ELECTRONICS • TECHNOLOGY • AUDIO • VIDEO • COMMUNICATIONS • COMPUTERS • CIRCUITS

Australian

Roger Harrison's

ELECTRONICS

Monthly

DEC. 1988 $3.95
NZ$5.50

IMPROVE YOUR TV RECEPTION

MYSTERIES OF THE "MAGIC EYE" TUBE

BUILD: FAST NICAD CHARGER FOR R/C MODELS

PROXIMITY/MOTION DETECTOR

PA: MEET THE MIXING DESK

ELECTRIC VEHICLES — A BYPASSED TECHNOLOGY?

Can you spot the eight features on this scope that you won't find on most low cost 20MHz scopes?

Checking the specs on low cost scopes can get a bit repetitive - Yes, they all have 20MHz bandwidth and Yes, they've all got 6" rectangular screens. Some have1mV max sensitivity. So what's different about the New Goldstar OS7020?

1. Variable Sweep Control incorporating x10 Magnifier

Simply adjust the sweep to give a suitable trace then pull control for a x10 magnified image.

2.Uncal Warning Lights

When the timebase or input controls are not in their calibrated positions you'll see a warning light - handy if you're taking measurements.

3.Triggered LED

If the input level is sufficient to trigger the OS7020, then this LED is illuminated. Saves a lot of time fiddling when you're not certain that you've got proper triggering.

4. TV-V & TV-H Triggering

These switches are a further aid to triggering and are particulrly useful for the TV service technician.

5. Trigger Hold-Off

Another aid to triggering - use this control to delay the sweep on complex waveforms

6. Professional Tilt Handle.

Many manufacturers take a short cut and give you a cheap carry strap. Not so on the Goldstar OS7020; you get a professional multi-position tilt handle.

7. 1mV maximum Sensitivity

Use the built-in x5 magnifier to get 1mV/div maximum sensitivity.

8. Made by GoldStar

Your guarantee of quality. The OS7020 is designed and built in Goldstar's own factory. Many of the parts are specially made by GoldStar. That's why we can offer a *one year warranty* and extra features at no extra cost!

Also enquire about the OS7040 scope. 40MHz/1mV with delayed sweep.

$1380 inc tax with 2 probes.
$1150 ex tax with 2 probes

Check these prices !

$888 ***inc tax complete with two high quality switchable probe kits***

$740 ex tax with probes

Gotta Getta GoldStar

Supported & Serviced Australia-wide by
Elmeasco Instruments Pty Ltd
Dealer enquiries welcome. Call (02) 736 2243
Recommended prices only

You've Gotta Getta Goldstar Scope from :

A.C.T. John Pope Electrical 80 6576 ● J Blackwood & Sons 80 5235 ● George Brown 80 4355
N.S.W. George Brown 519 5855 Newcastle 69 6399 ● Ames Agency 699 4524 ● J Blackwood & Sons ● Auto-Catt Industries 545 1322 ● D.G.E. Systems (049) 69 1625 ● W.F.Dixon (049) 69 5177 ● Macelec (042) 29 1455 ● Newtek (042) 27 1620 ● Novacastrian Electronic Supply (049) 62 1358 ● Obiat Pty Ltd 698 4776 ● David Reid 267 1385 ● Digitel 709 6511 ● Geoff Wood 427 1676
N.TERRITORY J Blackwood & Son (089) 84 4255, 52 1788 ● Thew & McCann (089) 84 4999
QUEENSLAND Auslec 854 1661 ● George Brown 252 3876 ● St Lucia Electronics 52 7466 ● L.E.Boughen 369 1277 ● B.A.S. Audiotronics 844 7566 ● Colourview Wholesale 275 3188 ● E.C.Q. Electronics 376 5677 ● The Electronics Shop (075) 32 3632 ● Thompson Instruments (Cairns) (070)51 2404 ● Solex (Townsville)(077) 72 4466 ● Xanthos Electrical (079) 27 8952
S.AUSTRALIA George Brown 212 3111 ● J Blackwood & Sons 46 0391
TASMANIA George Harvey (003) 31 6533 (002) 34 2233
VICTORIA Radio Parts 329 7888 ● George Brown Electronics Group 878 8111 ● G.B. Telespares 328 4301 ● J Blackwood & Sons 542 4321 ● The Electronic Components Shop 670 6474 ● Factory Controls (052) 78 8222 ● Mektronics Co 690 4593 ● Truscott Electronics 723 3094 ● A.W.M. Electrical Wholesalers
W AUSTRALIA Atkins Carlyle 481 1233 ● Dobbie Instruments 478 1366 ● George Brown 362 1044
PAPUA NEW GUINEA T E (P.N.G.) Pt Moresby 25 6322 Lae 42 6248

IT'S DECEMBER. Christmas; the end of the year and all that. The time when editors review the year past and preview the year ahead. Well, rats to that this year. I'm stirred up about something more important. It is to do with reviewing the past and previewing the future, though. Ask a politician, state or federal, to explain how fibre optic communications works, in simple terms. It's easy to predict the answer — with the rare exception, you won't actually get one. There are probably only two politicians in federal parliament who *could* answer. As for asking them about the technological and sociological implications of the technology. . .

It's a sad and terrifying indictment of one of our most important sociological systems — it's out of touch and out of step with one of the most fundamental and important driving forces of change and development in our society — science and technology. The two are *inextricably* linked. It is scientific research which drives technological development.

Australia's CSIRO is not just characterised by its successes - its winnings, if you like — but also by its failures by omission, its losses. e.g: In the 1950s, the Menzies Government, perhaps following a lead set earlier by IBM, forced the CSIRO to abandon research into computing and computers, despite its pioneering work up to that time. These days, as at any other time, money for research is not "money for nothing and your chips (ICs) for free", to paraphrase the lyrics of a *Dire Straits* hit song. IBM subsequently corrected their error, Australia didn't. No one has done more to make scientific and technological development a political and social issue in this country than Barry Jones, the Minister for Science, Customs and Small Business. The portfolio's title is a farce, seen in federal politics more as the Ministry for Screwballs, Cussedness and Silly Buggers. Mr Jones has argued in recent times of the decline in this country's "production" of scientists and engineers. When the politically conservative scientific community conducts public demonstrations about science policy and practice, it's a sure sign something's amiss. Scientific research was the Big Loser in this year's federal budget. But that wasn't the fundamental catalyst.

Are we destined to repeat the "intellectual vandalism", as Barry Jones puts it, of the '50s and lose out yet again in fields and activities which will ultimately benefit the country? Science policy established and administered by bureaucrats — those who "advise" the politicians — has a bad track record, as Barry Jones has pointed out. If the politicians understood better the *real world* around them and the influence of science and technology, they wouldn't be facing the future looking backwards, as they now are.

Best wishes of the season to all our readers, advertisers, friends and foes alike.

Roger Harrison
Editor/Publisher

EDITOR/PUBLISHER
Roger Harrison VK2ZTB

ASSOCIATE EDITOR
Ben Furby VK2XNZ

DRAUGHTING
Jamye Harrison

PRODUCTION
Graeme Knight

SPECIALIST AND EDITORIAL SERVICES
Jamye Harrison

MARKETING AND BUSINESS DEVELOPMENT
Val Harrison

EDITORIAL ASSOCIATES
Ian Boehm VK3XCD
Neil Duncan VK3AVK
B. App. Sci. Dip. Ed. M. Ed. Studs
Malcolm Goldfinch
Michael F. Heaney
B.M.E., Dip. Mus. Ed., L.T.C.I., T.C. M.A.C.E. M.I.M.T.
Colin de Kantzow VK2JCD
B.Sc..B.E. IEAust.
Jack Middlehurst
Tom Moffat VK7TM
Jonathan B. Scott VK2YBN
B.Sc./B.E.(Hons), M.Eng.Sc. MIEEE, MIREE

ARCHIVING
Corey Harrison

NATIONAL ADVERTISING MANAGER
Jean de Bogais (Mr)
B.Com.
(02)555 1677

EDITORIAL OFFICES
1st Floor, 347 Darling St
Balmain 2041 NSW
AUSTRALIA
Ph:(02)555 1677
Fax:(02)555 1400

ENQUIRIES
General & Editorial
(02)555 1677
9.00 am to 5.00 pm EAST
Technical
Only after 4.30 pm EAST
(02)555 1677
Roger Harrison
Subscriptions & Orders
(02)555 1677
9.00 am to 5.00 pm EAST

SUBSCRIPTIONS
$42/year Australia;
New Zealand:
A$60/year surface,
A$66/yr by air;
other overseas rates on application.

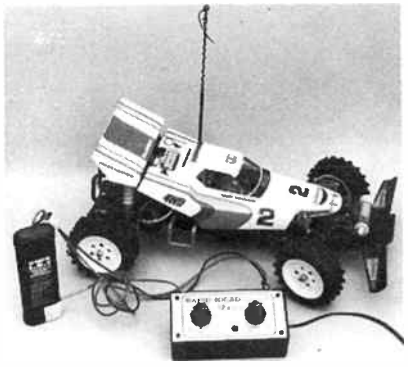
Pledge your plastic!
We accept Bankcard, Mastercard and Visa

SPECIAL FEATURES

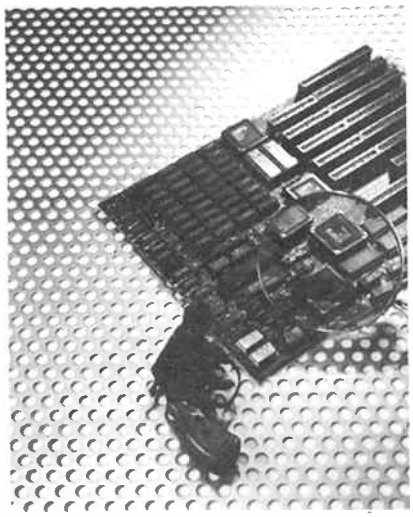
ADVERTISERS INDEX

This index is provided as a service to readers. However, while every effort is spent to make it accurate, the publisher accepts no responsibility for errors or omissions.

PRACTICALITIES

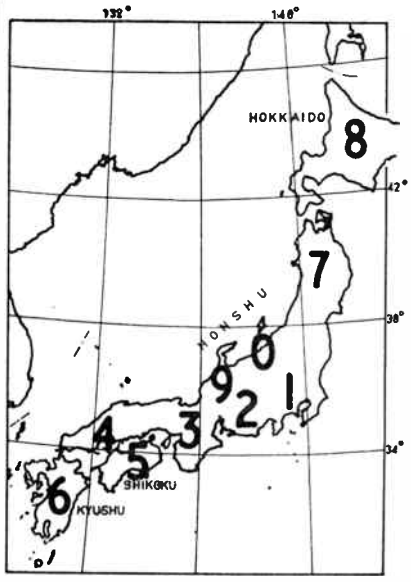


TECHNICALITIES



Using the 555, Part 4 has been held over due to lack of space. Our apologies.

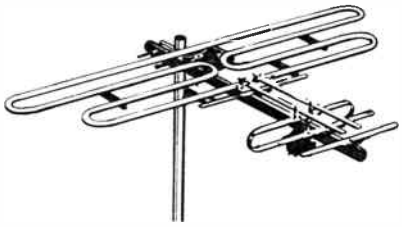
COMMUNICATIONS



AMATEUR RADIO: THE ART & SCIENCE OF KEEPING A LOG **100**
While keeping a log is no longer a regulatory requirement for amateurs, many still do — particularly VHF operators. While recording the "bare bones" of contacts is useful for QSLing, your log can actually be employed as a useful scientific record.

LISTENING POST SOFTWARE **97**
Receive, decode and printout Morse, RTTY and FAX transmissions using a SW receiver, our Listening Post project and your Apple, Microbee, or Commodore 64!

CONSUMER ELECTRONICS



IMPROVING YOUR TV RECEPTION — PART1 ..... **35**
Picture wobbles got you worried? Ghosting got you going? VHF or UHF — can't decide? Here's a guide to the tips and techniques to get the best TV reception you can in a two-part series. Ben Furby has spoken to the "experts" and gleaned their best advice to pass on to you.

TAPE LEVY RUSH **40**
The controversial tape levy will be upon us shortly as legislation was being rushed through Parliament as we prepared this issue.

PROFILE **42**
"Living Media" employs the concept of integrating a hi-fi sound system into you home and your lifestyle. Ben Furby probes the concept, the company and the people behind it.

NEXT MONTH

NEW CONSUMER TECHNOLOGY PREVIEW
Preview of the Sony GV-8 Video Walkman, a complete TV receiver and 8 mm video recorder the size of a small handbag, is due for release next March and is set to give the Video 8 format a new direction.

BUILD OUR MICRO SYSTEM TEST BOARDS
Here are two simple projects which give you some useful, low-cost "tools" for testing microprocessor-based systems. One is a "NOP" board for 8085-based equipment that uses the microprocessor as a "signal generator", as described in this month's instalment of *Introduction to Troubleshooting Personal Computers and Other Microprocessor Equipment.* The other is an 8085-emulator board that allows testing of most parts of 8085-based equipment. You can adapt this equipment to other CPUs, too.

VOICE-OPERATED RELAY PROJECT
This project switches a relay when the audio level from a microphone or on a mic signal line reaches a predetermined level. Great for making a voice-operated tape recorder, arranging voice-operation ('VOX') for a radio transceiver, etc. It's low cost and uses all off-the-shelf parts.

THE RECTIFIER — SO YOU THOUGHT YOU KNEW HOW IT WORKED?
The common capacitor-input rectifier, so widely used in power supplies for electronic equipment, is so simple that its "workings" are well understood — or *are* they? Here's an in-depth "exposé" of what really happens, complete with computer-generated graphic illustrations.

While these articles are currently being prepared for publication, unforeseen circumstances may affect the final contents of the issue.

REGULAR FEATURES

COVER
Ben Furby couldn't believe his eyes while working on his TV reception story featured this issue! Picture, David Liddle. Design, Val Harrison.

LISTENING POST SOFTWARE **97**
Receive, decode and printout Morse, RTTY and FAX transmissions using a SW receiver, our Listening Post project and your Apple, Microbee, or Commodore 64!

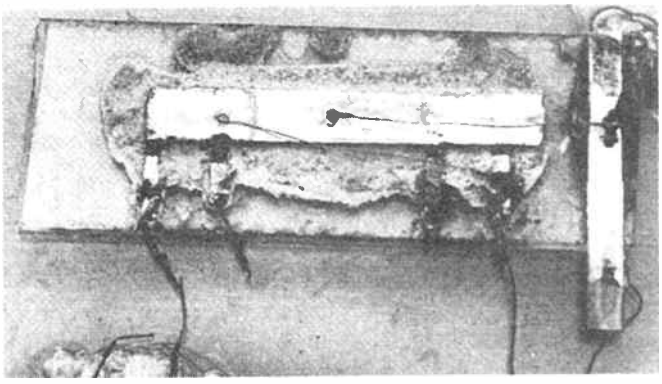
SPECIAL OFFERS

THE 'PA BIBLE' **86**
Don & Carolyn Davis' *Sound System Engineering* is the "bible" of PA and sound system engineers, technicians and installers. Buy it at a considerable saving.

POCKET TESTERS **28**
Great tools for around the house or workshop.

Thirty years of the integrated circuit

While many newsworthy events of yesteryear have seen prominence in the press lately — the anniversary of one significant event, with an impact on life in the 20th century, and ultimately all the peoples of the world, went virtually unremarked.



The device that started a revolution in electronics. A 1958 photograph of the original integrated circuit produced by Jack Kilby at Texas Instruments.

September 12 was the 30th anniversary of Texas Instruments engineer Jack Kilby's demonstration of the first working integrated circuit — the IC — the lone device with the shortest acronym and greatest impact.

