltage and current measurements, the 3210 offers true RMS measurements via an AD636 true-RMS converter circuit. This can cope with a crest factor of over 5 times at full-scale reading.

Five ranges are provided for AC voltage measurement, with nominal full-scale readings of 200mV, 2V, 20V, 200V and 750V. Accuracy on all ranges between 45Hz and 1kHz is quoted as +/- (0.5% rdg + 2d), with this figure also applying for the three lowest ranges up to 1kHz. These figures fall on the two lowest ranges to +/-(1.5% rdg + 2d) at 10kHz, with the two next higher ranges falling to +/-(2% rdg + 2d) and +/-(5% rdg +5d) respectively. The 750V range is not specified above 1kHz.

As with DC current there are again six AC current ranges, with the same nominal FSR figures. Quoted accuracy between 45Hz and 1kHz for the five lowest ranges is +/-(1% rdg + 2d), falling to +/-(2.5% + 2d) on the 10A range.

There are six resistance measurement ranges, with nominal full-scale readings of 200 ohms, 2k, 20k, 200k, 2M and 20M respectively. Quoted accuracy for the four lowest ranges is +/- (0.15% rdg + 1d), falling to +/-(0.2% rdg + 1d) on the 2M range and +/-(1% rdg + 2d) on the 20M range. Maximum testing voltage on the 200 ohm and 2k ranges is 0.5V, and greater than 0.7V on the four higher ranges – sufficient to achieve about 100uA forward conduction in a silicon diode, for diode testing.

In addition to these main measuring ranges, the 3210 also provides a 'continuity' range, where a beeper sounds when the resistance between the test probes is less than about 50 ohms.

The 3210 comes with a test lead set, an instruction manual and a set of alkaline batteries.

Checked out against our reference instrument (a Fluke 4.5-digit 8050A), the 3210 gave a very good account of itself. In fact it appeared to be well within the quoted tolerances on all of the ranges we could check, which was all except the highest voltage and current ranges. Its readings were commendably stable, too, with very little 'bobble' even on the AC measurements.

In short, the 3210 seems a very nicely made little meter, and one that for the price and considering that it's a true-RMS reading instrument, represents excellent value for money.

The Apollo 100X

The Apollo 100X is described as a Universal Counter-Timer, capable of operating up to 100MHz and with a TCXO type timebase replacing the standard timebase of its cheaper counterpart the Apollo 100. It's a little larger than the DMM, measuring 219 x 240 x 100mm and weighing 2.2kg.

In this case the display is an 8-digit LED type, with very bright digits 12.5mm high. The display has leading zero blanking, automatic decimal point indication and there are a number of accompanying discrete LEDs to indicate MHz, kHz, seconds, microseconds, thousands of RPM, overflow and the various gating times and functional

There are two separate input channels, the main 'A' channel covering the full DC-100MHz range and the secondary 'B' channel designed for inputs up to 2MHz. The B channel is used mainly for relative measurements such as frequency ratios and time interval measurements.

Both input channels have a basic sensitivity of better than 5mV, and are provided with an input coupling/termination/filter switch (AC – 50 ohms – DC – LPF), an attenuator switch (x1 – x10), a triggering polarity switch and a triggering level pot. Each is also provided with a pair of LEDs, to indicate when correct triggering is taking place.

The basic measurement functions provided cover frequency, frequency ratio, RPM, event counting, period counting, time interval measurement and stopwatch. For many of these functions it is possible to have the instrument make either single measurements with indefinite hold time, or repetitive measurements with adjustable hold time. Frequency ratio, period and time interval measurements can also be carried out for either single measurements or averaged over 10, 100 or 1000 cycles or periods.

An interesting feature is that the 100X provides an inbuilt signal frequency multiplier system, to achieve higher resolution when measuring low frequencies. Signals between 6Hz and 100kHz can be fed to a 10x multiplier, while those between 14Hz and 10kHz can be fed to a 100x multiplier – giving an increase in resolution by the same factors, respectively.

This facility is very handy, offering much of the convenience of 'intelligent' counters which measure low frequencies by measuring period, and then automatically calculating the reciprocal. The only penalty here is that there is a 5 second settling time, for the inbuilt PLL multipliers to lock onto the signal (indicated by the illumination of a 'Lock' LED). In most cases, this short delay is likely to be of no consequence.

Another very handy feature is that a BNC socket and switch on the rear panel of the instrument allows you either access to a buffered version of its internal 10MHz timebase signal, or the ability to feed in an external timebase – from say an off-air frequency standard. It's a pity more counters don't provide such a flexible arrangement!

There's also an adjustable triggering hold-off control for input channel B, to allow more accurate measurements of time intervals in situations where there is noise or bouncing of mechanical contacts. The hold-off control allows the B channel input to be effectively disabled for an adjustable period (5ms to 500ms) after triggering of the A channel input – again a very useful facility.

The basic 8-digit counter inside the 100X uses an ICM7226 VLSI counter chip, with a variety of other devices for input processing, frequency multiplication and general housekeeping. The TCXO oscillator is a small self-contained module, with a rated stability of better than +/-0.2ppm, a temperature stability of typically +/-0.5ppm for 0 – 40°C, and an ageing rate of better than +/-1ppm per year.

The instrument has a mains-type power supply inbuilt, with a power consumption of 24 watts.

Checked out in our lab, the Apollo 100X also gave a very good account of itself. Its timebase stability and accuracy appeared to be well within the quoted spec, and its readings were quite stable and unambiguous. If anything, we felt the LED display brightness was a whisker too high – the drive current could probably be reduced a bit without causing any reading problems, and this might give longer life for the display devices.

The relatively large number of front-panel controls and status LEDs took a while to get used to, but the initial bewilderment phase soon passed. We expecially liked the twin LEDs on each input channel, to let you monitor the triggering status, the inbuilt multiplier for low-frequency signals and the timebase input/output connector on the rear panel.

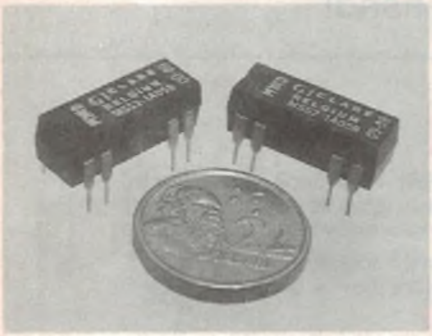
In short, the Apollo 100X also seems to be a very nice performer, and good value for money in a multi-function 100MHz counter timer with TCXO.

In fact judging from these two samples, the Black Star range seems to be an excellent addition to the local test instrument market, with a good balance between economy and performance.

As mentioned earlier, apart from DMMs and counters the range includes a couple of function generators, a 15MHz dual-trace battery scope, a colour-bar generator for TV work and a very interesting RS-232C I/O expansion interface for computers. We're hoping to check out one or two of these in the future.

Meantime, further information about any of the Black Star instruments can be obtained from Len Altman at Obiat, 129 Queen Street (PO Box 37), Beaconsfield 2014 or phone (02) 698 4776.

NEW PRODUCTS



All position' DIL mercury relay

The MSS2 dual in line mercury relay features Clare's exclusive MYAD switch for all-position mounting of wetted reed contacts in a miniature form A contact configuration.

The relay offers life-long stable 100 milliohms max. contact resistance, high sensitivity, low input power and reliable switching from low levels to 30 watts. It features one form A (normally open) contact configuration in a miniature epoxy molded DIP package, for automatic board processing and high density board mounting.

The nominal input power is as low as 178mW, with operating times of less than 1.5ms.

Three stand coil voltages are available: 5, 12, and 24V DC with the option of a clamping diode.

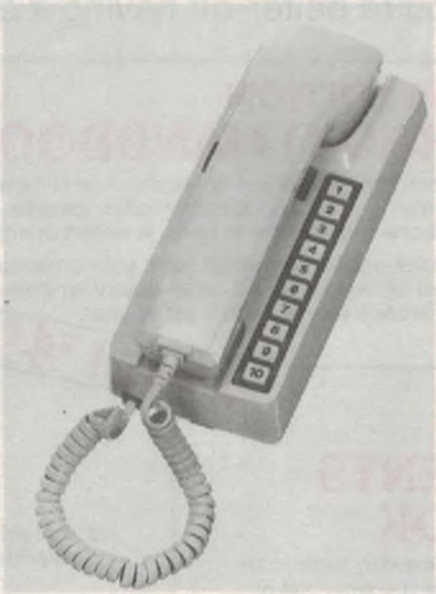
For further information contact IRH Components, 32 Parramatta Road, Lidcombe 2141 or phone (02) 648 5455.

Telephone intercom system

The TH-10 is a multi-station intercom system from GME Electrophone, designed for a maximum of 10 stations.

The telephone style handset allows the intercom to be used in noisy environments, making it especially suitable for installation in boats or workshops. The telephone handset not only minimises interference from noisy environments, it also ensures privacy of conversation.

Easy installation of the TH-10 allows Direct, Master or All Master systems. The TH-10 operates on 12 volts DC or with a 240V AC/12DC adaptor such as the GME BCE-1445 plug pack, or the



system can be powered from the 240 volt household power.

Interconnecting cable is available in convenient pre-packed lengths or in bulk to suit most applications.

Further details from GME Electrophone, 6 Frank Street, Gladesville 2111 or phone (02) 816 4755.

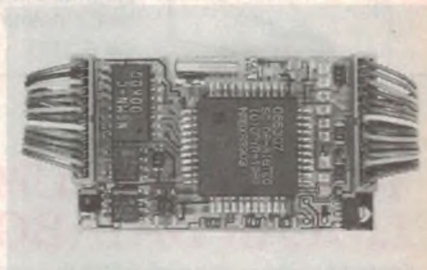
Optical position sensing

UDT's model 531 is a computerised instrument which allows users to connect one or two single or dual axis optical position sensing detectors or autocollimators for high precision position or angular measurement applications. Typical uses might be in precision mechanical alignment of machinery, alignment of optical systems, scientific and experimental applicaiions etc.

Position sensing with a few micrometres of resolution, 0.1% of full scale and over 10mm FSD are achievable, and angular resolution of up to 0.01 arc-sec can be achieved.

A wide variety of position sensors and autocollimators and other accessories is available to compliment the 531. All of these sensing systems are based around a quadrant or linear silicon position sensing detector housed in an appropriate assembly with lenses.

For further information contact Kingfisher International, 14 Excalibur Avenue, Glen Waverley 3150 or phone (03) 233 5998.



Encoder/decoder for multiple calling

The new S1516 5-tone sequential selective calling encoder/decoder is specifically designed for multiple calling applications in portable and mobile transceivers. It has multiple calling capacity of 10,000 when using a 3 x 4 keypad or BCD switches.

The S1516 has 100,000 address codes, time out timer, auto acknowledgement and international group call decoding or extended group format. Automatic Number Identification (ANI) or PTT is also included.