In only 30 years the IC changed far more lives than any US president, not only in the USA but for all mankind.

The IC has materially helped the electronics industry grow from US$25 000M in 1960 to nearly US$500 000M, while projected to reach US$900 000M in the next decade.

Mr Kilby thought out the idea when he joined the TI Semiconductor Division in 1958, which was then trying to find ways of making circuitry easier to assemble and smaller. This was because solid state was creating opportunities for more complex designs.

He did not like a system of Micro Modules of components of uniform size that could be snapped together, because he did not think it really addressed the miniaturisation problem.

Instead, he began to think of the semiconductor housed together with the passive devices of capacitors and resistors made of the same material.

"I also realised that, since all of the components could be made of a single material, they could also be made in situ, interconnected to form a complete circuit," Kilby wrote later.

"I then quickly sketched a proposed design for a flip-flop using these components. Resistors were provided by bulk effect in the silicon, and capacitors by p-n junctions."

He used a sliver of germanium on a glass slide, and built a phase-shift oscillator.

On September 12, 1958, he connected 10 V to it and was rewarded by seeing a sine wave appear on his CRO's screen: the age of the IC had dawned.

The first IC computer, made for the US Air Force in 1961, showed the potential. Of less than 600 parts, 103 cm^3 in volume and weighing 283 g, the new breed IC computer compared more than favourably with one of conventional discrete construction, consisting of 8500 components, volume 16 400 cm^3 and weighing 13.6 kg.

If electronics people sneer at those who fear to accept change, note that despite the IC's lightness, compactness, more reliable and less expensive properties it was not readily accepted by designers who felt uncomfortable not being able to "see" the components assembled into circuitry and unsure how to use the invention.

This led to a calculator small enough to fit into a shirt pocket but capable of performing the four arithmetic functions of adding machines many times its size.

Thus were the inherent advantages of the IC and its potential brought home to the industry and to users.

So much for the first 30 years.

The potential of Jack Kilby's invention is far from being fully realised: now it's the next 30 years we face and what IC developments there will be, or what will surpass the IC, only time will unfold.

Electric vehicle interest

The State of California and smog-ridden Los Angeles have committed to obtain 10 000 electric cars and light trucks within the next three years and put them into service, a deputation told the EV (electric vehicle) Symposium No. 9 at Toronto, November 13 to 16.

Mr Roy Leembruggen, Sydney-based designer of the Townobile battery bus and car/van derivatives, who was Australia's representative at Toronto, said it was a first step in electrifying Los Angeles transport.

His company, Elroy Engineering, would submit proposals to LA based on the Townobile cars. Mr Leembruggen told AEM that a memorandum was signed at Toronto to form a worldwide EV association.

More than 100 papers were presented at the symposium.

More R&D needed

Australia must increase the level and effectiveness R&D in information and communications technology to develop a competitive advantage in these high technology industries, says a report from the Federal Government's Industry Research and Development Board.

The report, "Research Priorities in Communications and Information Technology", was prepared by two IR&D Board Committees and is based on a workshop of leading information technology professionals held earlier this year. The committees were Information and Communications technologies.

A board member and chairman of both committees, Dr Frank Barr-David, said the goals of the Federal Government's ambitious Information Industries Strategy required marshalling scientific advances and technology innovations nationally.

He said the information industries were founded on continual, rapid technological advance and the central message of the report was that Australia must not only increase industry-oriented R&D but also link it more effectively to publicly financed research and ensure it was driven by international market requirements and led to commercial products, systems and services.

The report identified research areas important to developing hardware, communications, software and information systems technology in Australia.

This included network services software and systems, new semiconductor technologies, sensors, optoelectronic devices, embedded software systems and artificial intelligence based technologies.

Although the board supported research into information and communications technologies through its Generic Technology Grants Scheme Dr Barr-David said more was needed to instil an awareness of the need for R&D in Australia's research bodies and business enterprises.

He said Australia's poor trade performance in electronics, computers and communications clearly indicated the nation was not investing effectively in industry oriented R&D.

The report is sold at AGPS bookshops. Volume I, the main report at $3.95 and Volume II (workshop papers) at $9.95.

NELCON '89

With the theme "Electronics: An Economic Opportunity", New

Zealand's national electronics conference and trade exhibition next year — NELCON '89 — will be held in the nation's capital, Wellington, September 19 to 21.

The venue will be the Plaza International Hotel, opposite the Michael Fowler Centre in the city's centre.

Preliminary inquiries to Mr **L.F. Harris, c/o Harding Signals, PO Box 36 007, Lower Hutt, New Zealand.**

Entrepreneur awards

Developing a Duo Steer System, a steering system for people with upper limb disabilities, won the Royal Melbourne Institute of Technology's Entrepreneur Award for a group of first year students in the Department of Communication and Electronic Engineering (CEED).

Nine groups submitted entries to an invited panel of judges representing the Venture Capital Industry.

The assignment to develop a marketable product from the concept stage to developing a marketing strategy was the first stage of the CEED programme which runs through the four years of the electronic engineering course.

The programme is collaboration between industry and education where students can help companies design, develop, and implement designated products or processes.

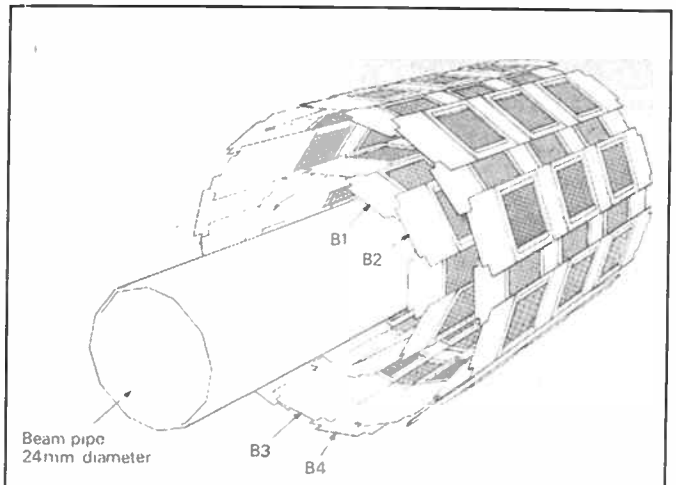
The programme aims to stimulate students' awareness of the commercial, technological and social environment of the Australian engineering industry and to encourage entrepreneurial and marketing skills.

The state manager of Dick Smith Electronics, Mr Andrew McEwin gave 15 digital multimeters to the winners. DSE sponsors the competition, along with Royel International and Scope, who both gave soldering irons.

The runners-up had developed a Switch Master, which is an infra red controller that switches devices on and off that are powered from the mains through a power point.

A charming quark watcher of great beauty

When so-called zero quarks decay, they produce sub-atomic particles known as charm and beauty quarks. A British detector that will form the heart of a "vertex microscope" to study charm and beauty quarks is nearly finished.



The "vertex microscope" for detecting charm and beauty quarks; nest of four barrels, B1-4, surrounding beam pipe.

It is being assembled through collaborative research at the UK Science and Engineering Research Council's Rutherford Appleton Laboratory (RAL) near Oxford, and Brunel University on the outskirts of London. The work began in 1984.

Based on CCDs, the vertex detector will be at the centre of a large, 4000 tonne detector in a particle collider at the Stanford Linear Accelerator in California. The experiment is scheduled to move into the collider interaction region towards the end of 1989.

Each of the CCDs is a silicon chip of 1 cm^2 area and is sensitive to charged particles which pass through it. An assembly of these will locate the paths of particles with a precision of about 5 µm.

In the vertex detector there will be 300 CCDs in a nest of four barrels surrounding the interaction region. Each barrel will comprise some strips of ceramic board, each with eight CCDs to cover an area of 9 x 90 mm continuously.

The first complete prototype assembly carrying five CCDs has been tested at the RAL and has confirmed the array behaves as expected.

Tests have shown that preamplifiers, striplines and microconnectors of the kind to be used in the final detector work together to give fast readout with low noise.

It is possible, in a cryostat cooling the assembly to 180° K with nitrogen gas, to achieve a readout time of 50 ms and a noise level equivalent to a signal of only about 30 electrons.

In the Stanford machine, electrons and positrons will collide with an energy of 50 GeV (giga electronvolts) per beam. This will provide a "factory" for producing zero quarks, which will decay prolifically to charm and beauty quarks and may even discover other, so far undiscovered, heavy quarks.

Only the best for some thieves

Almost $350 000 worth of new colour TV sets have gone missing from a terminal in West Melbourne, and Philips is asking retailers and the public to help Victorian police track down the 236 sets and the thieves.

The CTVs were highly featured and expensive. The KR6687 with a 66 cm flat square picture and remote control, RRP $1900, was one model and another was the 21CN4763.

This distinctive ebony-black CTV with a 51 cm flat square picture and full remote control, RRP $1200, has not yet been released.

Group general manager of Philips Consumer Products, Mr Larry Wilton, said that because the second model had not been available on the Australian market, thieves could have trouble disposing of their haul.

Philips has passed all serial numbers to the police and asks anyone with information to contact the Victoria Dock CIB or their nearest police station.

Although this was a TV crime, Philips did not say that the cast of Cop Shop had been reassembled to help find the missing sets.

Sydney stages show next March

More than 90 per cent of available space has already been booked for ELENEX Australia, the Australian International Electrical and Electronic Industries Exhibition, to be staged for the first time March 14 to 17 next year at Darling Harbour, Sydney.

The show will be open from 10 to 6 each day.

Organised by Australian Exhibition Services (AES), the show expects more than 130 local and overseas exhibitors. These include Siemens, Auslec Industrial, HPM Industries, Mayer Krieg, 3M Australia, Square D and Anitech.

AES said that AEEMA (Australian Electrical and Electronic Manufacturers Association) had endorsed the show.

There will be group stands from several countries including the UK, Spain and Finland.

Parameters will exhibit a broad spectrum of equipment, emphasising new products including oscilloscopes from BWD and Grundig, logic analysers from Gould and analysing recorders, digital power meters and insulation testers from Yokogawa.

Look for cables, optoelectronic indicators, connectors, test and measuring instruments, sensors/transducers and workshop equipment on the Radio Spares Components' stand.

Coltronics expects to show the IR-300 infra red reflow systems from Electrovert and a Lasar fault simulator for test equipment from Teradyne.

AES said response to this first show was so good it was already allotting sites for a second exhibition in Melbourne, May 27 to 30, 1990, and ELENEX would alternate between Sydney and Melbourne.

AES is on show at the **3rd floor, Illoura Plaza, 424 St Kilda Rd, Melbourne, Vic 3004 ☎ (008)33 5010.**

Omron chooses ACD Elektron

About to enter a new phase of growth, Omron Electronics has appointed ACD Elektron as its Australian distributor for its OEM products.

These include pc board relays, photo micro sensors and small switches.

Elektron is an operating division of Advanced Component Distributors, which is a subsidiary of University Paton.

Jemal appoints Queensland agent

A Perth-based company that specialises in designing analogue, digital and microprocessor circuitry, software and CAD pc board art, Omnitronics, will now represent another Perth-based company, Jemal Products, in Brisbane.

Contact Mr Phil Lonsdale, 25 Donkin St, South Brisbane, Qld 4101, for inquiries about pc boards, single, double and PTH, membrane switches, precision metalwork, screen printing and assembly ☎ (07)846 2446.

Petersen and Poulsen celebrate 70 years!

Birthday greetings are sent by Ortofon to all the people the company has been corresponding with over the years. This reverse procedure marked the company's 70th anniversary, on October 9.

Founded by two Danish engineers, Axel Petersen and Arnold Poulsen, in 1918, with the aim of developing a synchronised sound system for films, the company was first named The Electrical Phono Film Co.

In 1923 the first sound film recorded indoors was shown in Copenhagen, and the next year came the first recorded outdoors.

The first 16 mm sound camera appeared in 1938, and the company went on the develop microphones, oscillographs, optical instruments and similar equipment, and a revolutionary cutter head for gramophone records in 1946.

Two years later came the world's first moving coil pickup cartridge, and then Ortofon A/S was established as a trading company under its renamed parent: Fonofilm Industri A/S.

The company has greatly expanded with worldwide subsidiaries and agents, and while still producing high quality pickups, also makes a power amplifier, Scan Micro diamond stylii and audio instruments.

Philips, Fluke, alliance

Fluke and Philips have allied in Australia and New Zealand in a move that has worked successfully in the USA and Europe to enhance test and measurement sales.

Philips said the alliance offered single source supply of a wide range of proved equipment plus the wealth of knowledge of local customer requirements.

The manager of the Test and Measurement group of Philips Scientific and Industrial, Mr Timothy Wortman, heads the group selling Fluke and Philips products.

He said Philips was able to supply solutions to many more test and measurement problems, and for systems applications, customers could now buy a complete package of compatible test equipment from the one supplier.

"This package can even contain an IEEE 488 bus controller and software," Mr Wortman said.

The Australasian head office for Philips Test & Measurement has moved into larger premises within the same centre court complex at 25 Paul St North, at North Ryde, Sydney.

The phone number is unchanged.

In Victoria the Test & Measurement group is now in the Philips complex at the Tally Ho Technology Park at Burwood East ☎ (03)235 3666.

Award winner

Winner of the inaugural Australian Telecommunications and Research Board award is Dr Robert Minisian, a senior lecturer in electrical engineering at the University of Melbourne.

The award is a medal and a price of $2500.

The board was called the Radio Research Board until 1985, and has sponsored research by promising physicists since before World War II. It is supported by the CSIRO, telecom Australia, OTC and the Department of Defence.

CSIRO Institute director and board chairman Dr Bob Frater, in presenting the award said the granting of the award to Dr Minisian reflected the importance placed on innovative technologies.

Applications for the award are sought in November each year and applications for 1889 are now open.

Inquire at the **CSIRO Institute of Information and Communications Technologies, 105 Delhi Rd, North Ryde, NSW 2113 ☎ (02)887 8222.**

Fibre optics bonds communications

Telecom is reported to have "pulled out all stops" to install its fibre optics communications system called Optical Fibre Optic Customer Access Service (OFCAS) a year before expected, but the job was for the Bond Corporation.

The 50 storey R&I Tower in Perth became the first in Australia to get the system, and the company is looking to install the system in the proposed new building in Sydney, at Chifley Square.

The installation allows high speed data rates of high capacity while error-free. The fibres are duplicated and if a circuit is broken the system immediately switches without interruption.

The transmission equipment will operate at 34 M bits/sec and multiplexing equipment that would divide this into 16 x 2 Mbit streams.

The first configuration of the OFCAS will provide for the building: 2 x 2 Mbit streams for digital tieline links between PABXs in the company network; 10 x 2 Mbit streams for the public switched telephone network access; and 4 x 2 Mbit spare for additional services.

The infrastructure for the OFCAS can be readily refigured with some more equipment to give much greater transmission capacity for future wideband communications such as video conferencing and high definition video.