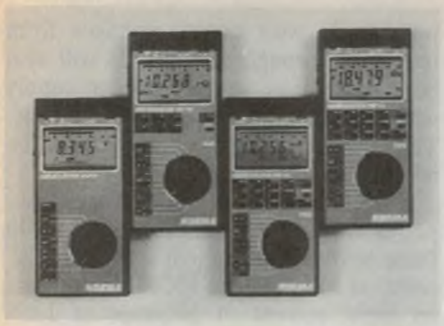
It also has multiple sequence operation for applications that require tone sequential access.

For further information, contact Signalling Technology, 107 Seaford Road, Seaford 3198 or phone (03) 786 0077.

Multimeters with bar-graph display

A large LCD display that incorporates a high-resolution bar-graph is the added feature of a new range of multimeters, known as Normameters.

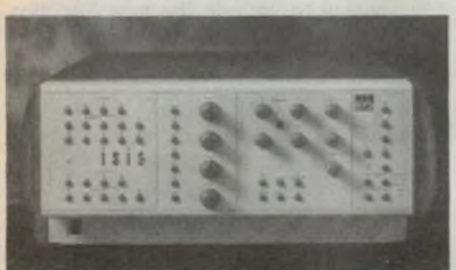
The combination of an analog movement with those of a robust liquid crystal display not only allows the digital indication of measured values, but also their changes and trends electronically, faster and more accurately than traditional pointer-type meters. The bar-



graph is updated every 40ms, indicating virtually immediately the direction in which the quantity selected should be re-adjusted.

Other features of the Normameter MP range include temperature and frequency measurement and. autoranging. Some models in the four model range include more sophisticated facilities such as 'HOLD', 'TIMER', max. & min. value, relative or differential measurement and decibel measurement and adjustment.

For further information, contact Parameters, 25-27 Paul Street North, North Ryde 2113 or phone (02) 888 8777.



Television standards converter

AVS is introducing a new standards converter, ISIS. It is a 4-field motion adaptive unit with the capability to develop stage by stage into a full broadcast bandwidth, high performance machine.

The basic ISIS system will perform standard conversion of composite, PAL or NTSC signals with a bandwidth of 3.5MHz. It utilises a 4-field motion adaptive interpolation aperture and 8-bit CCIR 601 4:2:2 processing throughout. When fully optioned, ISIS offers conversion between all six world television standards.

Among the main performance options is the Digital Comb Filter Decoder which extends the composite signal bandwidth to the full 5.5MHz of the broadcast signal. The addition of the 'motion adaptive post processor' (MAPP) gives ISIS outstanding noise reduction capabilities – over 17dB in the luminance channel and 21dB in the chrominance channel.

For further information, contact Magna-Techtronics, 7-9 George Place, Artarmon 2064 or phone (02) 427 0666.

Laser power meter

Gentec has released a new portable laser power meter, the Series 310. It has been designed specifically for laser maintenance and service applications, but its characteristics and versatility make it useful for medical, industrial and research applications.

Offering five different power detector heads, the Series 310 allows average power measurement of any kind of laser up to 10 watts. All these sensors can be easily used with the TPM-310 analog power monitor. Moreover, a wide choice of accessories completes this series.

For further information, contact Laser Electronics, PO Box 359, Southport 4215 or phone (075) 53 2066.

Video sweep generator

The Leader 430P provides three generator functions of video sweep multi-burst signals and colour patterns.

The sweep signal generator covers a wide range from 100kHz to 10MHz, with selectable sweep width. The multi-burst function generates a 100% white reference signal and seven types of burst signals from 500kHz to 7MHz, whilst the colour pattern generator supplies full field and SMPTE colour bars and raster patterns of eight colours.

Because the 430P's sweep and multi-burst signal levels can be set without changing the sync signal level, frequency characteristic changes can be measured by amplitude, and the multi-burst signals up to 7MHz can be used to check the resolution of monitors and S-VHS VTRs.

By using the built-in colour bars, the linearity and phase characteristic of a sweep transmission can be checked.

For further information, contact AWA Distribution, 112-118 Talavera Road, North Ryde 2113 or phone (02) 888 9000.

100MHz scope has autoranging sweep

Hitachi's V1065, 100MHz oscilloscope features sweep time autoranging. The selection of the appropriate sweep time is usually one of the most troublesome tasks related to scope use.

Now simply push a button to automatically select the optimum sweep time (with approx. 1.6 to 4 cycles of signal displayed). This design refinement simplifies and speeds up measurements. Of course, manual override of this function is possible using a large, easy-to-use rocker switch.

Observation of complex pulse trains with previously available scopes relied on variable hold-off, with the accompanying problems that a change in sweep time setting resulted in loss of trigger. With the V1065's trigger lock, however, the sum of the hold-off time and sweep time is held constant, enabling you to change the sweep time without upsetting the stable trigger condition.

For further information, contact IRH Components, PO Box 14, Lidcombe 2141 or phone (02) 648 5455.

Physically polarised tantalum electros

The problem of inserting components the wrong way around because of placement system 'errors' has been solved by Siemens for three of its radial-leaded types of tantalum electrolytic capacitors (B-45181/85/87), in a simple but effective manner: a flattened section makes the positive lead wider than the negative and thus precludes mis-orientation.

To eliminate placement error, the capacitors are now available with an 0.85mm wide flattened section on the positive lead. It does not fit into the 0.7mm hole for the negative lead. All the user has to do is to enlarge the diameter of the capacitor mounting hole. This polarising feature allows the capacitor series' high reliability (FIT) to be fully utilised.

For further details contact the Communications Equipment Department of Siemens, 544 Church Street, Richmond 3121 or phone (03) 420 7716.

Handheld fibre optic fault finder

Tektronix has announced a handheld fibre finder designed as a low-cost restoration tool to locate cable faults and identify major events in fibre optic links.

The TF2020 FiberScout combines high performance, miniature scale and innovative use of graphics in a portable, low-cost, extremely easy-to-use instrument. It is designed primarily to address restoration requirements in the optical telephony, CATV and local area network environments.

Historically, restoration functions have been supported by optical time domain reflectometers (OTDRs) which provide full-range capabilities.

But now, because of its low-cost and ease of use, the FiberScout can be deployed throughout the service area in greater numbers than the more expensive, more complex OTDRs.

FiberScout is available in combinations of long-range and/or short-range options for fault finding on a wide range of fibre optic communication cables.

For further information, contact Tektronix Australia, 80 Waterloo Road, North Ryde 2113 or phone (02) 888 7066.

4000 watt power supply

HC Power has released its new series, HC40 4000 watt power supply. It is designed for absolute current sharing with similar supplies, so modules can be used to configure extremely large power systems.

A great deal of attention has been given to the thermal design of the supply. It is in a 12" wide case with two fans on the inlet end of the supply, where both operate at room ambient.

The HC40 is available as a single output supply with output voltages from two volts through 48 volts. It will also be available as a dual output supply with each section rated for 2000 watts. The output voltage values could be independent of one another.

HC Power also has PowerMiser power factor correctors to operate with these units. Even though it is 75% efficient, at full load the HC40 will require an input current of 36 amps at 230V AC. The PowerMiser will reduce the input current to only 24 amps.

For further information, contact Dewar Electronics, 32-34 Taylors Road, Croydon 3136 or phone (03) 725 3333.

Microwave cable assemblies

Huber + Suhner have recently expanded their microwave cable assembly division to include the new Sucoflex MW cable. This cable offers a very low

VSWR and low loss and has ideal characteristics for reliable applications in industry, laboratories, ship and aircraft building.

The new cable uses a high grade polyurethane jacket and is extremely robust and resistant against abrasion, extreme weather conditions, oil and nuclear radiation. The product range of these new assemblies consists of 11 different connectors of the series SMA, N, TNC and PC3.5.

The frequency is only limited by the connectors. Typically for an assembly with PC3.5 connectors it is at 26.5GHz.

For further information, contact Huber + Suhner, PO Box 372, Narrabeen 2101 or phone 913 1544.

Higher value SMT caps

Siemens has increased the capacitance range for its size 0805, 1206 and 1210 ceramic multilayer SMD capacitors. Some of the capacitance values have been more than doubled.

The COG ceramic capacitor ratings range from 1pF to 1nF (previously 560pF) for size 0805, from 1pF to 2.2nF for the next higher size, and from 1.2pF to 4.7nF for size 1210. Chip capacitors in X7R ceramic technology are available in ranges extending from 1nF to 33nF for size 0805, from 1nF to 100nF for size 1206, and from 22nF to 150nF for size 1210.

Shipping unit sizes have been increased as well. In addition to 180mm reels with 1500 to 4000 components (depending on size), SMD capacitors are now also available on 330mm reel with 12,000 to 16,000 units to help reduce retooling times for automatic component placement machines.

For further details, contact Siemens Communications, 544 Church Street, Richmond 3121 or phone (03) 420 7313.

Microwave synthesisers

Systron Donner's 1700 series microwave synthesisers cover the range 2GHz – 26.5GHz with an extended range down to 10MHz with the use of the optional downconverter. They feature 0.1Hz resolution as well as fundamental oscillators up to 26.5GHz to avoid troublesome sub-harmonics.

The 1700 series Microwave Synthesisers incorporate AM, FM, and pulse modulation, and incorporate sweep capability. Remote programming via the standard IEEE-488 bus is also available.

For further information, contact Anitech, 1-5 Carter Street, Lidcombe 2141 or phone (02) 648 4088.

Miniature signal relay

NEC Corporation of Japan has released one of the smallest low-current switching relays available on the market today. The EA2 series relay is suitable for a wide range of small signal and low current switching operations in telecommunication and instrumentation equipment.

Ultra compact, the EA2 measures a mere 14 x 9 x 4.75mm and is ideal for use in modern, state of the art, products where printed circuit board space is at a premium.

It comes in standard and latching versions with operating speeds of 2 milliseconds.

For further information, contact Soanar, 30 Lexton Road, Box Hill 3128 or phone (03) 895 0222.

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.

March 1940

Frequency Modulation: The biggest news of a technical nature in the radio industry is the newly developed transmission technique known as 'frequency modulation', which has been perfected by Professor Edwin H. Armstrong of Columbia University, USA.

Briefly, frequency modulation is a method of transmission in which, instead of varying the amplitude as is done at present in conventional transmitters, the frequency of the transmitter is varied under modulation. From the listeners' point of view this means static free reception of high fidelity, while from the transmission angle it means relatively cheap transmitters and the opening up of an unlimited number of new channels for broadcasting purposes.

All this certainly sounds most intriguing. It will, of course, be quite some time, probably years, before we in this country will experience this new development.

Radio Altimeter Uses Microwaves: Radio has solved the problem of working out an aircraft's altitude, when it is flying 'blind'.

The new radio altimeter is essentially a simple device, measuring the time interval between a transmitted radio signal and its 'echo' reflected from the ground. The present radio altimeter can accurately measure time intervals of one 20,000,000th part of a second, corresponding to a height of 20 feet, and will soon be able to measure, just as accurately, time intervals of one 50,000,000th part of a second.

March 1965

Theatre TV Experiments in Britain: One aspect of TV which we hear little about in Australia is its use in theatres for presenting sporting and other events of high immediate interest. A recent demonstration in Britain, when the Pastrano-Downes fight was relayed from Manchester to London, might well herald a rapid expansion in this field.

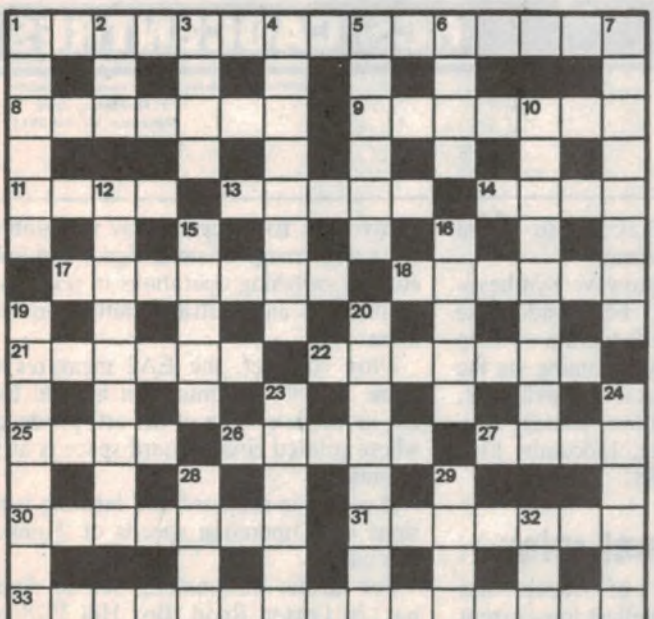
The pictures received at the Phoenix Theatre in Charing Cross Road were occasionally of variable quality, though at no time during the 90-minute relay were they unacceptable. Allowance must be made for the fact that the camera crews were unused to working with Eidophor projectors and were working under difficult lighting conditions – partly due to smoke in the arena.

Communication for Skin Divers: An underwater communication system that uses only the human ear as the receiver was shown by the Bendix Corporation at a recent New York Boat Show.

The device, known as 'Watercom', will enable a diver to talk to all others beneath the surface of the water within a range of 100 yards. The sound of his voice is transmitted through the water and can be heard without the aid of special receiving equipment.

The system includes an amplifier which connects to the diver's air tank, a special mouth mask that allows the diver to move his lips freely and ennunciate his words, and a throat microphone. The entire unit, including batteries, weighs only five pounds under water. EA

EA CROSSWORD



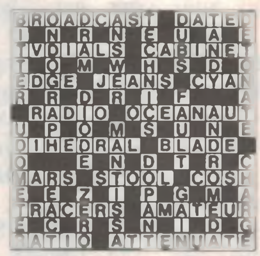
ACROSS

1. Causes of complaints about programmed intrusions. (8,7)
8. Scan information incorrectly. (7)
9. Joystick. (7)
11. Cycle with sparking plug. (4)
13. Charged particle. (5)
14. Periodic disturbance. (4)
17. Covered with spaghetti. (7)
18. Electrical appliance. (6)
21. Meteorological phenomenon. (6)
22. Raising status of computer. (7)
25. Items of radio equipment. (4)
26. Shape of DNA molecule. (5)
27. Restricted transmission. (4)
30. Weapons of science fiction. (3,4)
31. Part of a program. (7)
33. Said of an easy-to-use battery. (11-4)

DOWN

1. Particular terminal. (6)
2. Semiconductor. (3)
3. Computer operator. (4)
4. Put at risk. (8)
5. Measurable quantity such as electric field strength. (6)
6. Tone of telephone. (4)
7. Joined by metallic fusion. (8)
10. Aspect of impedance. (9)
12. Process of obtaining distant data. (9)
15. Indexes on screen. (5)
16. Metric prefix greater than centi. (5)
19. Outdated unit of length. (8)
20. Antiparticle. (8)
23. Attenuate. (6)
24. Electricity pioneer, 1775 – 1836. (6)
28. Program function allowing termination of current process. (4)
29. Colloquial term for a television set. (4)
32. High-vacuum device, the Intersecting Storage Ring. (1,1,1)

FEBRUARY SOLUTION



PC Interfacing Feature:

Low-cost EPROM programmer for PC's

This versatile EPROM burner card fits the expansion slot of any IBM or compatible PC. It handles EPROMs with memory capacities up to 64KB, and is supplied with its own menu-driven operating software.

Computer-driven EPROM programmers are quite an attractive proposition when compared to stand-alone units. They tend to be low in cost, and use most of the functions of the host machine such as the keyboard, screen, disk drives and on-board memory. These facilities are generally far more practical and powerful than their counterparts on a dedicated programmer. And as a bonus, the software that controls the computer-based unit is simple to upgrade – just load in the new version from a floppy disk.

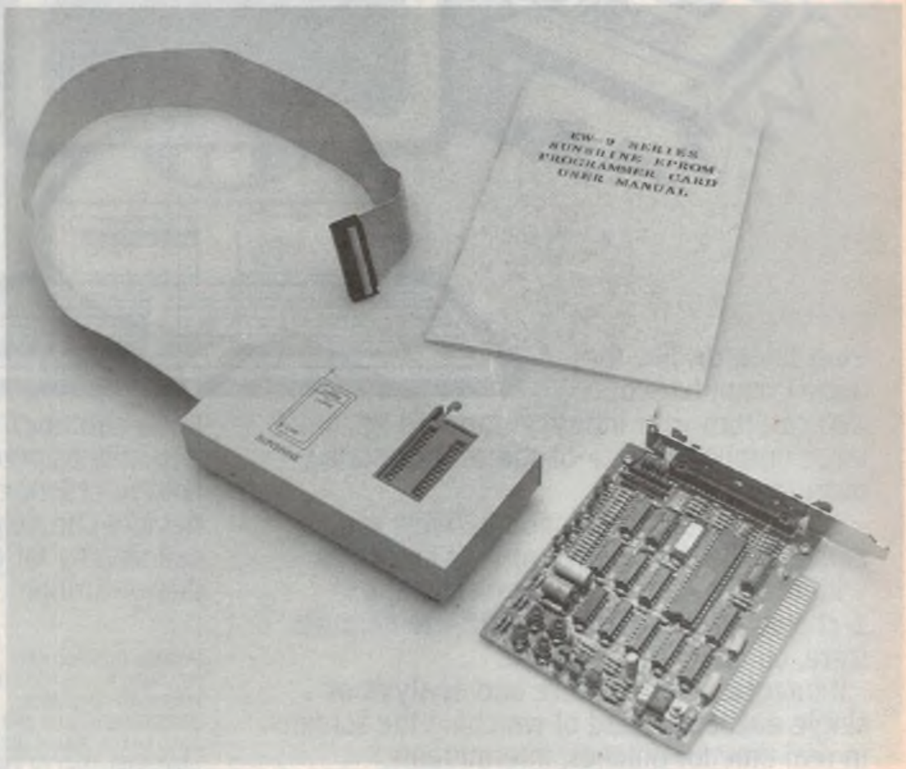
The Sunshine EW-901BN EPROM programmer is a fine example of this technique. It's very simple to install and operate, produces reliable results, and won't cost you an arm and a leg. As a package, it's composed of the card itself, a single floppy disk of operating software, a remotely connected EPROM test socket, and the instruction manual.

The card is a 'short length' type measuring roughly 125 x 100mm, and contains a 40-pin I/O chip, quite a number of standard logic ICs and switching transistors, and a small programmable switchmode power supply. When installed in a PC, this hardware is entirely controlled by the programming software. This selects the appropriate voltage levels and pin connections for various types of EPROM, and generates a complex set of timing loops as required by the programming process. In effect, the software takes complete control of an essentially 'dumb' card.

A 34-way IDC-style plug is positioned on the mounting plate end of the card, which connects to a matching socket and ribbon cable from the EPROM test box. This remote style of connection enables the user to position the test box on the top or alongside the computer case, which in turn allows for easy access to the EPROM itself. Many other EPROM programming cards have the test socket mounted on the actual PCB, which means that the computer case must be permanently open – rather a clumsy method.

With the Sunshine programmer, the remote test box measures 75 x 150 x 25mm, and holds a single 28-pin Zero Insertion Force (ZIF) socket. This caters for the programmer's maximum EPROM size, which is the 27512 type with a 64KB capacity. A test box with four ZIF sockets and matching hardware is also available from Sunshine (model EW-904BN), which would suit the more industrial need for bulk EPROM programming.

Since the software takes total control of the programmer's card and test box, it's this program that finally determines just how well the complete unit works. So to really judge the effectiveness of this EPROM programmer, we need to have a close look at the software itself.



Software

Working with the programmer's software is very straightforward. The main menu (as shown in Fig.1) simply uses control numbers or letters to call up the required function, and displays a running status of the current settings in the top right-hand corner of the screen. Basically, the operations are divided into two distinct areas – accessing the EPROM itself (reading, programming, verifying etc), and manipulating the program's 'buffer' memory (loading,

```
SUNSHINE EPROM Programmer V7.0
MODEL: EW-901BN (C) 1989
-------- Main Function Menu ---------
[1]: File directory
[2]: Load BIN file into Buffer
[3]: Save Buffer content to disk
[4]: Edit,Display,Print Buffer content
[5]: Change I/O base adr. of Hardware
[6]: Display loaded file information

[T]: Type number      [M]: Manufacturer
[R]: Read
[B]: Blank check
[P]: Program
[V]: Verify
[A]: [B] and [P]
[D]: Display
[C]: Compare

[S]: Assign Programming algo.
[Z]: Assign Target Zone
[Q]: Quit
-------------------------------------
Select which function ?
```

```
* MFR.: 27/27C       * Q'TY   : 1
* TYPE: x64          * MASTER: NO.1
  VPP : 21V          * ALGO. : INTL

  TARGET ZONE -- VS -- EPROM ADR.
start adr: 0000 -------- 0000
end   adr: 1FFF -------- 1FFF
check sum: 0000
```

Fig.1: The main menu screen provided by the software which comes with the Sunshine EPROM programmer.

saving, editing etc).

The buffer is a 64KB section of the computer's main memory, which is used by the software to store data from the EPROM, or from an EPROM file on disk (or both). This allows for 512K *bits* of information, which in turn defines the largest size of EPROM that the system will accept as the 27512 type.