New MD boots up old retailer

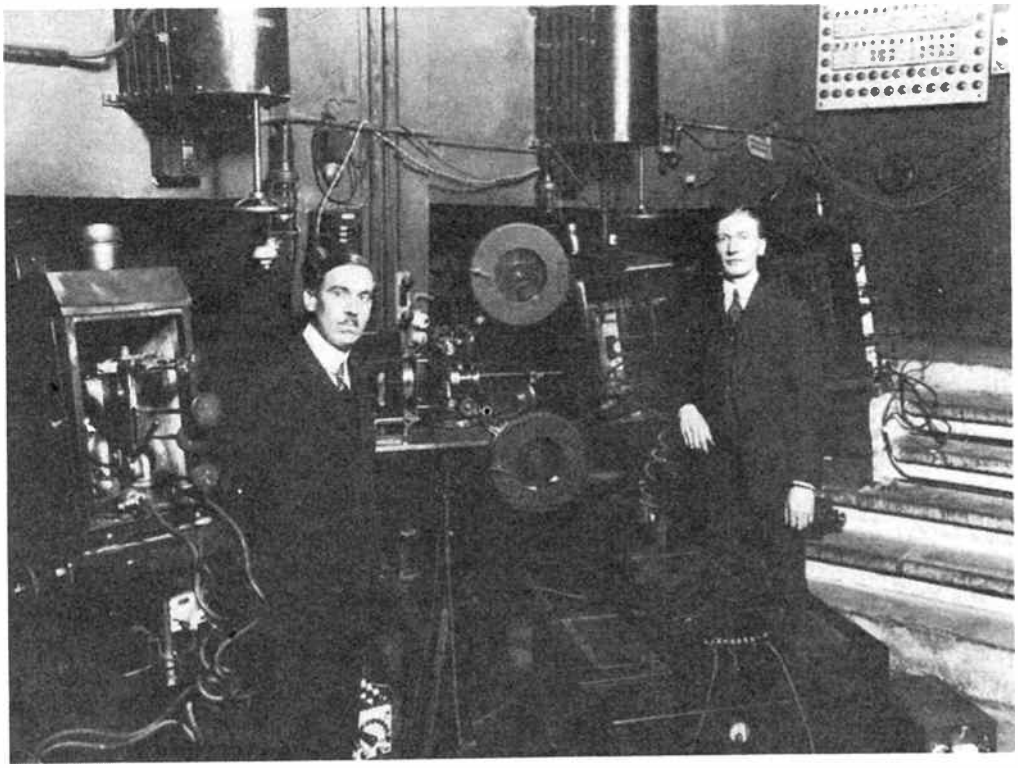
Newly appointed managing director of Ritronics Wholesale and Rod Irving Electronics, Greg Boot takes over from Rod Irving who has resigned to concentrate on his real estate interests and "enjoy life a little more".

Mr Boot has been a director and shareholder of he company for five years, running Melbourne City Retail as well as being managing director of Software Express.

Key breakthrough in access control

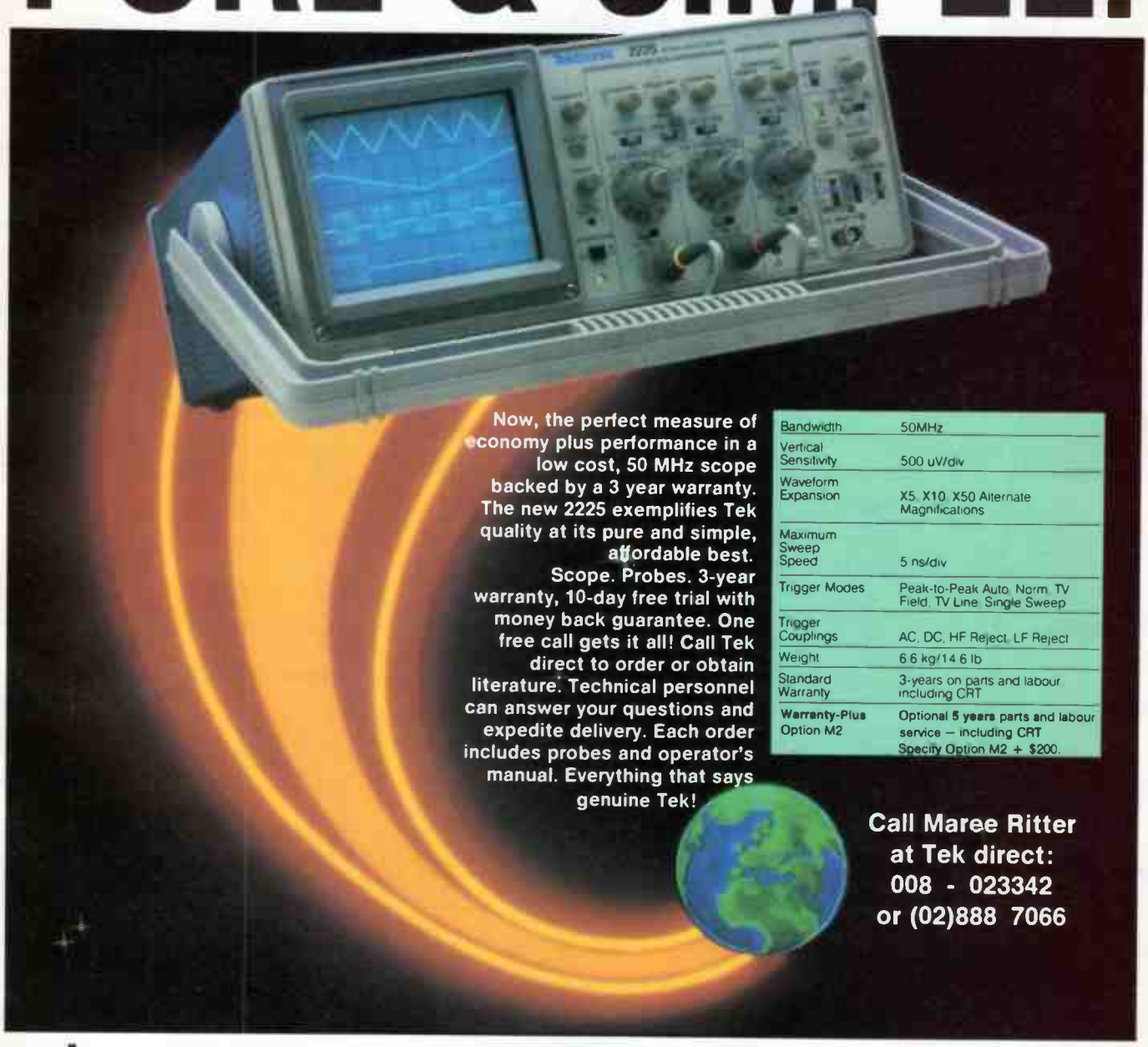
Designed for single or multi door access control, Voicekey is said to be a completely stand-alone speech verification system.

It needs no keys or cards, nor central computer, while claiming to offer simple operation for users and better security for ▷



Founding engineers Axel Petersen and Arnold Poulsen, who began the Electric Phono Film Co. — parent of Ortofon — in 1918.

TEK
PURE & SIMPLE.



Now, the perfect measure of economy plus performance in a low cost, 50 MHz scope backed by a 3 year warranty. The new 2225 exemplifies Tek quality at its pure and simple, affordable best. Scope. Probes. 3-year warranty, 10-day free trial with money back guarantee. One free call gets it all! Call Tek direct to order or obtain literature. Technical personnel can answer your questions and expedite delivery. Each order includes probes and operator's manual. Everything that says genuine Tek!

Bandwidth	50MHz
Vertical Sensitivity	500 uV/div
Waveform Expansion	X5, X10, X50 Alternate Magnifications
Maximum Sweep Speed	5 ns/div
Trigger Modes	Peak-to-Peak Auto, Norm, TV Field, TV Line, Single Sweep
Trigger Couplings	AC, DC, HF Reject, LF Reject
Weight	6.6 kg/14.6 lb
Standard Warranty	3-years on parts and labour including CRT
Warranty-Plus Option M2	Optional **5 years** parts and labour service — including CRT Specify Option M2 + $200.

Call Maree Ritter at Tek direct: 008 - 023342 or (02)888 7066

$1995

PLUS SALES TAX

Bankcard & Visa accepted

Tektronix®

COMMITTE

Head Office:
80 Waterloo Road,
North Ryde N.S.W. 2113
(02)888 7066

WA: (09)325 8433
QLD: (07)394 1155
ACT: (062)516 111
VIC: (03)836 3355
SA: (08)223 2811

WIN!

We could have said **SUBSCRIBE!**, but that's not as enticing as WINNING something. By subscribing to *Australian Electronics Monthly* in the next few months you could be doing both, subscribing **and** winning.

How, I hear you ask? Well, AEM, in conjunction with Tektronix are offering you, our devoted readers, the chance to win this Tektronix Electronic Workshop, as pictured.

Just think, you could be the proud owner of not only a subscription to Australia's finest electronics magazine, but the smug possessor of four pieces of lab equipment from the highly regarded Tektronix range, generously offered by Tektronix Australia.

So, you could say you'll be winning in two ways. You get the chance to win the Tektronix workshop and be the envy of all your mates, AND you get Australian Electronics Monthly mailed straight to your home or work, also becoming the envy of all your mates. HOW CAN YOU LOSE?

Don't wait! Complete the coupon provided and mail it TODAY! Just fill in the details, answer the question and tell us in twenty-five words or less what is attractive about this offer. It's that simple!

Yes, I would like to subscribe to Australian Electronics Monthly for:

☐ 1 year ($42)
☐ 2 years ($78)

NZ: A$60 1 yr surface mail, A$66 air mail.
(Unfortunately competition is unavailable to residents outside Australia)
Overseas rates on application.

☐ Yes, I do want to enter the competition.
☐ No, I don't want to enter the competition.

Name: _____

Address: _____

_____ P/code: _____

Phone: (__) _____

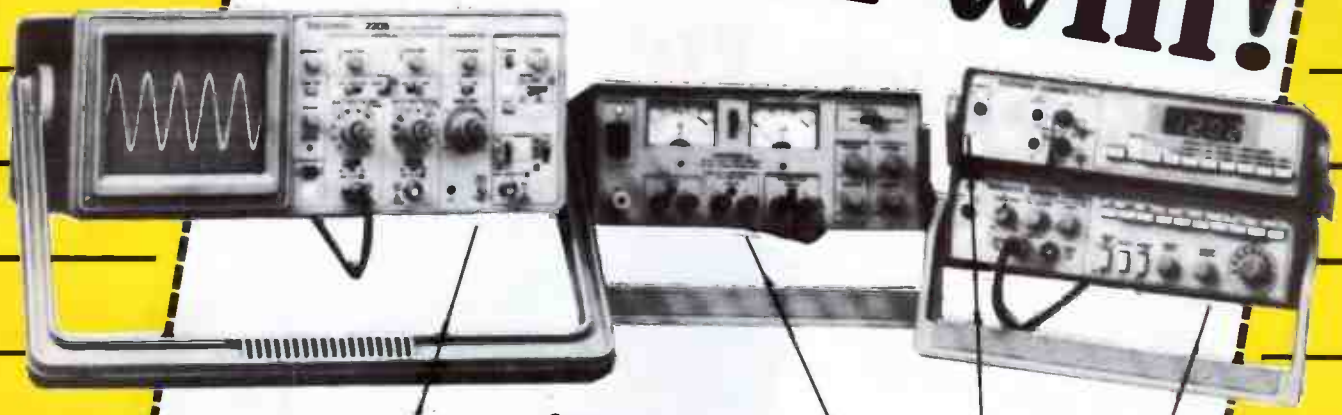
I am paying by:
☐ cheque ☐ money order
☐ Bankcard ☐ Mastercard ☐ Visa
No: _____

Signed: _____
(unsigned credit card orders cannot be accepted)

● Q. What is the name of the circuit in any oscilloscope which sweeps the spot from left to right across the screen?

Tell us in 25 words or less what is attractive about this special offer.

Here's what you can win!



2205 Oscilloscope
- 20 MHz Bandwidth
- Dual Trace
- Single Timebase

CPS250 Tri-output Power Supply
- Three outputs; 0-20 Volts, 0-20 Volts and +5 V
- Voltage and Current Metering
- Overload Indicator

Instructional Material Credit
- This gives the winner a credit to redeem their choice of instructional material from Tektronix, choosing from either a well written instructional manual OR a comprehensive video tape.

CDM250 Digital Multimeter
- 3.5-digit Operation
- 5 Functions
- 0.5% Vdc Accuracy

CFG250 Function Generator
- 2 MHz Bandwidth
- Square/Triangular/Sine and TTL Pulse signal output
- Low Distortion and High Accuracy

Total Value $3300 (inc. tax)

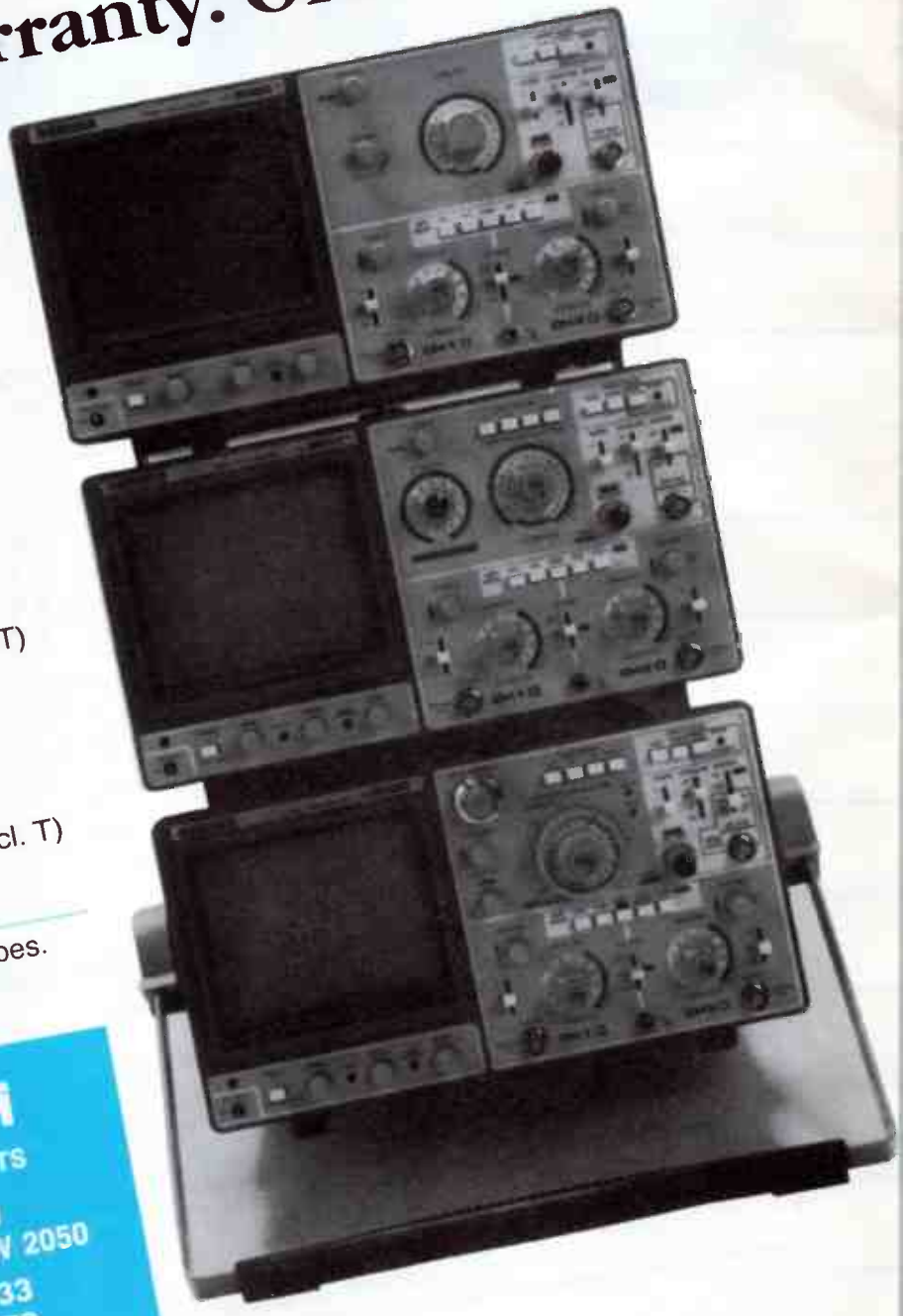
What are you waiting for?
Fill in the coupon and send away today.
You could be the lucky winner.

The competition is open only to Australian Residents authorising a new subscription or renewing an existing one before the last mail on December 31st 1988. Orders received postmarked after this date will not be included in the competition. 2. Employees of Australian Electronics Monthly, the printer Offset Alpine, the magazine distributor Network Distribution Company and Tektronix and their families are not eligible to enter. 3. Residents of South Australia need not order a subscription to enter, but may enter, once only, by submitting their name, address, and phone number on a hand written facsimile of the coupon. 4. The competition commences on 30 Sept. 1988. Judging will take place in Sydney between 3rd and 10th Jan. 1989 and the winner will be notified by mail and phone. Results will be published in the next available issue of the magazine. 5. Prize may not be transferred or exchanged or exchanged for cash. 6. Competition unavailable to residents outside Australia.

Australian Electronics Monthly is published by Kedhorn Holdings P/L, 1st Floor, 347 Darling St, Balmain 2041 NSW

Why choose anything but Kikusui?
The 5000 series incorporates the most up to date scope technology, which not only enhances performance but ensures an unbeatable price to performance ratio. All 5000 series CROs provide as standard features: Vertical Triggering Mode, Autotrigger Level Lock, Variable Hold-Off and TV trigger coupling, ensuring ease of use especially during frustrating measurement situations.

Announcing KIKUSUI's exclusive CRO offer. Four specially priced models. Proven quality and 2 year warranty. Order Now.



1 COS-5020TM
2 Channel
20 MHz Bandwidth
Max. Sensitivity 1mV/Div
$799 (excl. T) **$933** (incl. T)

2 COS-5041TM
2 Channel
40 MHz Bandwidth
Delayed (B) Timebase
$1,258 (excl. T) **$1,468** (incl. T)

3 COS-5060TM
3 Channel
60 MHz Bandwidth
Delayed (B) Timebase
$1,704 (excl. T) **$1,989** (incl. T)

4 COS-5100TM
3 Channel
100 MHz Bandwidth
Delayed (B) Timebase
$2,861 (excl. T) **$3,338** (incl. T)

***Includes**
- 2 quality switchable probes.
- Full 2 year warranty.
- Japanese quality.

EMONA
INSTRUMENTS
86 Parramatta Rd
Camperdown NSW 2050
Tel (02) 519 3933
Fax (02) 550 1378
CALL FOR LOCAL DISTRIBUTOR

managers in a more manageable system.

The user inputs his or her PIN to a membrane keypad and speaks one word of their choice into the built-in microphone to gain access.

The PIN and spoken word are administrative only and can be disclosed without breaching the system's security.

Units are available with up to 225 users in the single door configuration or up to 1000 in the network versions.

Standard features include 10 time zones, three security levels, duress and forced entry alarms and full audit tracking of events which can be stored internally for later down loading to a printer or the unit can print live.

Daily fluctuations in voice patterns automatically update the users' speech profiles, so use improves the system.

Voice-activate MTI Equipment for more information at **2-35 Shearson Cres., Mentone, Vic 3194 ☎ (03)584 2699.**

Elmeasco and Tech-sales merge

Elmeasco Instruments and Tech-Sales, which were both members of the Tech-Rentals Group, have merged. The move is expected to strengthen the company's market position as they had largely complementary product ranges, with little overlap.

The merger was effective from November 1. There is no truth in the rumour that they're to be renamed Melmac and all sales staff's names changed to Alf.

Amplifiers galore

Making big noises in places as far apart as the Sydney Opera House, Federal Parliament and the Sydney Power House Museum, Murray Amplifiers has just finished three contracts for supplying 2844 audio amplifiers for those places worth more than $2.5M.

Acting as a sub-contractor to the Australian Broadcasting Corporation, Murray Amplifiers designed and made more than 5000 items of audio equipment for the new Federal Parliament house. These are used for broadcasting, sound reinforcement and PA. Most of the equipment was designed to specific ABC requirements.

There were more than 900 special purpose microphone amplifiers, more than 1200 distribution amplifiers and 176 power amplifiers. Other items were stereo headphone amplifiers, panning control amplifiers, audio switchboards, connector boards and power supplies.

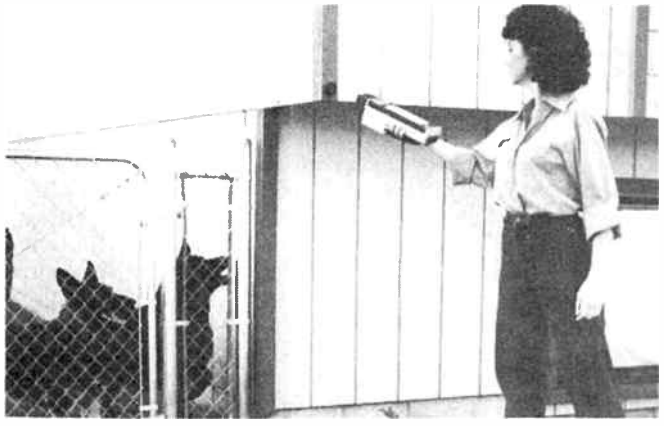
Innovative speaker systems were designed and constructed to cater for the particular acoustic environments of the various halls. Conventional speakers were used as well as directional and broad coverage arrays.

The company designed and supplied 76 power amplifiers and 50 sound distribution amplifiers to the Sydney Opera House. The model MA538L power amplifiers delivered can each supply 300 W into 4 Ω and 150 W by a 100 V line output.

The sound distribution amplifiers were specially designed for the Opera House and incorporate a peak programme meter, remote gain control and transformer isolating options.

The Power House Museum in Ultimo, Sydney, has received more than 100 Murray Amplifier monitor amplifiers. They are used to provide audio to many of the exhibits throughout the building.

Other equipment used by the museum includes MA538C power amplifiers and MA637 remote gain interface units. The power amplifiers are used for high level sound needed by the no. 1 steam locomotive, while the interface units are used with infra red detectors to control sound level depending on the presence of people at the various exhibits.



Old radios again

With interest in valve radios riding high, there are two books from New Zealand vintage radio enthusiast John Stokes, obtainable in Australia, which may help feed the habit of the vacuum state brigade.

There is "70 years of Radio Tubes and Valves", which is a guide for electronic engineers, historians and collectors. It describes the history of the thermionic valve, also known as a "vacuum tube", and talks of the great valve companies: Cossor, Mullard, Raytheon, RCA, QRS, Grigsby-Grunow, Schickering, Westinghouse, Philips, General Electric and more.

This is 256 pages, ISBN 0-911572-27-9 in hardback and ISBN 0-911572-60-0 in softback.

Mr Stokes' other work is "The Golden Age of Radio in the Home", ranging from when solid state was a catswhisker and crystal, through the pre-TV radio which in the 30s and 40s became the centre of the home, through to the resurgence of solid state in the late 50s.

Although mainly written around New Zealand radio, there is a wealth of detail on the imported Australian, American and British sets imported before World War II.

These are obtainable in Australia from the **Orpheus Radio Museum, RSD, B98 Ballarat, Vic 3352** or **Resurrection Radio, 14 Chapel St, Windsor, Vic 3181.**

Gas meter readers computerised

A specially designed handheld microcomputer will make reading hard-to-find meters a gas for the Australian Gas Light Co. of Sydney.

The 80 Itron Datacap portable computers can read a small device called a Hexagram which conveys readings from gas meters not readily accessible to the 48 meter readers with AGL in Sydney.

AGL said 40 000 meters, or 10 per cent of all Sydney's meters, would ultimately be read with the Hexagram.

The device reads consumption data from a gas meter and uses a two wire to deliver the information to a small device called a ScanDisc. This is mounted outside a building or inside a window. The portable computer, with a scanner, gets a reading within 6 cm of the ScanDisc.

Sydney meter readers will get the computers before Christmas with other AGL operations in NSW to follow.

The meter reader sets out with data relevant to the daily round loaded into the handheld computer from an IBM pc in a zone office.

The screen shows customer's name, address and account number, meter number and location, plus even warnings about unfriendly dogs or other special instructions.

The day's readings, usually about 300, will be transmitted to AGL's mainframe computer for overnight billing and posting. This will reduce the time between reading the meter and billing the customer from four days to one.

Sydney forms Audio Engineering section

Meetings are planned every two months, for Sydney's newly-formed section of the Audio Engineering Society. These meetings will be various technical seminars, facility tours and social functions.

The inaugural meeting, attended by 70 audio professionals, toured the anechoic chambers, reverberation rooms and the plane wave tube at the National acoustic Laboratory, Chatswood, Sydney.

The second meeting was at Transound Systems, Chippendale, Sydney, as a two-part meeting that opened with a technical lecture on the Application of Digital Filters to Loudspeaker Crossover Networks, presented by post-graduate student Miss Rhonda Wilson of Sydney University.

Mr Richard Priddle showed 35 members and visitors around the new Transound facilities that include a purpose-built listening room, workshops for designing, making and testing loudspeakers.

The society is an international organisation now in its fourth decade with a membership of 10 000 worldwide.

A third meeting was scheduled for December at the Australian Film, TV and Radio School, Epping, Sydney.

Officers are: chairman, Mr Andrew Horman (Rebel Audio); secretary, Mr David Hudson (Amber Technology); treasurer, Mr Karl Seglins (Amber Technology); promotions, Mr Leon Hart (Studio Supplies); education, Mr Rod Reilly (The PA People); and seminar co-ordinator, Glyn Adams (University of Sydney).

Contact Mr Andrew Horman 6 (02)713 6866 during office hours or write: **The Secretary, Audio Engineering Society, PO Box 91, Brookvale, NSW 2100.**

Electric vehicles - a bypassed technology?

Part 1

Ben Furby

Why haven't electric vehicles supplanted the fossil fuel burning car? Well, it's not a matter of adapting a newer technology to an older technology, which is where many past electric vehicle designs have failed. "Appropriate technology" is the key.

Solid-state electronics, partly through the thyristor, has done a lot to make electric vehicles (EVs) more practical through economising battery energy and more sophisticated solid state control systems have allowed experimenters to try motors other than the classic dc series motor, and various power-saving variations.

At the same time, research has been improving the classic lead-acid battery, and developing new storage cells. Nor are Australians generally aware of what their fellow countrymen have achieved in original EV design. Yet, despite many advantages of the EV, only a few dozen are seen on Australian roads, posing the question: "Why?"

In this article, the first of two, Associate Editor Ben Furby, who has been interested in EVs for 15 years, looks at the state of EV art in Australia. As well as reporting the technical achievements in Australia and New Zealand, however, he points out some of the social and political problems and entrenched opposition inhibiting our capitalising on the inventive work of Australians.

The point being, that technical excellence is not always enough to get a good idea off the ground, and that technology does not exist in a vacuum.

This is a lesson all technical people have to learn to live with, and the Australian EV saga is as good an example as any.

AFTER OWNING — or being a slave to — some three motor cycles and 13 cars, I emancipated myself 11 years ago from working to keep my current fossil-fuel burner/air and noise polluter in the state to which it was accustomed, by selling the thing and relying on public transport, an occasional hire car and lifts, plus Shank's Pony.

My life has been much more tranquil and financially better since I threw off the motor vehicle chains, which make a state of mind where your mental horizon is so limited you cannot see beyond life without a motor car.

I think my revelation occurred one night in North Sydney, when I was watching a whole street of cars patiently pulsating before a red traffic light. "What," I asked myself, "Would you do if you discovered oil? How would you make a buck out of your discovery?"

Well, one idea would be to design a device that used your liquid fossil fuel to do some work, like a vehicle for transport. But the touch of real genius would be to invent a vehicle that not only used your fuel while it was moving, but burnt it when it was not moving. After all, it's not called "idling" for nothing. EVs do not use fuel when they are standing still, and steam cars use very little: over a prolonged stop, only an occasional squirt to keep the boiler pressure up.

Historical perspective

If you were to go back to the heady days at the end of the last century, when Daimler and Benz and de Dion were toying with these noisy, smelly, unreliable petrol vehicles, you would find that in 1899 a motor car at last broke the one mile in one minute barrier, a preserve previously the exclusive property of crack railway trains.

This vehicle was the "La Jamais Contente", a French car driven by the Belgian Camille Jenatzy, who achieved 65.82 miles per hour (105 km/h) on April 29, 1899. (This day and month achieved further fame 27 years later when I was born. B.S.F.) Another authority gives Jenatzy's speed as 68.8 mph (110 km/h) and adds that the vehicle unofficially achieved 75 mph (121 km/h).

However, the vehicle was electric: no contemporary internal combustion vehicle (ICV) could have achieved anything like that speed, and probably its big ends and crankshaft would have collapsed at half that speed, let alone the valves that would have dropped into the cylinders and so on.

So: smooth and relatively silent, the EV was ideal town transport, suitable for doctors on house calls or ladies visiting friends. Town and city roads at that time were not sealed or contoured to anything like today's standards, and country roads were usually little more than dirt tracks churned up by horses' hooves. The fragility of the early pneumatic tyres for motor vehicles was another reason for not venturing far from your town or city in your car, if you could avoid it.

People travelling between towns used the excellent railway services in Britain and Europe. In the USA the almost non-existent inter-city tracks discouraged country motoring, especially when you consider there was usually a train service. So if you depended on trains between cities but looked for personal transport close to home, the EV had it all. Instant starting, noiseless and smokeless running, no involved gear changing or temperamental clutches and crash gearboxes. Short running? — No problem, just down to Fortnum and Mason's or Selfridges for shopping, tea at the Savoy, and a quick run back to Kensington. Short running in the cities and towns ideally suited the smooth-running, near silent, smokeless EV.

In 1900, the last year of the 19th century, 4200 cars were sold. Of these, 38 per cent were electric, 40 per cent were steam, and only 22 per cent were ICVs. Also smooth, gearless, with a more than a century's development to make it reliable and efficient,

Sydney-designed, the Townmobile battery electric bus can carry 116 passengers on a circular inner city route for four hours on tne battery charge. The designer, mechanical engineer Mr Roy Leembruggen, played a considerable part in designing Sydney's original double-decker suburban trains. One objection to the Townobile by the NSW Government's Urban Transport Authority was that the prototype was not fitted with a lock on the door! Other objections needed only slight design changes which were well within existing technological practice.

and with enormous power, the steam car was another contender at the turn of the century for the King of the Road stakes. The Stanley Steamer was to be the first vehicle to break the two miles a minute barrier: in the USA on January 24, 1906, driver Fred Marriott reached 127.6 miles per hour (204 km/h).

The next year Marriott and the Stanley Steamer returned. With a flying start for a measured mile, together they crossed the start line at 190 mph (304 km/h), worked up to 197 mph (315 km/h) and then hit a rock on the Daytona beach. At that speed, the Stanley Steamer became airborne and flew for nearly 35 m before writing itself off in a crash landing! Fred Marriott, the fastest man on earth at the time, survived and lived to an honourable old age.

Now given the early pre-eminence of electricity and steam, how did these grand personal transport vehicles become supplanted by such a mechanical monstrosity as the ICV? A two cylinder, double acting steam engine and an electric motor are self-starting. Who would bother with a vehicle that could not start without being wound up first, a feat needing a fair bit of muscle power and dexterity?

The first step for petrol was Charles Kettering's invention of the self starter in 1911. The starter took starting and driving a petrol noise factory out of the strength of a chauffeur or a strong male into the world of gentlemen and ladies.

Even after the self-starter, New York, for example, in World War I years was an electric vehicle scene. Not an offshoot of Prohibition but concurrently with its introduction came more powerful and reliable petrol burners that began to leave EVs behind while at the same time in the USA and elsewhere intercity roads improved.