However this buffer area is not restricted to a single block of information, and may be loaded with up to 20 'files' of EPROM data. These files can be loaded from the computer's disk drive(s) with the menu's '2' option, or read in from the EPROM test socket using the 'R' (read) function. In both cases, the software prompts the user for a loading address within the buffer's 0000H to FFFFH range. Also, selecting '6' on the menu will display the buffer's current contents as a list of files and matching addresses.

This type of data manipulation is very versatile. It allows the user to assemble several blocks of sequential information within the buffer, which may then be programmed into an EPROM as one contiguous file. As a simple example, the data from two 2732 EPROMs could be placed in successive 4KB blocks (0000 to 0FFF, and 1000 to 1FFF), and then programmed into a single 2764 EPROM as a single 8KB block.

On the other hand, if only a section of the buffer memory is to be programmed into an EPROM, the menu's 'Z' function will allow a specific area of memory to be selected (the Target Zone). Since the function also asks for an address to start programming *within* the EPROM, all (or part) of its space may be filled with only a section of the buffer data. The example in this case would be programming a 2732 EPROM with a 4KB section of an 8KB file, which represents the contents of a 2764 EPROM.

While this may sound a little confusing in print, it's quite clear when using the program. All current addresses are shown in the main menu's status window, which provides a clear indication of the redirection process at any time.

Further to this, function '4' calls up a sub-menu (as shown in Fig.2) which allows the user to manipulate the buffer contents at a bit level. This screen editor is not unlike the DOS Debug facility, but operates in a far more 'user friendly' manner – it's quite easy to search and alter the contents of an existing file, or write your own code from scratch.

The other options in the main menu generally refer to the EPROM in the test socket itself. The 'R' function (mentioned above) will read the contents of the EPROM into the buffer, as defined by the Target Zone addresses. Similarly, the 'P' option programs the selected data from the buffer into the EPROM, with a programming technique assigned by the 'S' menu function.

This function allows the user to choose between three programming modes or 'algorithms' – Normal, Intelligent and Quick. The Normal function pulses the data into the EPROM at the standard rate of 50ms per byte, and sets the supply rail (Vcc) to 5 volts.

The Intelligent mode however, sets the rail to 6 volts and attempts to write the data with a 1ms pulse, then immediately reads back the byte to check the result. If the data is incorrect, another 1ms pulse is applied, and so on until the result is confirmed. It may only take 10 or 20 attempts to solidly lock the data into the EPROM, which makes this programming method much faster indeed. The Quick algorithm goes a step further, and uses only a 0.1ms pulse with the above method, and a 6.25V supply rail.

To test the relative speeds of each method, we first erased a 2764 EPROM, and programmed the chip using the Normal algorithm. Since an erased EPROM has all data bits set to a high logic level (FFH for each byte), we set the entire data in the buffer's target file to a low logic level (00H per byte) – quite an easy job with the 'fill block' option in the menu's function '4'. The programming time in Normal mode was eight minutes and 25 seconds.

We then repeated the procedure with the Intelligent programming algorithm, which rocketed through the chip in only one minute and 25 seconds – not bad at all. Unfortunately, we were unable to try the Quick mode through lack of a suitable EPROM, since this algorithm only applies to the less common (generally CMOS) EPROMs with 12.5V supply rails. Nevertheless, we would expect this programming mode to be even faster. So, Quick is faster than Intelligent...hmm!

The style of EPROM is selected with the 'T' and 'M' functions of the main menu, which correspond to the chip's Type and Manufacturer respectively. Rather than prompting the user for an actual manufacturer's name, the 'M' option offers a choice of three manufacturing styles. These incorporate the common 27 and 27C series devices, the 87C

```
                      EDITING COMMAND SUMMARY
-------------------------------------------------------------
D [start],[end]              <RETURN> : DUMP
E start                      <RETURN> : EDIT
M start,end,destination      <RETURN> : MOVE BLOCK
F start,end,data             <RETURN> : FILL BLOCK
P start,end                  <RETURN> : PRINT BLOCK
C start,end                  <RETURN> : CHECK SUM
S start,end,ASCII data       <RETURN> : ASCII  SEARCH MAX. 15 characters
B start,end,BINARY data      <RETURN> : BINARY SEARCH MAX.  7 BYTEs
. filename [argu1] [argu2]...<RETURN> : SHELL
?                            <RETURN> : HELP
Q                            <RETURN> : QUIT
-------------------------------------------------------------
* The information listed below is for reference only :
  The absolute start address of BUFFER : 4D4D:0000
  The Buffer size : 64 K BYTES
```

Fig.2: For editing and manipulating the RAM buffer contents the Sunshine software provides this further sub-menu of options.

addressed latched EPROMs, and the more exotic NS CMOS chips.

Within each category, the 'T' function offers up to 13 EPROM types, covering storage capacities from 2KB to 64KB – that is, chips with both low (12.5V) and high (25V) programming voltages, in the 2716 to 27512 range. To take the guesswork out of choosing the correct parameters, both the programmer's manual and the software's help file provide a comprehensive list of chip types, from the major EPROM manufacturers.

The other main menu options are quite straightforward. The Blank Check function simply checks for a data reading of FFH at each EPROM address, while the Display option causes the screen to scroll through the entire data contents of the EPROM.

Both the Verify and Compare functions compare the data at the selected addresses of the EPROM and the buffer memory, then report any discrepancies. The Verify option simply displays an error and terminates the scan, while the Compare command provides a list of differences between the two blocks of data.

When the Program option is selected, the EPROM is programmed with the chosen algorithm, and then automatically checked by the Verify function. This is in fact a final check, since the programming algorithms check each data byte immediately after it is written. For a more automated function, the 'A' option will Blank Check, Program and Verify the EPROM data, in a single operation.

While the Quit option exits the program as you would expect, it also saves the current Type, Manufacturer and Programming Algorithm settings to a data file on disk. When the program is re-loaded, it automatically selects the user's last settings from this file.

Ironically, the Quit function is our only (minor) quibble with the programmer's software. The problem is that you only need to type 'Q' (Quit) from the main menu to exit the program, without the need for a following carriage return (Enter) or query message which must be followed by a confirming 'Y'. Now if the buffer contains valuable data, such as a source code that has taken hours to prepare, it will be lost if the program is terminated accidentally – all it takes is a touch of the 'Q' key. Nevertheless, as with other programs used to manipulate files, it's best to 'save' frequently (this includes word processors!).

If the software needs to be controlled in a more automated fashion, the program may be loaded in conjunction with a keyboard input file, which is accessed via the DOS redirection command '<'. The instructions in this additional file will simply replace the usual input from the keyboard, and force the software to perform any number of menu selections, in a continuous manner. For example, the program might be loaded by typing: EPROM1 < KEY.

In this case, EPROM1 is the software's main EXE file, and KEY is the input data file, as written by the user. The KEY file may have any name, and is a simple text file which may be created by a standard text editor, such as a word processor. So when the program is loaded as above, the letters and numbers in the KEY file will sequentially activate the appropriate menu functions.

The obvious use for this technique is in a small manufacturing environment, where the program might be regularly used for one particular programming task. The input file (KEY) could tell the programmer to automatically select the EPROM type, load a file from disk, perform a blank check, program and verify the EPROM, and quit the program – all with a single command.

If you have any trouble with the programmer's operation, the main menu offers a further (unlisted) command for checking the various voltage levels at the EPROM test socket. By typing 'X' at the main menu, the software begins quite an elaborate test routine which cycles (when prompted) through all the possible voltage combinations at the test socket.

So all in all, the software provided with the Sunshine EPROM programmer is very well thought out, and transforms the card into a versatile and powerful tool. Several utility programs are also included, which help in managing the various EPROM files and data formats. There are a couple of Hex to Binary converters, a screen dump routine, and two file splitter programs for handling 16 and 32 bit wide data files.

As a total product, the Sunshine programmer works well. It makes the most of the host computer's facilities, and is both easy to install and operate. At only $190 for the complete system, it must represent about the best value around – particularly when compared to stand-alone programmers, which tend to weigh in at the $1000+ mark.

For more information on the Sunshine programmer (or to get a little sunshine into your life!), contact Microgram Computer at 17 Barry St, Bateau Bay, NSW 2261, or phone (043) 32 8651. (R.E.)

Progress in PC-based data acquisition

The idea of using a low-cost personal computer as the heart of a data acquisition system, or low-frequency digital storage scope, is an attractive one. As a result, many plug-in ADC cards have appeared for the IBM PC and compatibles. But not all such cards are equal...

by R. JOYCE
Project Engineer, Analog Devices Inc.

The proliferation of data acquisition plug-in boards for PCs gives laboratory users a wide choice in performance and speed. Lower speed signals (up to several thousand Hz) are relatively easy to accurately acquire at moderate sampling rates (up to 10kHz) and resolution.

The real challenge is to effectively and precisely capture data at rates of 100kHZ and above. If a plug-in board has the wrong architecture, components, or support software, the acquired data will be inaccurate in value or time, and the PC will be burdened with storing and processing excess, erroneous, and useless data. The result is CPU overload, in which even simple data-related tasks cannot be completed, or the data rate is unnecessarily constricted.

In addition, a properly selected PC plug-in can add to the capabilities of the system by adding data acquisition options. For example, alternative choices in triggering allow the user to prequalify data so that irrelevant or redundant data are not acquired; data both after and prior to a critical trigger event can be stored and examined; and precise timing of the sampling and analog-to-digital conversion itself can be established. Finally, two or more signal channels can be digitised with true simultaneity, so that channel-to-channel correlations can be performed.

PC data acquisition

The simplest approach to acquiring an analog signal requires an analog-to-digital (A/D) converter, as well as circuitry to interface to the PC bus (Fig.1). This scheme can work well at low rates, but has many drawbacks.

Firstly, the sampling points are controlled and triggered by the software of the PC, so any changes in the PC program or its operating system affect the precise timing of the samples. Variations in unrelated CPU activity cause clustering and ultimately spreading of samples times, even if the average time between samples is correct. Even if the signal is noise-free, this timing jitter has the same effect as noise added to the input signal and essentially negates the high resolution of the conversation.

Secondly, the maximum rate clock that the CPU can generate is fairly low

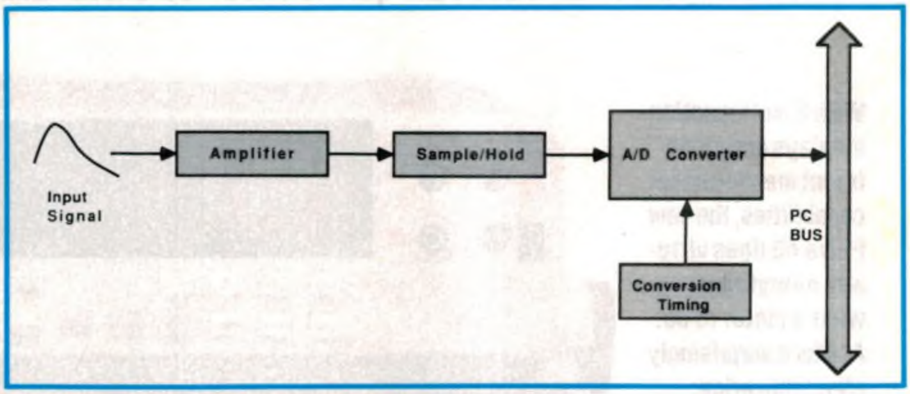


Fig.1: Basic functions of a PC-based A/D conversion system.