Let's stop for a moment to look at some of the pros and cons of the three basic fuels and their users. The EV usually used the dc series motor, which, like the reciprocating steam engine, exerts greatest torque at lowest revolutions: this means that at starting, when the need for torque is greatest, EVs and steam cars can exert the most torque without expensive, space and efficiency-consuming gears, and a fragile clutch.

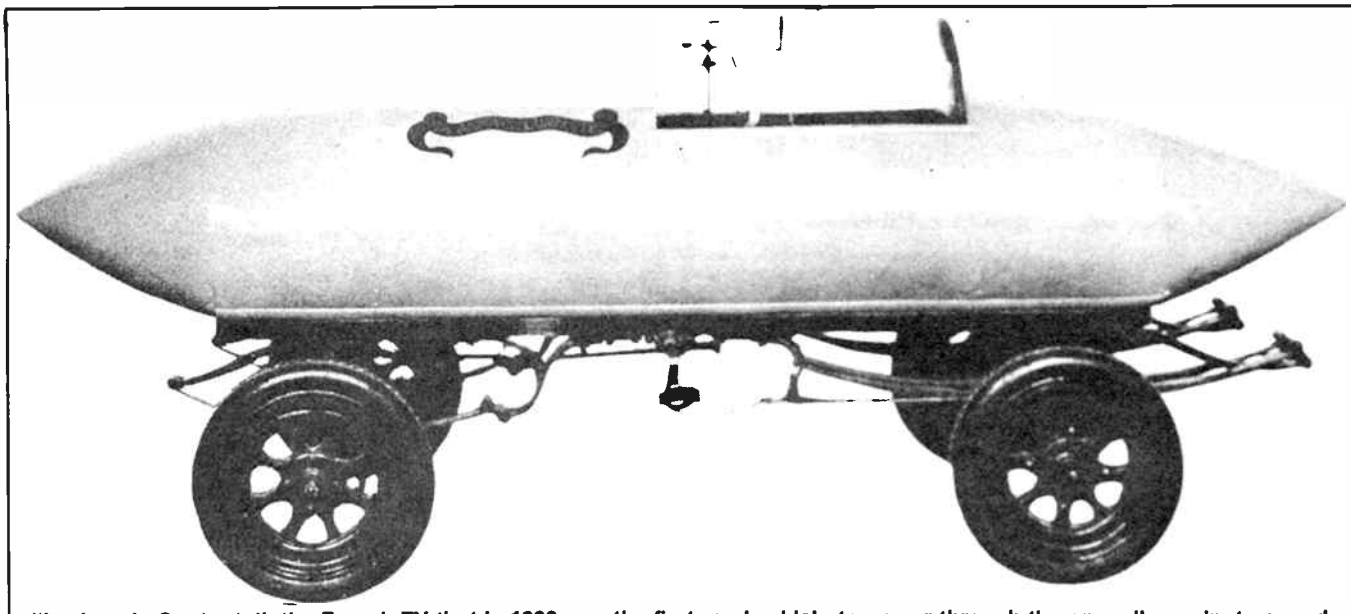
EVs have been limited in range: the payload versus overall weight is relatively small. To match the acceleration of ICVs, battery-powered EVs take more power out of their batteries. However, when it is accepted that battery power and therefore range will be sacrificed to match petrol's acceleration, most EVs will leave the ordinary car for dead at a traffic stop getaway.

Automatic transmission

There was an EV here in Australia 11 or 12 years ago: the Enfield. The performance of this vehicle was far below that of ICVs, and like bicycles, joggers, elephants, camels, pedestrians and horses, it was not "traffic compatible" in ICV-dominated streets. Donkeys are traffic compatible, but only because they are driving ICVs who are prepared to put up with this clutching and gear-changing performance, or to pay more for "automatic" transmission.

"Automatic" transmission? Who on earth would clutter up their vehicle with silly and expensive, energy-wasting and complicated gears and clutch when EVs and steamers did not need them? And then to cap the whole idiocy with the further complication of "automatic" transmission!

Surely, a lot of car designers missed their vocations, when ▷



"La Jamais Contente", the French EV that in 1899 was the first road vehicle to power through the one mile a minute speed barrier. (Photo: Museé National du Chateau de Compeigé.)

there are all those drivers just waiting for good keen men and women to sell them the Sydney Harbour Bridge and shares in the Westgate Bridge too, after they have been conned into buying ICVs.

The Enfield sort of experience taught EV designers they had to design cars that would compete with ICVs in acceleration, top speed (within town limits) and braking. But consider the average family in an Australian city and their requirements for personal transport. The commuter — man or woman — who drives a kilometre to the railway station each day plus three or four more kilometres each weekend to visit the club or go shopping, has little need of range. A housewife and mother uses her vehicle for only a few kilometres each day to run the children to and from school, do some shopping and visit friends. This short running wastes fuel and, incidentally, hurries the mechanical demise of an ICV.

Yet such a car-owning family will buy an ICV with a 400 km range, instead of an EV with a 80 km range, because they occasionally go for a spin in the country and drive away on holiday once a year. Some time working out expenses would show it more economical to own EVs, more cheaply fuelled, and with a life expectancy of 15 to 30 years, and to hire a petrol burner for the monthly visit to parents in the Blue Mountains and the yearly holiday trip.

Steamers

Of course, farmers and company reps and others need ICVs with their greater range, so there are plenty of transport applications better served by an ICV — or better still, by a steamer. By the same token, EVs would serve some commercial applications better. A classic is the English EV milk delivery waggon, a familiar sight in British cities. Not surprising, when you know that there are 50 000 of them. Or, think how EVs would be ideal for meter readers (gas or electricity). Low speed, stop-start: this is ideal for an EV but anathema for an ICV, which wastes fuel prodigiously and rapidly wears out its motor and transmission in this type of service.

Steam cars lost out to petrol because it took longer for them to raise steam. Stanley Steamers used to take about 10 minutes each morning. It could be argued that 10 minutes was only a fraction of the total time in a two or three hours' drive, as it would be today if you were driving from Sydney to Newcastle, but it was a different matter in a 15 or 20 minute journey around town in motoring's early days.

There were cars with flash boilers which took only a minute or so to raise steam, and in Australia Ted Pritchard a few years ago got his steam raising time in his steam car from cold down to 35 seconds. Once the boiler was hot, the steaming point was reached much quicker when you started again after stopping for quarter or half hour periods.

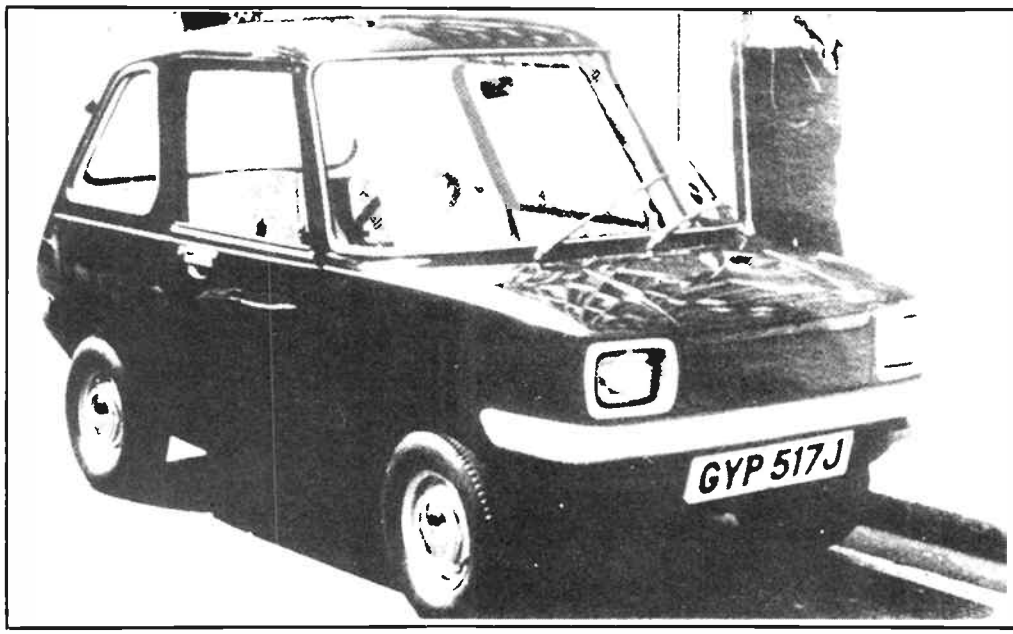
Just one more advantage of the steamer is that it is not critical about fuel. Petrol, kerosene, a, CNG, NPG or home-grown ethanol (alcohol) and others will any of them have a steamer merrily trundling down the Princes Highway at a rate of knots, smoothly and silently. Only relatively small changes to the burner and fuel injecting system would be needed.

The other objection to the classic Stanley Steamer was that it did not condense its steam, but exhausted it to air. So every 100-150 km you had to stop and fill up the water tank. This was a lesson not lost on Ted Pritchard, whose condenser-fitted steam cars needed only a glass of water to top up every 1000 or so kilometres.

Because of their starting torque, the steamers need no gears. A lever quickly alters valve timings to provide a forward-reverse action that again does away with gears. Watching Ted Pritchard forwards-reverse/forwards-reverse into a parking place, with a flick of the fwd/rev lever and a touch on the accelerator was a delight which made you wonder why ICV drivers go through the declutch/change gear/clutch/accelerate dance they do.

The fwd/rev lever in the steamer saved brake wear and tear. When you saw a red traffic light looming up ahead, or some other reason for slowing down, you just moved into reverse. The car slowed down smoothly and controllably, ending with a light tap on the foot brake. EVs can do a similar trick with "regenerative braking", to be discussed in the second article. Not for nothing is the foot brake in EVs and steamers called the "emergency brake".

Now doing away with gears means no clutch, which means no obtrusive swelling of gearbox and clutch housing in the middle of the car under the dash. Also, every stroke in a double acting steam engine is a power stroke, so a two cylinder steamer is as smooth as an eight cylinder petrol burner. Smooth power = less vibration = less dead chassis mass to absorb vibration = more efficiency. No gears: more efficiency, smooth



Not traffic compatible: the Enfield electric car.

acceleration, less driver hassle, and less wear and expensive tear on the whole thing.

Because you convert a steamer's fuel into heat in a chamber designed to act as a heat converter and nothing else, the expansive potential of the steam is converted into mechanical power in a device dedicated to that purpose and no other. This process is more efficient and creates less atmospheric pollutants. In an ICV you make the cylinder work as a heat generator for the fuel and as a power converter for the ensuing expansion, with the usual penalty of inefficiencies that result from a compromise.

Mass transport

The steamer has been discussed to highlight the appalling mistake we have made by committing ourselves to the ICV for long distance transport. But returning to EVs, stepped resistor power switching in the pre-solid state era was inefficient, wasting valuable battery power in heat instead of powering the vehicle. Memories of trams of the time before Melbourne got its present thyristor-controlled fleet remind us of the leaps in acceleration as the driver ran up through the resistors: perhaps a little too fast?

At this point an inherent superiority of electric power over internal combustion should be cited. In trolley buses, where the fuel is not loaded on board the vehicle to subtract from the payload, the vehicle is not constrained to preserve battery power by restricting acceleration. Thus the "gradeability" — the speed of climbing hills — of trolley buses always far exceeds that of diesel buses. They are smoother, less demanding to drive, and because they do not shake themselves to pieces, have a life expectancy usually of 30 years, compared with a diesel bus's 12 or 15 years.

Just take a flight across the Tasman and ask the men and women who drive hilly Wellington's "Big Reds" — the city's mixed fleet of diesels and trolleys — whether they prefer trolley or diesel. Or if you want a holiday further afield, go to hilly Seattle in the USA and ask the citizens why they rebelled against their city council for letting the trolley bus system fall to pieces and daring to foist smelly and inefficient diesels on them. They compromised by allowing a temporary diesel fleet for two years while new trolleys were instituted.

Only two years saw the diesels condemn themselves as Seattlians who were used to soaring up hills speedily, without vibration and smoke, had to endure buses that crawled uphill with great noise and effort. The new trolleybuses were thankfully received in Seattle.

Two hilly cities have shown they prefer EVs in the form of trolleys. The Russians are great trolleybus users, with even trolley trucks where they have fixed routes to cover. The Hungarians have made trolley bus exporting quite a useful little industry. Although Australia has an interesting trolley bus design (see next article) it would never occur to us to commission a few trolleys and lay the foundation of an export industry?

— Oh no, it's easier to dig up coal and iron ore and flog it off to someone who will make things they then sell back to us. And you can't eat trolleys like beef or shear them for wool, so what would the farmers do for a crust? No, what's good enough for grandad's good enough for Aussies. You don't have to stop the world for us: we got off years ago. . .

Who not more EVs?

Well, if the arguments against ICVs are so good, why haven't we more EVs? First, I am not suggesting some sinister plan by the oil, car and tyre companies. These people usually follow normal commercial practices to protect their investments and markets. New Zealand, rich in gas, coal, hydro power and ethanol potential for its own needs but without oil, was far more badly hit than Australia by the "energy crisis" of the 70s. So it seemed a good idea to encourage Kiwi motorists — and particularly commercial fleets — to change to LPG and CNG.

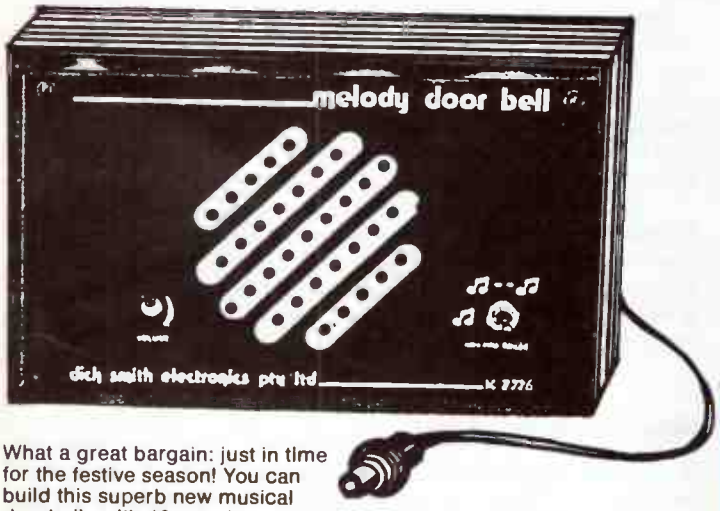
And it was a good idea, except that the NZ energy authorities found that people were reluctant to change. Their attitudes had to be researched, and the programme of gas substitution for oil had to include a large amount of consumer attitudinal education. Note, for example, how whenever a gas-powered vehicle in Australia burns in an accident the newspapers, TV and radio will highlight that the vehicle was fuelled with gas. That petrol in light thin-skinned tanks is more dangerous in a crash does not see "petrol-powered" automatically mentioned in reports of burn-ups of petrol fuelled mobile atmospheric polluters.

Another reason is the enormous supporting infrastructure for ICVs that has grown over the years. If you were to get half Australia's vehicle fleet changed to EVs in the next 10 years, garage attendants would have to relearn their jobs to refuel EVs.

Mechanics would have to go back to school to learn about electricity and how to service EVs — which need only a fraction of the maintenance of ICVs, by the way — so you're into redundancy payments and sackings. Half the mechanical engineers in town and city bus fleets would have to find new jobs and be replaced by electrical engineers. ▷

XMAS BONUS!

Build yourself a door-bell and we'll throw in an extra 8 Xmas tunes: FREE!



What a great bargain: just in time for the festive season! You can build this superb new musical doorbell , with 16 popular evergreen tunes, and we'll also include FREE a second tune chip with 8 extra Christmas tunes and Carols! What a fantastic project to build -and now you'll really impress the friends and rels this Christmas!

16 Tune "Standard" Repertoire

• Twinkle Twinkle • Eency Weency Spider • Santa Lucia • Are You Sleeping • London Bridge • Butterfly • Coo Coo Waltz (2) • The train is running • Coo Coo Waltz (1) • Lullaby • Clementine • Rocka-a-bye-baby • Little brown jug • Long Long Ago • Mary had a little Lamb • Dream of Home and Mother Cat K-2726

Bonus Xmas Tunes!

• Jingle Bells• Santa Claus is Coming to Town • Silent Night • Rudolph the Red Nose Reinder • Joy to the World • We wish you a Merry Christmas • O Come all ye Faithful • Hark the Herald Angels Sing

This chip normally $10 extra: This month FREE!

NORMALLY $49.95

THIS MONTH $39.95

Something to build over the break . .

What break, you say! OK - why not take advantage of the couple of days off to build yourself a great kit. Like these superb hi fi speakers, for instance:

Compact Book shelf System

Put them together in a night or so - and you'll have a great pair of speakers rated at approx. 40 watts cont (100W max). All you need is some glue, a screwdriver and a bit of time. Attractive woodgrain type finish.

You'll need:
An enclosure pack (K-4000) $212.50
Two Woofers (K-3998) $59.50
Two Tweeters (K-3999) $13.50

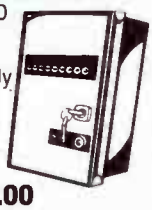
Normally great value at $249

THIS MONTH ONLY $229

More great kit savings . . .

Home Alarm

Build your own alarm controller and really save - AND only you will know the particular system you've built. It's easily good as most commercial alarms, too! Cat K-3424



Normally $149.00
THIS MONTH: $99

Optical Motion Detector

Nifty little idea for security alarms, etc. Photosensitive IC senses changes in light level when someone walks in front of it. Neat - but effective! Cat K-2721

Normally $27.95
THIS MONTH: $19.95

Walkabout Wadio

Why build yourself an AM radio when you can buy one - possibly even cheaper. Just for the fun of it! PS - Betcha this beats the pants off one you'd buy! Cat K-2720

Normally $19.95
THIS MONTH: $9.95

NEWKITSNEWKITS

Masthead Amplifier

Crook TV signal? Build your own masthead amplifier and fix it! Very simple to build, comes complete with all hardware, power supply, etc. Easy one night project. Cat K-5800

$49.95

Multi-Purpose Pre-Amp

Here's versatility! EA's ingenious new pcb is adaptable to just about any preamp - or the power supply for same. Whatever you want in audio preamps - you've got! Short form kit - includes pcb, op-amp etc; you supply passive components depending on type of preamp you want. Cat K-5010

$9.95

Proximity/Motion Detector

Another new one from AEM. It's an oscillator which reacts to bodies (yours, anyones!) -up to 20 metres away. Adjustable sensitivity down to centimetres. Think of the applications! Cat K-8100

$36.95

Remote Switch Transmitter

A really worthwhile add-on to for car alarms, etc etc. Suits the devices recently described in Silicon Chip - this kit is for the transmitter only. (EG a spare, one for your partner, etc etc). Cat K-8150

$16.95

DICK SMITH ELECTRONICS

WORLD EXCLUSIVE TO DICK SMITH ELECTRONICS

TELETEXT

for your existing TV set!

- Not a kit — it's ready built and tested. Just plug it in!
- Uses your VCR tuner to save you $$$.
- Hundreds of pages of the latest news, sport, finance, weather, information . . . all free!
- Also receives "subtitles" or closed captions for hearing impaired.
- Easy to use!
- Designed and manufactured in Australia, with full service back-up through Dick Smith Electronics.
- Infra-red remote control INCLUDED at no extra charge!

At last! Now you can receive Teletext — without going to the huge expense of buying a new Teletext TV!

Haven't seen Teletext yet? You're missing out on the latest news, stock exchange and financial information, sport results and TAB information, weather reports and forecasts, even recipes, jokes and much, much more. It comes to you absolutely FREE — courtesy of the Australian Television Network.

On a normal TV, it's the little colour flashes you see in the black bars between picture frames when your TV "rolls". Unless you have a Teletext TV or decoder, you don't even know they're there!

And don't forget, most stations transmit popular programmes with subtitles for the hearing impaired. This Teletext decoder will let you see subtitles too!

Until now, you've had to buy a specially equipped TV to receive Teletext.

Now you can buy just the Teletext decoder — and keep your TV set!

It's not a kit — it's ready to go. And because it plugs into your video cassette recorder, costly duplication of the tuner section is eliminated. So you save!

Isn't it time you had the benefit of Teletext in your home?

WHY BUY A NEW $1100 TELETEXT TV?

ONLY $579 Cat L-4468

ONLY AVAILABLE FROM

DICK SMITH ELECTRONICS

The Townmobile

Sydney transport engineer Mr Roy Leembruggen engineered and built the *Townobile* battery bus several years ago, and has not yet succeeded in having it accepted. Now the essential factor in Mr Leembruggen's development is that the battery bus is only the hardware in his plan for revising inner Sydney's public transport. Unfortunately most people get hung up on the mind-boggling — to them — idea of an electric battery bus, and can't get their tiny minds beyond that to grasp the total concept of Mr Leembruggen's plan.

However, classically an engineer is defined as someone who does for one guinea what someone else needs two to do. "Why not," asks Mr Leembruggen, "have diesel buses running from the suburbs to the inner city and unloading their passengers there? Where those people want more transport they switch to the Townobiles. Then the diesels can turn around and get themselves out of the city snarl and do their proper job of serving the suburbs, with shorter and more effective running time per journey, with greater passenger loads?"

He envisages a fleet of 60 Townobiles running through Sydney's CBD, through Eddy Avenue, Town Hall, Wynyard, Circular Quay, and St James and Museum Stations. These are the present points where buses and ferries arrive at the inner city from the suburbs.

It is a "hub and spokes" system, where the suburban buses approach the hub, and passengers then change to the "conveyer belt" Townobiles. Mr Leembruggen points out that at present glutfuls of diesel buses from the suburbs wend their ways, particularly at peak times, to the inner city, and then they snail among multi-bus traffic to Circular Quay or another turnaround point, dropping off passengers as they travel, more than half empty for more than half of their inner city run.

No wonder Sydney's state-owned buses lose money! Mr Leembruggen estimates that 60 Townobiles would release 240 diesel buses to do effective work out in the suburbs. The Townobile service would see a bus go past each stop at one minute intervals: "There'd always be one in sight," Mr Leembruggen told AEM.

The Townobiles would not squirt poisonous nitrous oxides and carbon monoxide over Sydney's innocent shoppers, compressed in the dense inner city. The Townobiles would not need high, battery-draining speeds, so a battery would hold enough charge for four hours' running. For second shift running, Mr Leembruggen has engineered the buses so exhausted batteries are easily swapped with freshly charged ones in two minutes: far less time than it would take to refuel a diesel bus.

At this battery exchange station the bus fleet would be serviced and cleaned overnight, although because EVs need so little service, compared with diesels, the maintenance would be simple and quick. Mr Leembruggen has taken the existing and proved technology of mining vehicles with their "electric motor in wheel" concept.

Tried, tested, dependable

A point here is that this is not some novel, untested technology which could blow up in our faces and ruin the whole scheme. The motor-in-wheel has been tried, developed and tested to complete dependability in mining, which is a much harsher environment than Australian cities, or even Sydney's petrol and diesel induced smog. With a motor in each rear wheel, there is no rear axle, so the bus floor is far lower than in diesel buses: something bus fleet engineers are most keen to achieve.

Also known as "The Bus with No Steps", the Townobile has a floor height of 350 mm. Compare this with the 750 mm step up into one of Sydney's diesel buses, which are two tonnes heavier than a Townobile. It's not only tottering up this step that the elderly, infirm, or child-encumbered parents find difficult. It is teetering down as well. The Townmobile also carries 34 per cent more passengers than diesels.

Based on the proved performance of the electric motor in traction, Mr Leembruggen plans for the motors to be exchanged for service once every five years, the operation performed overnight at his kerbside service base, and taking four hours. This would be only little more than a matter of changing a wheel.

Compare this with the drama in regularly giving a diesel loving care and attention to last out five years, and the performance exchanging the engine in a bus. And while we are at it, think of the expense too. Taxpayers in NSW are like taxpayers elsewhere and do not like to see waste. The only problem they have is to recognise that waste and realise that pressure in the right places is needed to save some of the wasted resources.

Because the Townobile has two motors and duplicated batteries and electronic controls, if a motor did fail or a control system become faulty, the bus can still drive back to base. Analogous in public transport is the twin-engined aircraft, which can still fly on one motor if the other cuts out. Of course, this is another disadvantage for the single-engined diesel bus. It's engine cuts out, and: it's grounded.

Duplication was a feature in NZ EVs, as in the ac-motored Canterbury University vehicle and the light trucks made by NEEV in Christchurch for a while. The Canterbury University vehicle was a converted Mini, hence no back axle, and ideal for individual motors to drive the rear wheels. Another advantage of two motors is easily-designed independent suspension as well as no axle or differential. Remember that no differential and gears also means less power loss.

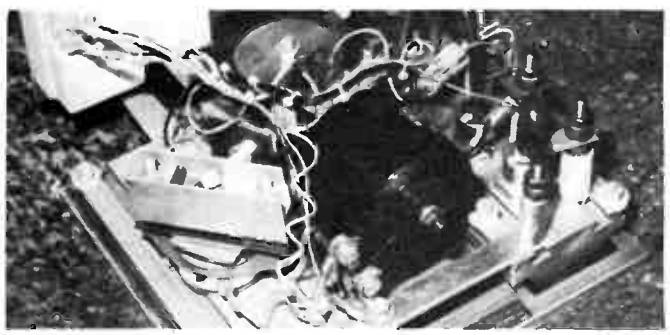
Group up, group down

There is another argument for two motors versus one, known to diesel railway engine enthusiasts or readers of naval history and specially submarines. This is the "group up" and "group down" practice. The dc series motor draws high current when starting from stopped. It presents a dead short to the power source. So classically you used resistors to limit current drain, progressively taking them out of circuit as the motor speed built up and a cancelling "back EMF" increased. Modern technology uses solid state electronics to do the same job more smoothly and without wasting power in resistors in heat.

Another way, of course, was to start on one 2 V cell or 12 V battery and step up voltage as speed increased. However, at slow speeds you can series the motors to increase resistance, until as they speed up they reach a point where you split them and run them in parallel off the battery.

While semiconductors have cut out the waste of power in resistors, and made the stepped cell or battery option practical with automatic sensing and stepping (as in the Flinders car), grouping up and down still is a useful technique and was used in the NEEV trucks. This was done by the driver but had the trucks continued in production electronics would have been substituted to do the changeover automatically.

Like New Zealand, Australia also had its ac powered EV, the "University of NSW" van. Just another example of what engineering development and innovation can achieve, NZ beat the Aussies with the ac EV spin-off. Having developed the process



Semi-conductor controller for a dc motor system. (Photo: NSW Dept of Energy.)

of converting battery dc to three phase ac to power the EV, plus variable frequency to control the speed of the Canterbury University car, the designer, Mr Dave Byers, went on to develop a series of applications for variable frequency three phase ac motor speed controls which have been seen in Australian industry for some years.

Certainly, it might appear that the New Zealanders have more faith in their inventors than the Aussies. Or is the fault elsewhere? The management expert, Mr Peter Drucker, writes that Sweden's change from a backward agricultural country to one of the world's foremost in technology came about because of the technological awareness of the country's bankers. Perhaps it needs our politicians, bankers, unions and media to move their minds above sport, wages and beer to the long-term: like, more than three years — the politician's span of the length of the future.

Without becoming involved in party politics, it is possible to comment — in the context predicated above - that there is a gleam of light in Australia's prospects in the Commission For The Future, our politicians' first hesitant acceptance of Life Beyond The Next Three Years. This three-year hang-up will arise again in the next article, but in the meantime, turn now to power generation.

Power generation

One good reason for putting more EVs on Australian roads lies in the pattern of electric power generation. Where electricity is generated by hydro, the generators can be switched on and worked up to put power into the grid within about a minute. Solar power advocates please note that hydro generation is solar power, since it is the sun that lifts water vapour off the sea's surface and into the atmosphere, where trees and mountains can help the vapour fall back again.

So hydro is ideal for peak power generation, where a thunderstorm or a cold snap may put a surge of demand on the grid within minutes. Another reason for seeing hydro as ideal for peak generation is that if a dam can generate a certain amount of power all year round, it can also generate twice as much power even although it works for only half the time.

Where coal-fired generators produce electric power, these work most efficiently if they work at the same rate all the time. Therefore the ideal is a mix with thermal generation for the base — that is, the constant, unvarying, — load, and hydro to handle the peaks.

Now, the NSW State Electricity Commission charges supply authorities for their power on a formula based to some extent on the power used 7.00 a.m. to 10.00 p.m on weekdays. This is not unreasonable, as the SEC has to recoup its capital expenditure on generating capacity as well as paying for generating costs and fuel. Therefore each supply authority is usually keen to sell power at off-peak times, because it offsets the price paid for the peak period charge.

One ideal use is off-peak water heating. But solar power is making inroads into off-peak water heating. Another ideal use would be to charge the batteries of EVs. In the small hours of the morning, supply authorities would be disposing of their otherwise unsalable power to paying customers.

Lower Prices

However, at comparative kilowatt rates between electricity and petrol prices, the EV owners will come out of it with more than huge grins on their faces: they would be laughing all the way to their banks. Not only would the EV owners benefit, but more a efficient use of electricity would enable prices to go down for all consumers.

While politicians are usually avid for ways and means of reducing taxes or prices, this one has escaped them. Either that, or it is a bit hard for their brains, which are good for counting numbers but not the numbers of EVs that would bring down power prices.

It might be expected that one of the keenest advocates of Mr Leembruggen's Townobile fleet in Sydney would be the Sydney County Council, the local supply authority who would sell off some off-peak power. This would be a steal. Also, it would cock a snook at gas, which in Sydney has dropped on to the home refuelling angle and is pushing the idea of driving on CNG and refuelling at home.

Where it could do the one-up trick on gas, is that to refuel a CNG vehicle at home needs quite a bit of gear like a fairly hefty compressor and other bits and pieces. All you need to refuel an EV is a battery charger, which is not as expensive, space-demanding or heavy as a compressor. In fact, some EVs come fitted with on-board chargers, which again because of solid-state electronics are not as heavy and bulky as they were previously.

However, the Sydney County Council, while active to sell electric power against gas for cooking, does not seem to have grasped the ready-made market it has going in EV battery recharging, once these non-pollutant buses got loose in downtown Sydney's greatly-polluted atmosphere.

This first article on Australia's EVs has attempted to show there is more to a successful EV than designing an efficient, practical transport. It is set against a background of industry, government, media and public inertia. It is also related to the country's pattern of power generation, and to the public's indoctrination into selfishly — in many cases — putting private transport before public, and lack of realisation of the long term effects of the ICV and its impact on our environment.

The background also notes Australia's reluctance to foster new industries at a time our traditional markets are changing. We do not appear to be keeping up with the rest of the world and this change.

The second article of this series will describe Australian EVs in more detail.

New UHF TV channels - "public" TV broadcasting arrives

Ben Furby

With three commercial TV channels, plus one ABC and one SBS, Sydney added to its choices last month when two more came on with some "tests". The new allocations go to specialist broadcasters, rather like the "community" broadcast stations on the AM and FM bands. More channels are set to go on in other areas.

IN REPORTING the two latest telecasters, VITU and Metro Public television, the *Sydney Morning Herald's* TV Guide remarked on the lack of publicity surrounding the new arrivals' début on air.