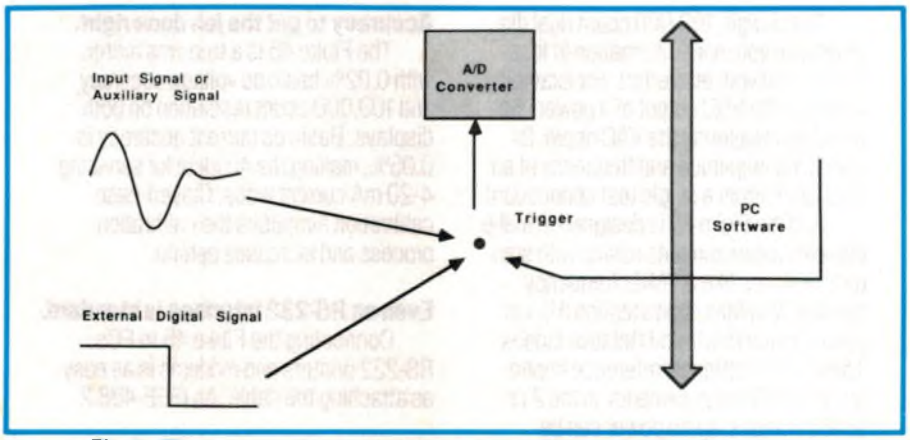


Fig.2: The conversion process can be triggered in various ways.

– about 100us between pulses, which limits the A/D conversions to a 10kHz rate. For these reasons, a hardware clock set by software on the A/D board is essential to precisely pace conversions from analog to digital.

The signal to be digitised cannot go directly into the A/D converter, even if its nominal level is compatible with the converter range. During the conversion cycle, the input signal can change and the converter tries to, in effect, measure something with a value that varies during this measurement. Even with a 25us converter (fairly fast), the maximum bandwidth of an input signal that can be converted to 12-bit accuracy (1 part in 4096) is just 25Hz. The solution is the sample and hold amplifier (SHA), which is an analog circuit that captures and then freezes the input signal value, for a time period longer than is needed for the conversion.

Triggering

There is more to capturing useful data than precisely initiating A/D conversions. Much data can be captured, but much of the data may be irrelevant (which means extensive data reduction is required), or useless (which means repeating the experiment). Triggering and synchronisation ensures capturing only the correct data and avoiding excessive needless data. The trigger defines when conversions should begin.

Advanced data acquisition boards, such as the RTI-860 (Analog Devices, Norwood, Massachusetts), support three distinct types of triggering (Fig.2): an internal software-driven trigger activated by the application program writing to a specific address: an external digital trigger (TTL-compatible) which initiates conversions on the trigger signal's transition from high to low state: and a versatile trigger which initiates conversions based on the level and slope of an analog signal.

The analog trigger provides a wide range of flexibility, since it starts conversions when either the signal to be acquired or an independent auxiliary signal crosses a preset threshold. This threshold can be anywhere within a -10V to +10V range and is set by the user application software which controls the setting of a digital-to-analog converter and comparator.

Analog triggering of this type is especially useful when the trigger signal is slowly changing (such as with temperature change or a biological process parameter) and must initiate a burst of relatively high-speed data acquisition. By explicitly defining the desired slope,

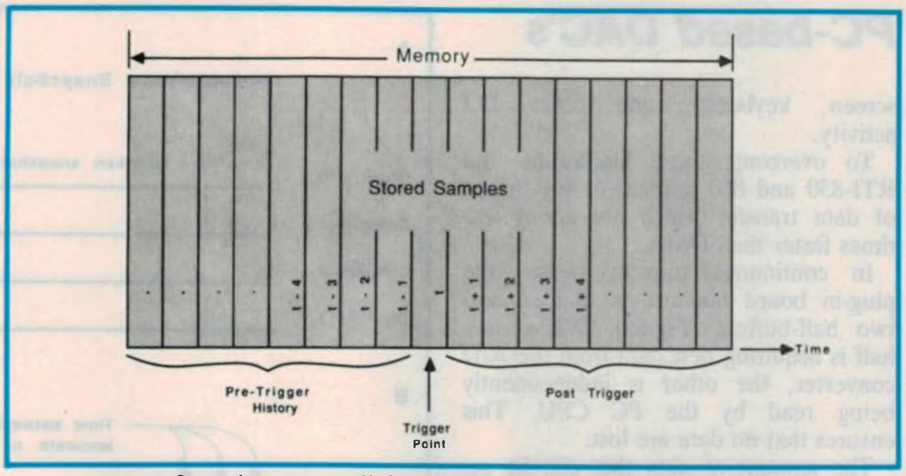


Fig.3: Samples are available both before and after triggering.

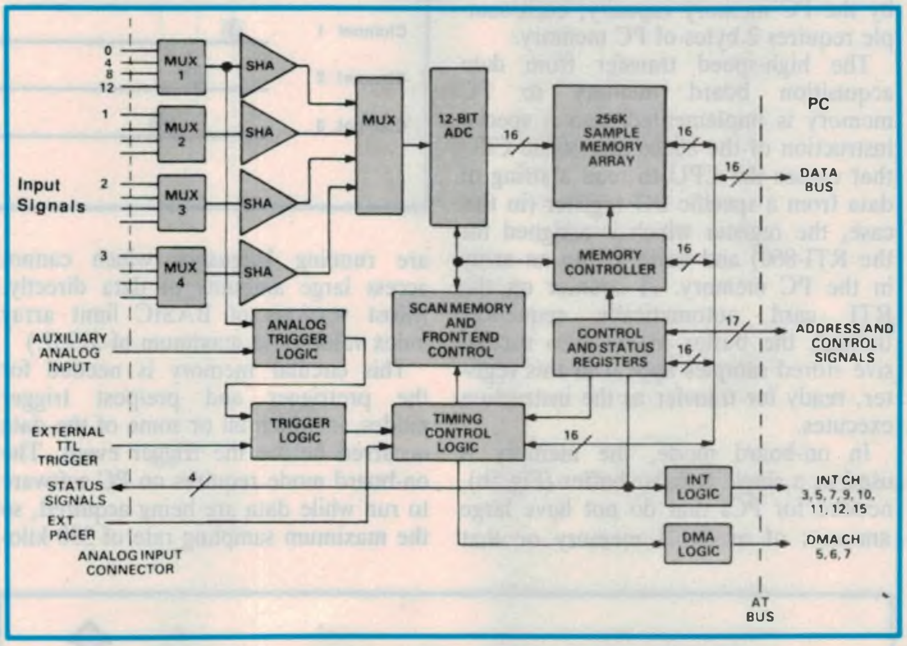


Fig.4: Block diagram of the Analog Devices RTI-860.

a group of 1000 samples can be acquired whenever the temperature increases past the threshold – but not when it decreases past the same point, for example.

A trigger – regardless of whether it is software, digital, or analog – can be used as the key to looking back in time to see data prior to the trigger event, or on both sides of it. In this pretrigger mode of operation the A/D converter is set to continuously convert and store the acquired samples in a buffer memory that is repeatedly overwritten as it fills. The triggering can be set up so that the trigger event causes the sampling to stop, meaning all data are historical. The triggering can also be set up to take a specified number of additional post-trigger samples, so that the data represent both past and future with respect to the trigger (Fig.3). This capability is ideal for studying which variable values led to an important and often hard-to-repeat event.

Memory & data transfer

Getting a large amount of highest-speed data acquisition plus efficient data transfer to the PC requires the proper memory architecture within the data acquisition plug-in board. The RTI-860 (Fig.4) provides enough memory for 256K samples.

However, unless coupled with proper management, having memory is not enough.

Traditionally, direct memory access (DMA) transfers are used for high rates of memory data transfer, but the maximum transfer rate of the AT class of PC has been experimentally measured at 66kHz, equivalent to transferring only one sample every 15us. In addition, the CPU stops during the DMA cycle, thus halting critical software timing and screen, keyboard, and other I/O activity.

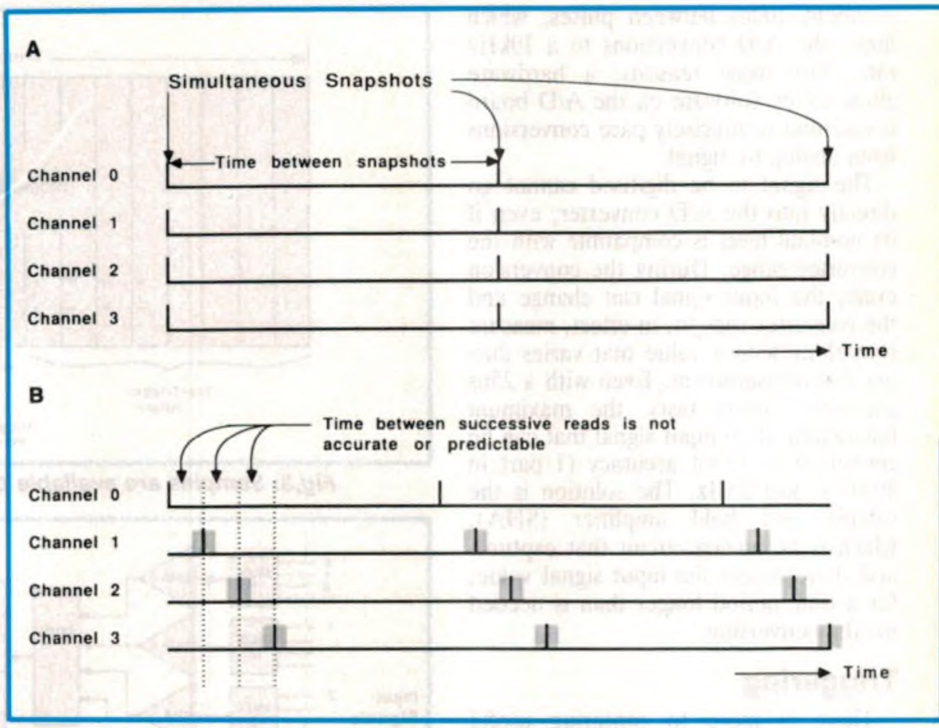
To overcome these limitations, the RTI-850 and 860 implement two forms of data transfer which are about five times faster than DMA.