"Neither station has the financial resources of a Bond, Lowy or Skase to gear the community up," the Guide said.

"Indeed, their ability to transmit at all shows how technically simple it has become to set up a television station with just a videotape player, a transmitter, an aerial and not much more."

Actually, Sydney already had a sixth channel: the Gladesville amateurs have been transmitting lectures for several years on channel 35 UHF (575 to 582 MHz) from VK2ATV on Wednesday nights from 7.30 pm, repeated on Thursday and Sunday nights.

However, we would have to concede that talks on Ohm's Law and transmission lines would hardly rate as entertainment or useful information to the greater part of the TV viewers and specially those who use their time to watch classics like Alf.

While VITU Channel 43 — which is a consortium of Sydney's four universities and the Australian, Film, TV and Radio School — is going to air with two tape players and a switcher, using a 1972 transmitter feeding an aerial on the University of NSW's tallest building, in fact there is a lot more to TV than the Guide's basic station.

Behind the 2-to-5 pm weekday afternoon broadcasts on Channel 43 are the not inconsiderable resources of the production departments of the Sydney University and the University of NSW, who are producing the tapes being broadcast.

In the Paddington Town Hall at the gateway to Eastern Sydney, Metro Public Television, transmitting on channel 31, has the resources of studios that began 10 years ago and have been built on and extended since.

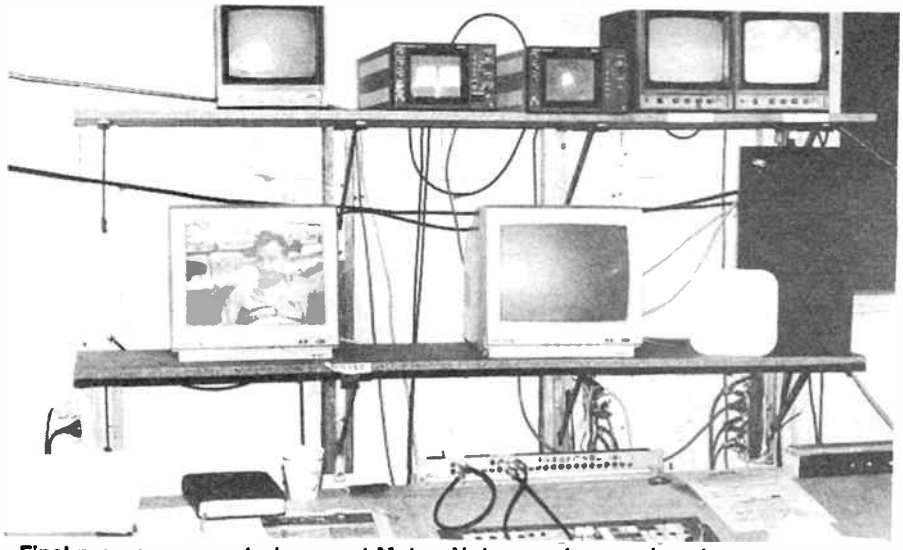
Nor is it only about equipment. Video co-ordinator at Metro, Paul Scott, told AEM it was totally different from public broadcasting on radio.

"In radio you go into a studio with a reel-to-reel. You've done your interview and you splice a few pieces together.

"To teach someone to do that is a lot less time consuming than TV.

"Here, first of all you have to teach

Metro's transmitting antenna uses a PA speaker stand.



Final programme control room at Metro. Note waveform and vectorscope monitors.

them how to operate a camera, and you have to teach them lighting and sound.

"Then you have to teach them to edit, and that's a very time-consuming process."

Mr Scott, who has worked in public radio, said Metro had taught volunteers to edit for TV. However, Metro has been going for 10 years and has paid professionals on the staff. At present there are two video co-ordinators, one training co-ordinator and a video technician.

"We have employed some people specifically to control the beast that is public TV," Mr Scott said.

To mount three weeks' 24 hour telecasting involved about 400 people.

"It was pretty ambitious to go to 24 hours," Mr Scott said.

The three weeks involved were one in November, the next from December 2nd, and finally, the week from January 20th.

A non-profit making organisation, Metro began as an access centre but after various ups and downs acquired new directors on its board whom Mr Scott said had brought it new life.

"It's main purpose is to service the independent sector of the video community.

"Video is so expensive that not everyone with the ideas has got the money so we help people."

Which must be good news for TV viewers blasé with overexposure to saccharine soapies and horse operas, and dubbed-in laughter backgrounding simplistic foreign humour.

Metro receives about $100 000 from the Australian Film Commission and makes about as much again producing some TV commercials and hiring facilities.

"We want to thank the Australian Film Commission for helping in the administration," Mr Scott said.

"We've been working towards this for a year."

TV alternatives

Earlier this year, the then Minister for Communications, Senator Gareth Evans, said he would allow public and educational broadcasters to hold test transmissions on UHF, but made it clear that the government was not committed to a policy of supporting these forms of TV.

While Sydney is Australia's biggest city, it is also the one with the least spare TV channels. Unlike the other state capitals with a handy hill to site line-of-sight transmissions to their audiences, Sydney has no hill but a hilly topography that gives many viewers marginal reception or no TV at all.

So there is a need for local UHF repeaters to supplement the four VHF and one 400 kW UHF transmitters in Artarmon and the five UHF duplicated services radiating from the Hyatt Kingsgate at Kings Cross. But frequency allocations must also include the nearby cities and population centres of Wollongong and Newcastle, whose transmissions can often be seen in Sydney.

Thus it comes about that the Department of Transport and Communications has limited future TV expansion in Sydney to one more channel, one less than for the other state capitals.

While there may be a view that Sydney's three commercial channels have taken enough of a scarce resource (the radio frequency spectrum) for private people to exploit for their own personal gain, the Federal Government may not be able to withstand the pressures that the profiteers seeking pay-TV can bring on the government.

"We'd like to see that last remaining channel go to public TV rather than go to a commercial interest," Mr Scott said.

"We figure if we don't get channel 31 we'll have missed out."

The debate's outcome will be influenced by the success of the present test TV programme, and the long term viability of public TV.

The director of International Programs and co-ordinator of Continuing Education at the University of NSW, Dr John Hedburgh, made the point to AEM that people were getting tired of some of the rubbish on TV.

He did not consider the consortium's present programme planning as an embryo "University of the Air".

"We like to refer to it as the Educational TV facility, so we look at educational TV as one side of the operation.

"The programme at present is aimed more at students or post-graduates.

"If we went beyond that we would have to get a variation of the licence."

At present this is regulated under the Radiocommunications Act.

"But we feel at this stage, given the technology, and what's happening, it would make more sense to look at a ▷

On-air activity at Metro.

University of Sydney edit suite.

shared resource."

The present programme of tests was being done without additional finance.

"Going out on UHF is not ideal but it makes sense for the sort of product we're trying to promote," Dr Hedburgh said.

"The response has been quite amazing and quite exciting."

Broadcasting from the university at its site in Randwick, in Sydney's eastern suburbs, meant viewers in most other parts of Sydney had to swing their antennas to receive the station.

In the long term, this was not a problem: one of the tertiary institutions owns land at Gore Hill, near the ABC's mast.

Dr Hedburgh said the TV educational programmes would aim more at graduates and undergraduates, with viewers phoning in with questions and comments.

"Now we're fitting a telephone. We've got the TV studio so all of that is possible now.

"We're just on the edge of a whole range of technological change."

As well as UHF, satellite and cable were opening up as offering other means of achieving the same end, and Dr Hedburgh said he thought the government was looking for ways not to create too much burgeoning interest in TV: "But it's starting to look at the way its whole telecommunications system is beginning to interrelate".

Fibre optics in the future might provide an education channel sharing a cable with 30 or 40 other channels.

"We're looking at a way of increasing access to education.

"Increasingly we're looking at people who're in work, they might be able to watch for an hour and then go back to work, if we can hit that sort of market.

"They can also use videotapes to record us off the air."

Dr Hedburgh said in education, programmes had to be repeated.

"There are real advantages in repeating."

Also, he said there were levels of production which could keep costs down, while still keeping interest.

"Talking heads can be tied up with colour, nice sets and good presentation; subtitles of words they are using."

Ideally, educational TV could be a national carrier.

Perhaps SBS, instead of broadcasting its test pattern each morning, could use its national facilities for carrying education programmes at those times?

Expansion

The tests in Sydney precede action in other state capitals.

"There are three groups in Melbourne," a spokesman for the Broadcasting Tribunal said.

"There are two in Adelaide — the Life Community TV and the Adelaide Community and Education TV."

She said the tribunal needed three months' notice of a proposed test, and intending applicants should telephone the tribunal's Licensing Officer for preliminary information. The number is (02)959 7811.

After first contact the inquirer could be sent a policy statement and an application form, for information of the applicant, the technical specifications proposed and other detail.

Test licences were not a right, and implied no promise of a future licence to broadcast. The government has not decided whether to licence public TV stations or not.

Hardware

But anyone interested in public broadcasting might be interested in the facilities being used at Sydney. At Metro Mr Scott said they had three Video 8 V90 cameras.

"People go out and shoot in the field on Video 8, and then come back and dump on to VO2630 flat top U-matics.

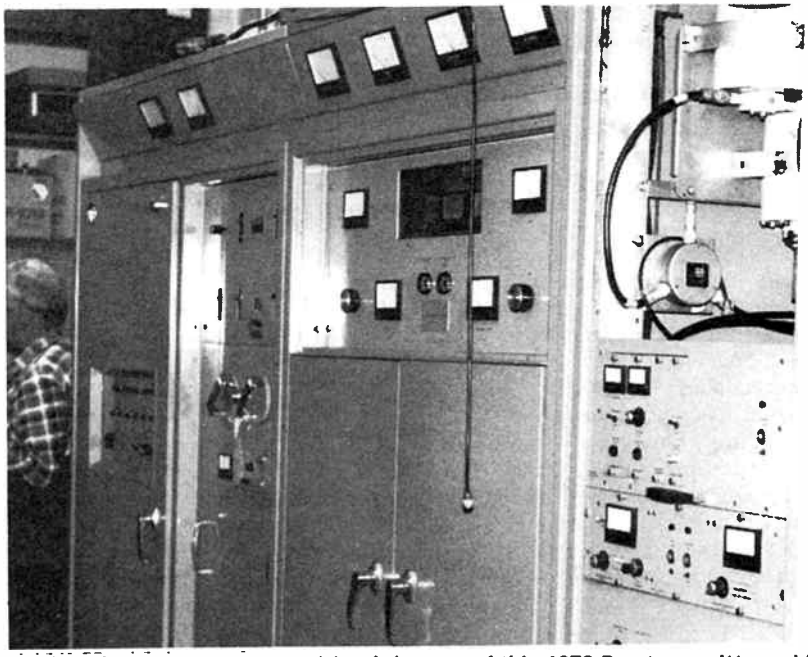
U-matic tapes were expensive, costing about $45 to $50 each.

But: "We picked up a lot from Channels 7 and 9 that they'd used only once.

"They've been great for secondhand tapes — we wouldn't have been able to do the test if we had had to supply new tapes."

Tapes are edited on a Sony Series 5 Edit Suite, which is a 5850. On loan from the Film School is a 5850 and a 58100.

"We also have a U-matic on-line edit suite.



University programmes went to air by way of this 1972 Pye transmitter, which uses a klystron final.

Radiator for educational programmes, on top of the NSW University's highest building (photographed at great peril in a springtime Sydney storm!).

"In the main edit suite we have 5850s again."

Mr Scott said the professional division of GEC had lent a couple of Electrocraft timebase correctors from the Image series.

"These are a TBC2981 and a TBC398."

Sony Trinitron monitors can be seen at Metro, along with some Philips CM8833 computer monitors. This is a case, inherent in the 80 years' history of amateur radio, and emerging after 11 years of public broadcasting, where amateurs can find cheaper equipment which can be adapted for a purpose other than what they were designed for.

Of the computer monitors: "They're tax-free and at $468 you can't get a monitor around that price; the Sonys are around $900," Mr Scott said.

In the studio control room was a Copps mixing desk with nine inputs: "They all have a purpose."

In the on-air control room was a WJ56100 mixing desk.

"It was a demonstration model we got from GEC for $5000 — it's proving to be quite useful too."

Mr Scott said the studio cameras all had remote control units but mostly were directed from the floor. A 16-channel mixing panel covered audio. Metro has a small VHS edit suite with a small Viscount mixer and a JVC VR8600 recorder.

"So we do send some stuff out on VHS," Mr Scott said.

"Usually it's a programme that's already made and if you transfer it up to U-matic you have another generation and don't gain anything."

Roll on complete digital, for professional and amateur. . .

Also on the first floor was another off-line edit suite.

"It's the same as the Sony suite downstairs," Mr Scott said.

In the on-air control room the technicians use a Philips VM5655 waveform monitor and a Philips PM5667 vectorscope.

The transmitter is a 10 W Teleco, from Magnatech in Artarmon, Sydney. The antenna mast is an outdoor PA speaker stand! The chief engineer for the project was Mr Hugh Worrall, holder of a TVOCP, who had worked at Channel 10.

"These days he's actually a social worker at a youth refuge," Mr Scott said.

"Our chief technician is Ian Andrews who is also a TVOCP and who has worked mainly in video post production houses.

"Without those two guys the whole thing wouldn't have come off, without their dedication."

He said the main reason so many people had been involved was dedication, and a want for an alternative.

"If we go to black for a minute, people would get sacked in a commercial station.

"When it happens here, it's 'Oh! We're on black, let's fix it up'.

"It's a laidback and relaxed atmosphere. The people who are involved — and we've got quite a few who work in commercial TV — find it's so relaxed.

"It's all about wanting to present an alternative."

Sydney University's TV department is more interested in education. It began in 1965 with a two million grant.

"That was a lot of money in those days," chief engineer Mr Peter Ellis told AEM.

"It did start with trained professional people, mostly from commercial TV or the ABC.

"Although staff numbers have dwindled they have still kept a reasonably professional staff here."

Sydney University employs 11 people full time and hires casuals for camera and associated duties.

"We're pretty well all trained professionals," Mr Ellis said of his colleagues, " — being one of the better-equipped universities in the southern hemisphere."

The unit has a comprehensive range of equipment.

"We have equipment to lend out to people to use themselves. These are the home-style VHS cameras, and we generally use National or JVC."

Next up are the ¾" units. "We have a ¾" edit suite which is lent to people in the university to do their own editing, and then we have a professional ¾" edit suite where we do our own off-line editing."

Mr Ellis said they would shoot material on a broadcast quality camera which was normally edited on broadcast quality equipment.

"You do a rough edit on U-matic equipment because then you're not tying up expensive equipment for your long edit sessions.

— to page 113. ▷

ONLY 3 WEEKS TO GO!

Ho Ho Ho. That's Santa laughing at all the bargains he's picked up at his friendly Dick Smith Electronics store. Santa knows that Dick Smith Electronics has everything for the electronics enthusiast - and much, much more besides!

Christmas morning — and you forgot the batteries!

Wouldn't you be popular? All those wonderful new wizz-bang goodies and not a battery to make them wizz and bang! Plan ahead — if you get batteries early, you won't forget. And if you get Nicads, they can be all charged up and ready to fire . .

TOOLS ARE ALWAYS TREASURED!

Can't work out what to give? Try some of these special value hand tools: they're a brand new range specially chosen for their strength and durability yet low cost. They'll really be appreciated!