In continuous transfer mode, the plug-in board memory is divided into two half-buffers (Fig.5a). While one-half is acquiring new data from the A/D converter, the other is independently being read by the PC CPU. This ensures that no data are lost.

The amount of data that can be acquired in this mode is actually limited by the PC memory capacity; each sample requires 2 bytes of PC memory.

The high-speed transfer from data acquisition board memory to PC memory is implemented with a special instruction of the 80286 and 80386 CPU that causes the CPU to read a string of data from a specific I/O register (in this case, the register which is assigned for the RTI-860) and write it into an array in the PC memory. A counter on the RTI card automatically sequences through the buffer memory so successive stored samples appear at this register, ready for transfer as the instruction executes.

In on-board mode, the memory is used as a single circular buffer (Fig.5b), needed for PCs that do not have large amounts of available memory or that are running languages which cannot access large amounts of data directly. (Most versions of BASIC limit array index values to a maximum of 32767.)



This circular memory is needed for the pretrigger and pre/post trigger modes, in which all or some of the data occurred before the trigger event. The on-board mode requires no PC software to run while data are being acquired, so the maximum sampling rate of 330 kilosamples/sec (for 8-bit samples) is achieved. The user application program sets up the process by writing to control registers. It then starts the process and polls to see if data collection is complete.

Multiple channels

In many applications, there is a need to take a snapshot of several signals at the same time. As Einstein noted, the simple phrase 'the same time' means different things under different circumstances. The easiest approach to apparently simultaneous measurements on several channels is to have a single A/D converter for each channel. This is costly, however, and requires that the converters have matched characteristics.

A simpler approach is to have an input signal multiplexer which can switch between one of several input signals in rapid succession. However, the actual time skew between samples on the different channels is at least as long as the amount of time an A/D converter requires to perform a single conversion. This is not including overhead time to take the results from the converter, put it into memory, and set up for the next conversion.

For a typical 25us, 12-bit A/D converter, the overall skew time is significant. This scheme also has a drawback in how sampling is timed: usually, the user wants to acquire the simultaneous data from several channels, wait some relatively long period of time, take another set of samples, etc. (Fig.6a).

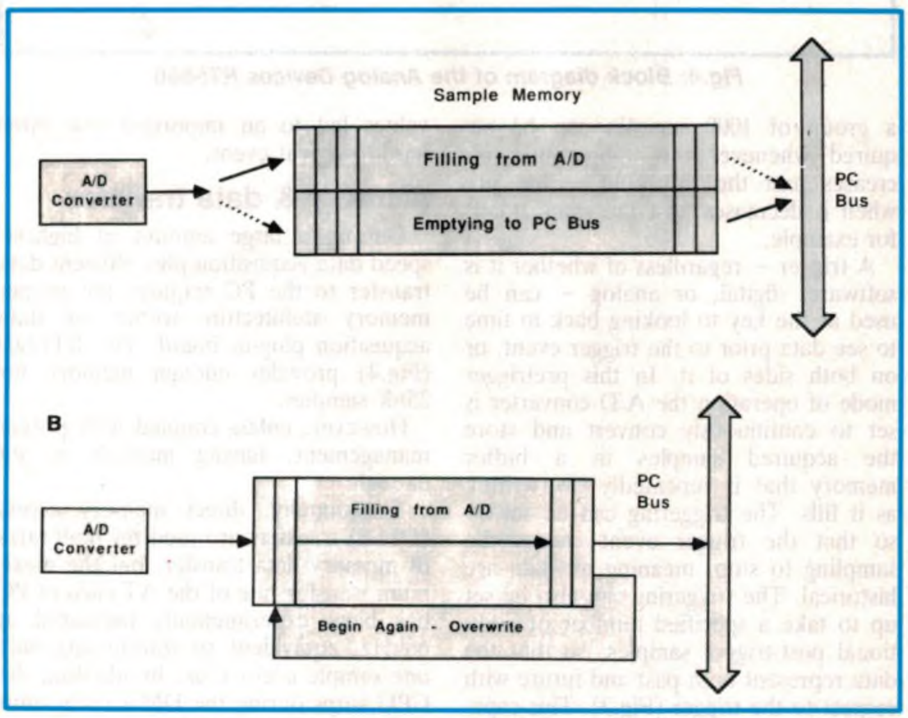


Fig.5: (a) Continuous transfer mode; (b) On-board mode.

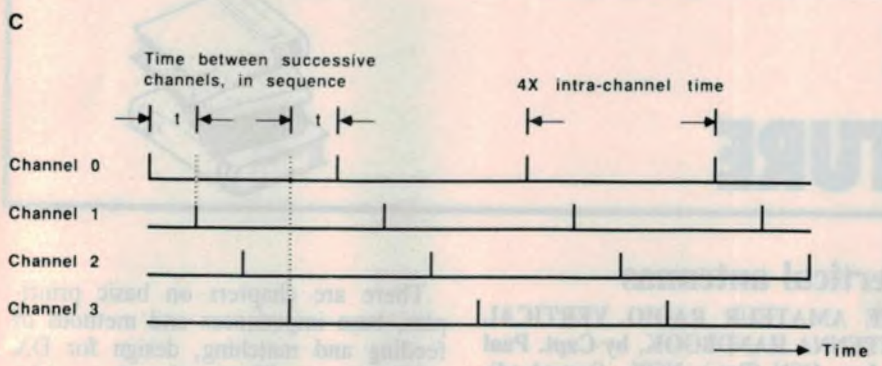


Fig.6: (a) Desired sampling in multiple channels; (b) Software paced multiple channel triggering; (c) Hardware paced multiple channel triggering with inappropriate architecture.

The software and hardware managing the multiplexed approach usually require one or two choices. In one case, the software must initiate each successive multichannel sampling cycle. This means that the time between sampling cycles is basically long and imprecise (Fig.6b), as we saw in the discussion of triggering.

If a hardware pace is used to initiate conversions, then the user must specify the total number of conversions and receives evenly spaced conversions across channels 0, 1, 2, 3, 0, 1, 2, 3. The interchannel time and the time between overall repetitions are forced to be identical (Fig.6c).

A better solution is implemented on the RTI-860 (refer back to Fig.4). Each of the four input channels has its own independent sample and hold device, and all four are triggered simultaneously to sample and hold their respective inputs. The held signal values go through a multiplexer, and the A/D converter performs its conversion operation four times, in sequence, yet the signal being converted was captured at the same time for all four channels.

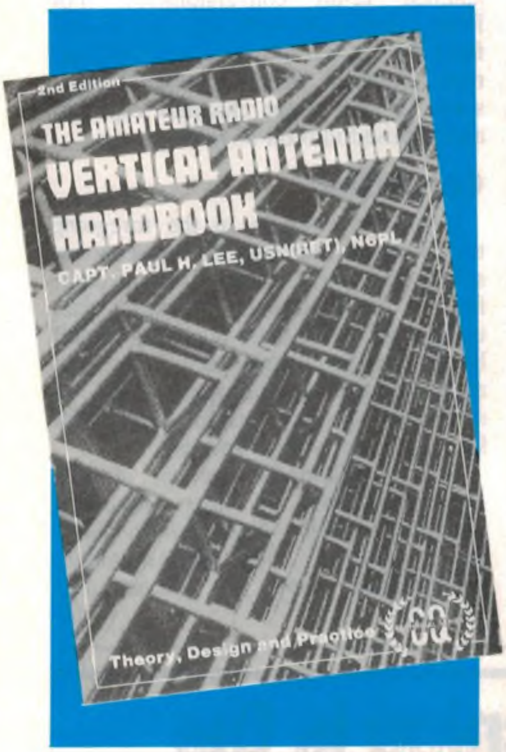
These channels are truly simultaneous, to within the aperture uncertainty of the sample/hold ICs, which is about 500ps. Best of all, the pacing of the sampling and conversions is set by precise circuitry and can be as high as 250,000 12-bit conversions/sec. For faster speeds, the RTI-860 is set to perform 8-bit conversions at a 330,000/sec rate, in which each conversion represents all four input channels captured and digitised into on-board memory.

Conclusion

It has been shown in the foregoing that there can be tradeoffs between raw speed and precise timing, among other factors, in acquiring real-world data using a PC. However, a plug-in circuit board with the proper architecture can minimise the compromises that are made and produce useful data, with known timing, at high speeds.

Further information on the Analog Devices RTI-860 PC data acquisition board is available from Priority Electronics, Suite 7, 23-25 Melrose Street, Sandringham 3191 or phone (03) 521 0266. EA

NEW BOOKS AND LITERATURE



Vertical antennas

THE AMATEUR RADIO VERTICAL ANTENNA HANDBOOK, by Capt. Paul H. Lee, USN (Ret.), N6PL. Second edition, published by CQ Publishing, 1984. Soft covers, 228 x 153mm, 139 pages. Recommended retail price $18.50.

An oldie but a goodie, and now readily available here in its second edition. It's a book which specialises in antenna theory, design and practice for amateur radio – and not just antennas in general, but specifically *vertical* antennas. There really isn't all that much reference material available on this (often ignored or wrongly maligned) type of antenna, so that it has little competition.

The author has long been interested in vertical antennas, and over the years has written many articles on the subject which have been published in the US ham magazine *CQ*. His book is in fact a carefully re-edited and revised version of many of these articles, published between 1962 and 1984.

There are chapters on basic principles, base impedances and methods of feeding and matching, design for DX performance, directional antenna design, short antennas, vertical stacking, broadband antenna design and configurations, operation and design of the folded unipole antenna, plus description of a number of specifical practical antennas. Very comprehensive coverage of the subject, in fact, from both theoretical and practical angles.

The text is clear and concise, and provided with plenty of illustrations – pictures, diagrams and graphs of calculated and measured performance.

All in all, then, a very informative treatment of the subject and one that should be found very useful by anyone needing a sound reference on the subject.

The review copy came from Stewart Electronic Components, of 44 Stafford Street, Huntingdale 3166 (PO Box 281, Oakleigh, 3166), which can supply it via mail order, for the price quoted. (J.R.)

Reception guide

BETTER TELEVISION AND RADIO RECEPTION – Your Self-Help Guide, published by the Department of Transport and Communications, 1989. Soft covers, 295 x 149mm, 56 pages. ISBN 0644 104473. Available free on request.

A new booklet produced by the Department of Transport and Communications to guide viewers and listeners in overcoming reception problems, and launched recently by Minister Mrs Ros Kelly. It also carries the endorsement of well-known consumer adviser and media personality Helen Wellings, host of the ABC television program *The Investigators*.

Written primarily in plain English for the non-technical consumer, the booklet gives down-to-earth but sound advice and information on the symptoms, causes and remedies of most familiar reception problems. This material is nicely augmented by pictures and diagrams, and should be found very useful by most intelligent consumers – particularly if they're also 'handy' enough to tackle simple operations with a screwdriver and pair of pliers.

Towards the rear, however, there is also material which should be found useful by the more technical consumer (such as those who are also readers of *EA*). This includes material on basic interference suppression techniques, antenna installation and a list of suppliers of interference suppression filters and associated devices. There's also a handy glossary of terms.

My impression is that it's a very practical and authoritative little reference book, and one that will be found of value by both lay viewer/listener and the more technical consumer.

Apparently copies of the booklet have already been sent to some 2500 technicians and antenna installers around the country, to make them aware of its existence. However basically it's intended for viewers and listeners, and copies are available free on application to any branch of the DOTC. You certainly can't complain about the price! (J.R.)

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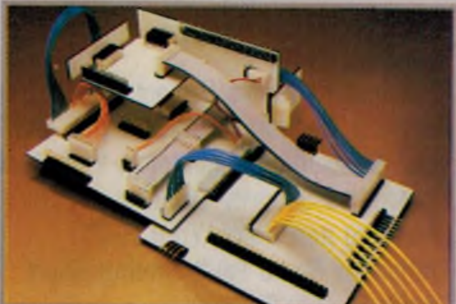

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Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

Affordable GaAs logic

US company GigaBit Logic is the first GaAs supplier to fully convert its fabrication lines from 3" diameter wafers to higher-yield 4" wafers and to supply digital GaAs ICs at competitive prices. With the introduction of plastic packaging, the prices are anticipated to come down further.

GaAs ICs, commonly associated with supercomputing applications in the past, have traditionally been too high-priced for other computer applications such as workstations, and have been price prohibitive at the PC level. The multi-gigahertz performance of GaAs logic is now available at prices competitive with low-cost ECL.

For further information, contact Integrated Silicon Design, PO Box 99, Rundle Mall, Adelaide 5000 or phone (08) 223 5802.

Thermally conductive circuit board

A high thermally conductive aluminium substrate for hybrid integrated circuits has been developed. The basic composition of the substrate is an aluminium plate (0.5 – 5mm), with insulated thermally conductive layer (50 ~ 150um) and the metal foil (35um copper foil).

The insulated thermally conductive layer is an epoxy-based resin with greater loadings of highly thermally conductive inorganic insulation material. The thermal conductivity of the layer is as high as 1.7W/m°C.

Apart from hybrid integrated circuits, this new material could be of use as substrate for transistor arrays, thyristors, switching regulators and chip carriers.

For further information, contact Crusader Electronic Components, 81 Princes Highway, St. Peters 2044 or phone (02) 516 3855.

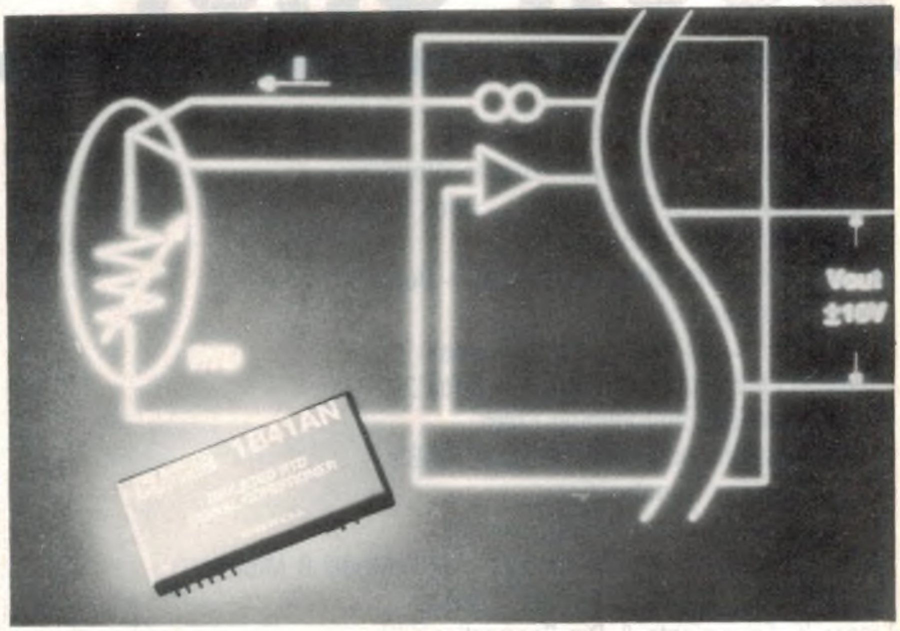
Graphics chips

Trident has released two graphics chips which are compatible with IBM PC/XT/AT and PS/2. The hardware register levels are also compatible with VGA, EGA, CGA, MDA and Hercules modes.

The TVGA 8800 has a resolution of 640 x 480 with 256 colours and a resolution of 1024 x 768 with 16 and 4 colours, all from a palette of 256K colours. Its 16Kb of software loadable font support makes it ideal for foreign language and scientific applications.

The TVGA 8900 has resolutions up to 1024 x 768 in 16 and 256 colours. It can have 132-column text with up to 60 rows and can support all existing monitors with only four crystal oscillators or a clock chip.

For further information, contact Veltek, 22 Harker street, Burwood 3125 or phone (03) 808 7511.



RTD conditioner

Using transformer-based isolation and surface-mount components, Analog Devices' 1B41 provides a compact, complete, resistive temperature device (RTD) signal conditioning solution. It includes amplification with resistor-settable gain and zero suppression, lead-resistance compensation, and filtering.

It supports RTDs with resistance from 20 to 5000 ohms and the output of +10 to –10V is directly connected as a high level input to temperature measurement systems. Filtering at 3Hz provides normal-mode rejection of 60dB and common-mode rejection of 160dB at 60Hz.

A single 1B41 module can develop one input signal proportional to the temperature difference between two independent 2-wire RTDs, thereby compensating for lead resistance. Its performance is specified from –25 to +85°C, with operation guaranteed to 40°C.

For further information, contact Avisun, Unit 9, 1 Short Street, Chatswood 2067, or phone (02) 417 8777.

Non volatile SRAM

Dallas Semiconductor's DS 1243Y is a fully static non-volatile RAM (8k x 8) with a realtime clock. It has a lithium cell and control circuit which constantly monitors Vcc for out of tolerance conditions.

When such a condition occurs, the lithium cell is automatically switched on and write protection is unconditionally enabled to prevent distorted data in both the memory and realtime clock. Data retention in absence of power is over 5 years.

For further information, contact IRH Components, 32 Parramatta Road, Lidcombe 2141 or phone (02) 648 5455.

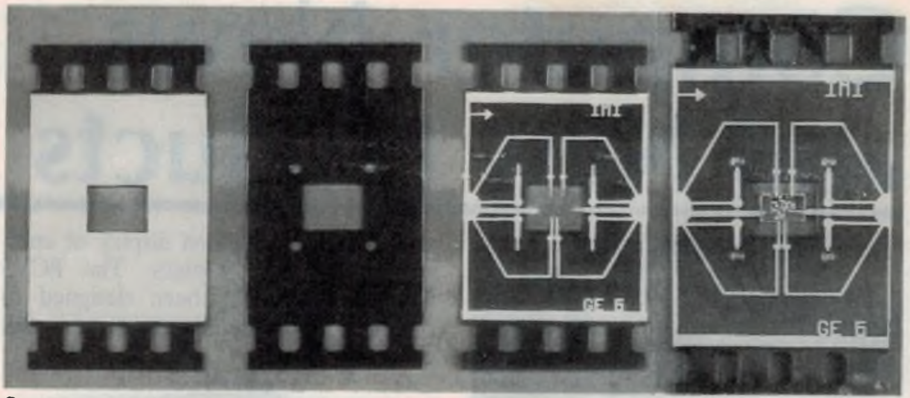
TAB bonded GaAs chip

International Micro Industries and General Electric have developed the first TAB lead connected GaAs chip assembly, incorporating a new multiconductive layer flexible printed circuit lead pattern.

When compared to wirebonds, TAB has superior microwave properties for connecting GaAs chips. The rectangular cross section of the TAB lead provides lower inductance and lower resistance connections.

The pattern shown has been designed with a ground plane, making the TAB connector on the polyamide film a microstrip structure. In addition, the pattern has ground connections on the top side of the polyamide, adjacent to the microwave transmission line, providing for electrical test probing.

The new structure is called MULTI-TAB, with lead density capability down to 50 micron lines and spaces. It is applied in high density multichip packages, as a chip-to-chip interconnect, and could be of use in credit card size products.



Stages in the assembly of a TAB bonded GaAs chip (L to R).

High speed GALs

US company Lattice Semiconductor has introduced GAL 16v8a and GAL 20v8a in the PLD market. At 10ns maximum propagation delay time, these are among the fastest speed PLDs available.

The CMOS process with electrically erasable floating gate technology allows these to consume just 75mA Icc, which means 50% power savings when compared to their bipolar counterparts. These are also capable of emulating 21 different standard types of 20 and 24 pin PAL devices.

GAL products are guaranteed for 100 erase/rewrite cycles and data retention exceeding 20 years.

For further information, contact RAE Industrial Electronics, Suite 6, 41 Rawson Street, Epping 2121 or phone (02) 868 3022.

Mobile radio audio processor

The CML FX506 is a microprocessor-controlled, single-chip IC containing all the circuit elements necessary to perform the audio functions of a mobile or portable radio system.

The on-chip signal paths include speech-band/pre- and de-emphasis filters, variable gain/attenuation stages, voice compression and deviation limiter circuitry.

Suitably software configured, the FX506, which can operate on voice, direct digital or tone data, is compatible with FM, AM and SSB type receivers.

For further information, contact VSI Electronics, 16 Dickson Avenue, Artarmon 2064 or phone (02) 439 8622.

Australians develop speech codec

In what is believed to be a world first, Electrodata, in collaboration with University of New South Wales, has recently developed a good quality speech codec for operation at 4.8kbps using a single DSP32C.

Using the codec, voice is inherently transformed into a non-simple bit stream, which will be of value in narrow band speech communications as used on satellite and/or cellular telephone links. The US Department of Defence has recently issued a 4.8kbps CELP (Code Excited Linear Predictive) standard for secure telephony circuits with which the new algorithm substantially complies.

For further information, contact Electrodata, 62 Blackshaw Avenue, Mortdale 2223 or phone (02) 570 6166.

Passive infrared detector

A passive infrared detector (PID 20), which can detect persons at a distance of up to 7 metres, providing that the difference in temperature between the human body and the environment is at least 5K, has been developed.

This device combines optical components and evaluation electronics to form a single system and has a low profile of only 21.5mm, which permits inconspicuous mounting.

As a switch operated by thermal radiation, the PID 20 may be used to control outdoor and indoor lights, door opening systems, burglar alarm systems and in various other applications.

For further information, contact Siemens Components, 544 Church Street, Richmond 3121, or phone (03) 420 7314.

Triple layer metal gate arrays

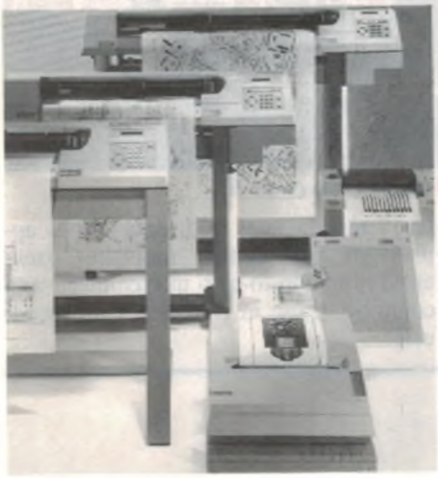
Toshiba has commercialized a new series of triple layer metal sea-of-gate type CMOS gate arrays which achieve a maximum of 100,000 usable gates. The TC150G series utilizes 1.0-micron design rule and features propagation delay time of 0.4ns.

Sea-of-gate type chips have no specific wiring areas, and transistors form the entire surface of the array. Gate arrays are semi-finished integrated circuits which can be wired in different ways to enable manufacturers to easily complete and deliver a specific IC tailored to the customer's requirements.

These are used as logic ICs for computers, telecommunications equipment, and other electronic equipment.

Contact your closest Toshiba office for further information.

Computer News and New Products



Oce expands in graphics market

Oce has acquired the graphics division of Schlumberger Technologies which will operate in the future as Oce Graphics.

The new company will provide the Australian design engineering industry with a wide range of graphics peripherals, pen plotters, thermal plotters, digitisers and tablets – featuring the latest technology from Oce's international resources.

Oce Graphics offers a choice of six A1 and A0 professional plotters, from the low-cost G1820 to the sophisticated G1835.

G1835 has features such as Pen Manager which exchanges pens before they run out of ink, Curve Manager which smooths out curves for better line quality, Soft Landing which avoids pen rebound at the start of each line, Area Manager for vector optimisation by area, roll feed and many more features.

Oce also offer Plot Station which is a unique pedestal design allowing for storage of the rolls as well as a drawer allowing storage of pens, inks, and the carousel.

For further information, contact your nearest Oce Australian office.

Full colour LCD graphics projector

In a long awaited industry breakthrough Electroboard has released the first full colour, liquid crystal display system for large screen display of computer data and graphics. The PCV5 Colour Viewer has been designed to project a computer screen image in full colour.

Using the latest in subtractive colour technology LCD's, the PCV5 has eight brilliant colours – red, blue, green, cyan, magenta, yellow, black and white.

Able to connect to most personal computers available in Australia, the PCV5 is suitable for use with the full range of IBM PC's and compatibles (including laptops). Using a small adaptor the PCV5 can also be attached to the Apple MacIntosh II, SE and Plus computers.

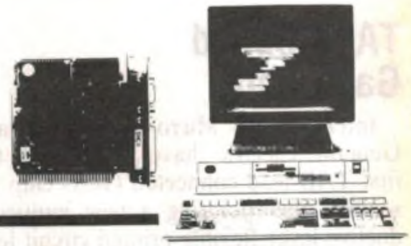
Providing a resolution of 640 x 480 pixels, the PCV5 gives a very high and crisp resolution with a contrast ratio in excess of 20:1. Full colour convergence is controlled by the red, green, blue convergence controls and the PCV5 operates on overhead projectors with stage operating temperatures of up to 70°C.

For further information contact Electroboard, Level 12, 275 Alfred Street North, North Sydney 2060 or phone (02) 957 5842.

2MB memory card for PS/2

Electronic Solutions has announced a range of low cost, high performance Microchannel cards. The first one to be released is a replacement for the IBM PS/2 2-megabyte expansion card.

The card is completely compatible with the IBM unit, with full 'auto configuration' to microchannel standards. Specifications of the memory card, CAT.MCM2 include use of 1MB DIP-type DRAMs; fully automatic configuration compatible with the programmable option select (POS) of the Microchannel architecture; full print spooling and virtual disk facilities, as well as EMS (LIM) support.



For further information, contact Electronic Solutions, PO Box 426, Gladesville 2111 or phone (02) 906 6666.

Entry level Epson printer

Increasing demand for low cost printers has prompted Epson to release a sister model to its popular LX-400 dot matrix printer.

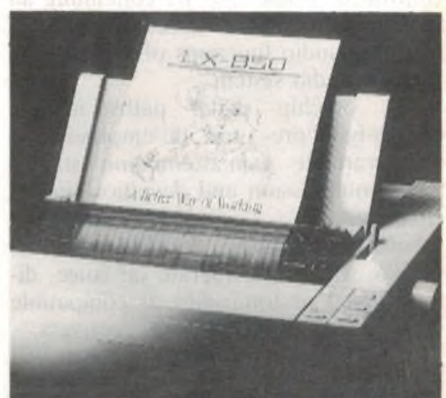
The new printer, called the LX-850, gives personal computer users extra flexibility in choosing a printer. It is faster, at 200cps in draft mode, and offers advanced paper handling features.

Single sheets of paper can be fed into the LX-850 without the need to remove continuous paper feeding from an inbuilt tractor, a feature incorporating "smart park" advanced paper handling.

Two fonts are available for near letter quality printing. Roman and Sans Serif, and many printing effects are available. Characters can be underlined, emphasised, enlarged, italicised or given superscripts and subscripts.

Speed in near letter quality mode is 30cps. An optional cut sheet feeder increases throughput of A4 correspondence and reports.

Further information is available from Epson Australia, 17 Rodborough Road, Frenchs Forest 2085 or phone (02) 452 0666.



SME Systems releases high-speed PCs

SME Systems has released a range of high-speed Unicorn personal computers. They range from a 80386 system capable of 40MHz performance, two AT machines and a fast XT.

The Unicorn XT-10 is an IBM XT compatible which has twice the speed of conventional models, and a number of extra built-in features generally seen on high-end machines. The system, while based on the same 8088 processor as conventional XTs, utilises advanced engineering which upgrades its speed from IBM's standard 4.77 to 10.00MHz.

A custom-designed in-built video display controller allows the user to switch between a monochrome or colour monitor at any time without having to alter adaptor cards.

The AT-16 is a 286 machine that incorporates the most popular add-on cards in the motherboard. Its built-in hard disk interface enables the machine to read and write data to a 45MB voice coil drive at twice the pace of the old standard. It supports VGA color software and has graphics compatibility with MDA, CGA and Hercules.

The AT-24 can handle the most demanding applications and, by installing an optional 80287-10 math co-processor, the system can deal with heavy mathematical calculations.

The 386-40 is the top of the range model designed for a variety of heavy-duty roles, such as departmental server, high-performance workstation or as a gateway processor. Its Intel 80386-25 processor speeds along at 24 to 40MHz with zero wait state, making it at least twice as fast as 16MHz systems, and capable of outperforming most 25MHz systems with its clever 32-bit concurrent bus architecture.

For further information, contact SME Systems, 22 Queen Street, Mitcham 3132 or phone (03) 874 3666.

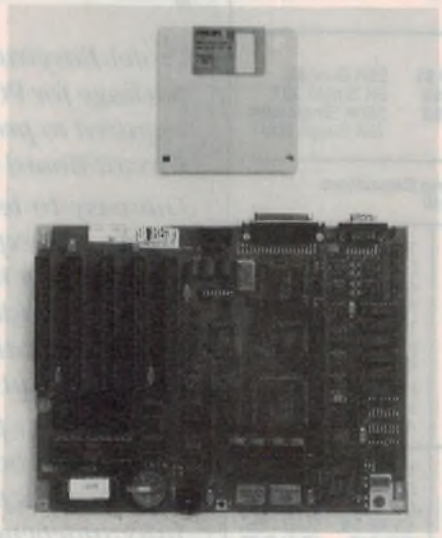
Premium 486/25 with Cupid-32

AST Research has unveiled its own i486-based personal computer, the Premium 486/25, incorporating upgradeable Cupid-32 architecture.

It comes with 2MB of zero-wait-state memory, expandable to 4MB on the processor board and a total of 36MB maximum system expansion.

The Premium 486/25 uses a 25MHz processor with 8KB of cache and an 80387-compatible numeric coprocessor integrated onto the chip. It also supports the Weitek 4167 co-processor for enhanced floating point calculations and its burst mode operation speeds data transfers between memory and cache, for increased overall performance.

For further information, contact AST Research, Level 3, 178 Pacific Highway, St Leonards 2065 or phone (02) 906 2200.



Entry level personal computer

Philips Telecommunications and Data System (TDS) has announced its P3120 personal computer, a small footprint, surface mounted technology entry level machine.

It is said to be suited to applications in the small business computer environment, or as a standalone or networked workstation in a larger organisation.

The P3120 uses Intel's 8088 processor running at 10MHz, and has 768KB of memory, 1.44MB 3-1/2" floppy drive, DOS 4.01, colour graphics adaptor, two serial ports and one parallel port.

The base level machine – a monochrome model – is priced at $1939 (inc tax) and includes a 15-hour training tutorial. With a 20MB hard disk, VGA adaptor and colour monitor, the recommended retail price for the P3120 is $3470 (inc tax).

For further information, contact Philips TDS, 15 Blue Street, North Sydney 2060 or phone (02) 805 4444.

Arcnet tester

A recently introduced ARCNET twisted pair tester for LAN troubleshooting simplifies the process of determining whether a local area network is operating properly.

Standard Microsystems Corporation's (SMC), latest ARCNET product checks for consistent polarity, determines activity on the network, and permits monitoring of individual nodes or portions of star and daisy-chain networks. Red and green LEDs provide instant status indication.

For further information, contact Email Electronics, 15-17 Hume Street, Huntingdale 3166 or phone (03) 544 8244.

Magneto-optical system

The Canon MO-5001S Magneto-optical Rewritable Mass Storage Sub-system puts optical disk technology to work for inexpensive high-volume data storage. It incorporates a non-contact laser read/write system that obviates problems of conventional systems, such as head crash and wear caused by contact between the head and the media.

It uses a proprietary Canon magneto-optical disk known as the EC-type (Exchange Coupling-type) that satisfies two conflicting characteristics – speed and good read signal – at the same time and has the world's fastest disk-rotational rate (3000rpm).

The MO-5001S is expected to have wide application in desktop publishing, electronic filing, external memory, and recording and playback of video images, music and sound. Interface kits designed by Canon assure compatibility with IBM-compatible and Macintosh personal computers.

For further information, contact Canon Australia, 1 Thomas Holt Drive, North Ryde 2113 or phone (02) 887 0166.

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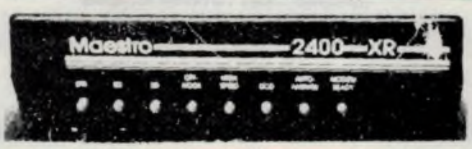

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