"Short" Long Nose Pliers
Short, squat jaws give maximum purchase. Serrated for positive grip. Cat T-3292 **$8.95**

"Medium" Long Nose Plier
Long, fine serrated jaws for positive grip. Insulated handles. Cat T-3290 **$8.95**

"Long" Long Nose Pliers
Very long (almost 60mm) blade for getting into those really awkward corners. Cat T-3293 **$8.95**

Diagonal Cutters
Quality box joint cutters with hardened cutting blades for long, long life. Cat T-3291 **$8.95**

Bulk Plier Pack: SAVE!
Want to save over $15? Buy this plier pack! You get two long nose pliers, one long nose angled pliers, one diagonal cutters and one flat surface cutters — all for just $29.95. They should be around $45 or more! Cat T-3295 **$29.95**

Here's Something Different!

Spike Filter
Own a computer? Get rid of mains-borne noise and garbage that corrupts computers & causes crashes! 3A rating, plugs in! Cat M-9850 **$149**

Single Power Point Protection
Click Surgebuster Junior plugs into your power point and protects any device plugged into it! Also includes $5000 insurance for devices. Cat P-5617 ~~$49.95~~ **$39.95**
SAVE $10!!

New "Flat" Double Adaptors
Spacesavers: not only do they look smarter - they're more practical. Less chance of getting knocked out of the power point! Use with old style or new style points - faces to right. Cat P-5442 **$3.95**

Surgebuster
It's a six way power board that also incorporates protection against spikes and surges. And there's a free $5000 insurance policy included for your gear! Details at point of purchase. Cat P-5615 **$59.95**

Twin Pack Spacesaver Double Adaptors
Contains one of the above right-facing flat double adaptors AND a left-facing one, so you can turn a twin outlet into a four-way outlet that looks so good it could have been planned that way! Great for computer systems. Cat P-5444 **$7.95**

How about some components for Christmas?

If you're looking for that completely different gift, you can't beat a bag of components. You can betcha bottom dollar that no-one else will give them the same gift: beats a pair of sox any day! Here are just three: there are many more in your Dick Smith store!

Greencap Pack
60 different capacitors - use one a day and you'll almost make it through February! Values from .001 to 0.22uF, all 100VW or better. Cat R-7040 **$12.95**

Power Pack
Actually it's a power diode pack, but the heading looked better! 57 power type diodes and scr's - including rectifier diodes & bridges plus 5 SCR's. Very useful pack indeed! Cat Z-3010 **$14.95**

LED Pack
Imagine their Christmas tree with 100 Premium LEDs on it. Oooh. Aaah. Preeety! Trouble is, you'll have to give them this pack before Christmas so they can have it ready. 60 red, 20 green, 10 yellow and 10 orange Premium LEDs. Cat Z-3015. **$26.95**

The Ultimate Hi-Tech Present

A Computer! But not just any computer - a superb ACER 500+ from Dick Smith Electronics. Australia's best value in an IBM compatible - and our low prices INCLUDE a beautiful soft-white monitor.
Three models to choose from, you choose the configuration you want to suit your needs. And don't forget, you can always upgrade your ACER later!

Acer 500+ Complete from only $995

USE NICADS: THEY'RE CHEAPER!

Sure they cost more than ordinary batteries. But you can charge Nicads hundreds of times so compare the price of hundreds of ordinary batteries! You'll save

Standard Nicads

"AAA" Size	180mAh	Cat S-3305	$4.95
"AA" Size	500mAh	Cat S-3300	$4.75
"C" Size	1.2Ah	Cat S-3301	$11.95
"D" Size	1.2Ah	Cat S-3303	$11.95
"9V" Size	110mAh	Cat S-3309	$16.95

High Capacity Nicads

"AA" Size	600mAh	Cat S-3312	$5.95
"C" Size	2.0Ah	Cat S-3311	$14.95
"D" Size	4.0Ah	Cat S-3310	$15.95
"SubC" Size	(Fast Chg)	Cat S-3324	$5.95

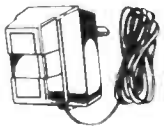
GELL CELLS Ideal for alarms & general purpose usage

12V	1.2Ah	Cat S-3315	$35.95	12V	2.6Ah	Cat S-3320	$38.95
12V	1.9Ah	Cat S-3316	$37.95	12V	6.5Ah	Cat S-3322	$55.95

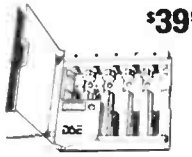
CHARGERS TO SUIT:

In-situ or loose - these chargers will see your NiCad batteries right!

Plug-Pack:
Suitable for most general purpose in-situ (ie batteries stay inside device) charging. Handles 6 to 10 standard or high capacity "AA" cells. Cat M-9517 **$17.95**



Standard:
Handles all types and sizes of Nicads from AA through to 9V; charge up to 8 cells at once. Automatically senses size. Includes charge test meter Cat M-9505 **$39.95**



Super:
Specifically for high capacity Nicads; also sences size and adjusts charge automatically. (Do not use for standard Nicads exce AA Size). Cat M-9506 **$39.95**

Give 'em some light reading matter

Giant Handbook of Electronic Circuits
A book any hobbyist would love for Xmas! Contains millions (slight exaggeration) of circuits and circuit ideas to do . . . anything! Cat B-1780 **$32.95**

Fibreoptic Space Age Projects
Yes, they really are right up there with the latest! A great "hands on" book for anyone wanting to start in this fascinating field of the next century. Cat B-1867 **$29.95**

Cmos Cook Book
It's on the bookshelf of virtually every designer and technician who's into CMOS. If you've been a bit left behind (still trying to battle TTL?) try this one for size. It'll help - promise! Cat D-1248 **$29.95**

Electronics: Physics - THE CORE
Intended as an HSC text - but one of the best introductory electronics books we've ever seen. Small - only 88 pages - but very well done indeed. Highly recommended. Cat B-3631 **$9.95**

DS Australian Marine Radio Handbook
Yes! It's back in stock again - everything you need to know if you own a boat or are thinking about one. It really could save your life one day! Cat B-9604 **Value: Still Only $6.95**

FUNWAY: THE BOOKS

Fun Way Into Electronics Vol 1. 20 exciting projects to build - no soldering. Cat B-2600 **$4.95**

Fun Way Into Electronics, Vol 2. 20 more fascinating projects - and we teach you to solder. Cat B-2605 **$6.95**

Fun Way Into Electronics, Vol 3. 10 "high tech" projects using integrated circuits. Cat B-2610 **$6.95**

INTO RADIO? TRY A SCANNER

The Ultimate: FRG9600
What a scanner! It covers all UHF from 300 to 950MHz - so it includes virtually everything you want to hear! Programmable, memories, even computer controllable! Cat D-2825
NORMALLY $1199 UNTIL XMAS JUST $999

Hand-Held Action: Bearcat 100XL
The go-anywhere scanner that means you can actually go to the action while you're listening! Full UHF band coverage (to 520MHz), inbuilt memories, rechargeable nicads and AC charger. Cat D-2813
Normally $399 UNTIL CHRISTMAS JUST $369

Now available at 60 stores:
• **NSW** • **Albury** 21 8399 • **Bankstown Square** 707 4888 • **Blacktown** 671 7722 • **Bondi Junction** 387 1444 • **Brookvale (Warringah Mall)** 905 0441 • **Campbelltown** (046)27 2199 • **Chatswood Chase** 411 1955 • **Chullora** 642 8922 • **Gore Hill** 439 5311 • **Gosford** 25 0235 • **Hornsby** 477 6633 • **Liverpool** 600 9888 • **Maitland** 33 7866 • **Miranda** 525 2722 • **Newcastle** 61 1896 • **North Ryde** 88 3855 • **Parramatta** 689 2188 • **Penrith** (047)32 3400 • **Railway Square** 211 3777 • **Sydney City** 267 9111 • **Tamworth** 66 1711 • **Wollongong** 28 3800 • **ACT** • **Fyshwick** 80 4944 • **VIC** • **Ballarat** 31 5433 • **Bendigo** 43 0388 • **Box Hill** 890 0699 • **Coburg** 383 4455 • **Dandenong** 794 9377 • **East Brighton** 592 2366 • **Essendon** 379 7444 • **Footscray** 689 2055 • **Frankston** 783 9144 • **Geelong** 43 8804 • **Melbourne City** 326 6088 • **Richmond** 428 1614 • **Ringwood** 879 5338 • **Springvale** 547 0522 • **QLD** • **Brisbane City** 229 9377 • **Buranda** 391 6233 • **Cairns** 311 515 • **Chermside** 359 6255 • **Redbank** 288 5599 • **Rockhampton** 27 9644 • **Southport** 32 9863 • **Toowoomba** 38 4300 • **Townsville** 72 5722 • **Underwood** 341 0844 • **SA** • **Adelaide City** 232 1200 • **Beverley** 347 1900 • **St. Marys** 277 8977 • **Elizabeth** 255 6099 • **Enfield** 260 6088 • **WA** • **Cannington** 451 8666 • **Fremantle** 335 9733 • **North Perth** 328 6944 • **Perth City** 481 3261 • **TAS** • **Hobart** 31 0800 • **NT** • **Stuart Park** 81 1977

DSX PRESS
STD FREE (008) 22 6610

NOW AVAILABLE AT ALL STORES — OR CALL
TOLL FREE: (008) 22 6610
FOR HOME DELIVERY!

AND THE WINNER IS . . .

We don't know! No one yet has claimed the $1000 bonus from the one millionth Fun Way Into Electronics kit. Which means one of two things

(a) It's still out there in a Dick Smith store or reseller, or even the DSXpress order centre. In which case, you could still be the winner!!!

(b) It's been bought as a Christmas present and the winner won't know until he or she opens it up on Christmas morning. In which case, we say congratulations!

Just in case it is still out there, why not duck out, duck into a Dick Smith Electronics store and duck over to the Fun Way into Electronics kits. Grab one and you still could grab a thousand dollar bonus!

PS: A final clue. The one millionth kit also happened to be the most popular Fun Way into Electronics kit. The $1000 bonus coupon was sealed inside the kit, so you can't cheat! That narrows the field down pretty dramatically, doesn't it.

$1000 BONUS!

Permit Nos: (NSW) TC88/2231 (ACT) TP88/7914

MULTIMETERS MAKE MAGNIFICENT MERRY XMASES!

Give the gift that keeps on giving year in and year out: a quality multimeter from Dick Smith Electronics. Models from less than $20 to more than $200!

Budget Mini

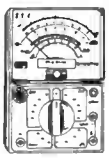
A great one for the kids - as their first meter. Rugged and reliable, great ranges for the projects kids want to get into. 2000 ohms per volt. Cat Q-1010

$14.95

Our Most Popular Moving Coil

And small wonder! 20,000 ohms per volt meter with inbuilt continuity checker AND 10A DC range - unusual on meters in this price range.

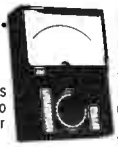
$34.95 Cat Q-1022



More than a meter . . .

It's a logic tester too. Ideal if you work on digital circuits -three LEDs show pulse, hi or lo states. 20K/V meter has 20 ranges, is diode and fuse protected too. Cat Q-1026

$49.95



Electronic FET VOM

Reads in both p-p AND RMS, with very high impedance (10 megohm). Professional quality for when you want the best. High 12A AC & DC ranges, too. Cat Q-1143

$89.95

NEW!!! Digital Capacitance Meter

A "must" for the service shop, technician, lab etc. Instant digital readout of all capacitors (electros included) usually "in situ". Great for checking out that cranky bypass without surgery! Cat Q-1222

$129

Low-Cost Digital is High Spec!

All usual multimeter functions PLUS it's a transistor and diode checker, battery checker AND a continuity checker - all in one! Cat Q-1445

$84

Digital with Capacitance too!

3 1/2 digit with a capacitor checker built in - as well as transistor, diode and continuity checker. It's fantastic value for such a versatile meter. Cat Q-1465

$99.95

Autoranging

No more madly swapping dials to find the right range: it does it for you. Also includes transistor gain measurement and buzzer continuity. Cat Q-1516

$109

And temperature, too!

Diode checker, continuity and all the usual multimeter functions PLUS a probe included for direct display of temperature from -20 to +1370 degrees C. That's some range! Cat Q-1511

$119

HOW ABOUT A CRO?

Not just any cro - but a superb 20MHz dual trace professional model, complete with a set of probes ready for action! But even more, this one has an inbuilt component checker so you can use it almost as easily as a multimeter - and with much better results - to check all types of components.

If you're looking for the ultimate Christmas gift (even for yourself???) this must be IT! Cat Q-1260

$995

DON'T GET CAUGHT THIS CHRISTMAS!

The experts (and statistics) say the light fingered larrikins are loitering at this time of the year - with intent! Don't let your Christmas goodies become the gleam in someone else's eye: install your own quality Dick Smith Electronics alarm system. You'll save -and save!

NEW!

DSE'S OWN 4 SECTOR CONTROLLER

A brand new design featuring 4 individually controllable sectors, home and away states, wire-out protected loops and state-of-the-art circuitry. Housed in heavy duty steel case, ready to install with your choice of alarm detection devices (uses all standard devices). Cat L-5140

Special introductory price: just $199

BUILD YOUR PARTY LIGHTS NOW!

Build Your Party A Lightshow!

Christmas comes but once a year (with its parties and celebrations). Turn your Christmas, New Year and every other party into a disco with the DiscoLite: More than a colour organ . . . More than a strobe . . . More than a chaser . . . IT DOES THE LOT!

Every possible combination of lighting spectacle is yours with the DiscoLite. Cat K-3150

Another great new project from Silicon Chip

$165

COLOURED LAMPS, HOLDERS AND CABLE TO SUIT . . .

HERE COMES CHRISTMAS!

Have you got your coloured lights all ready for Christmas – it's only a few weeks away (bet that scared the pants off you!). Christmas (and any other) parties take on a whole new atmosphere with the right lights – and here are the right lights:

Par 38 Heavy Duty Pressed Glass **$10.95 ea**

Yellow S-3850
Red S-3852
Blue S-3854
Green S-3856

R95 Light Duty Reflector Globes **$6.95 ea**

Yellow S-3851
Red S-3853
Blue S-3855
Green S-3857

Edison Screw Lampholder to Suit: Cat P-5620 **$7.95 ea**

Flexible Cable

Standard 3-core 10 amp flexible cable for general purpose use. Grey insulation.

$1/m Cat W-2055

Builders Cable

Standard 3 core (insulated earth) 15 amp building cable for "festoon" type lighting or general purpose building use. White insulation.

$1.25/m Cat W-2060

And a small selection of detectors & accessories:

Doorway/ Corridor Beam

Invisible infra-red beam for protecting anywhere people walk. Set for lock on or instant mode. buzzer or silent. Cat L-5050

$129

Economy Infrared

Perfect for flats, homes, etc where the area is not huge. Up to 6 x 6 metre protection zone, angled bracket for aiming. Cat L-5009

$89.95

Long Range Infrared

Up to 25m range (along a hall, corridor, etc) so you get maximum coverage. Very fine tolerance adjustment for minimum false alarms. Cat L-5013

$159

Horn Cover

A smart thief will try to disarm your horn speaker. Disarm him first! The horn cover protects the horn speaker and gives tamper protection Cat L-5300

$23.95

I/R Floodlights

Senses any movement and turns on floodlights for predetermined period (up to [illegible]mins) ideal for visitor welcome, security alarms, etc. Outside/inside use, all hardware included but no floodlights. Cat L-5335

$99

Merry Christmas and a bright and prosperous New Year . . . from all at Dick Smith Electronics.

DICK SMITH ELECTRONICS

GREAT READER OFFER!

HANDY 'POCKET' TESTERS

FEELING TESTY?

If so we have just the thing for you.

AEM, in conjunction with Aliette Pty. Ltd., are able to offer two incredibly useful and unbelievably priced test devices.

The PAMA Combi-Sensor

This unique device allows you to test whether or not a particular device or conductor is live, WITHOUT dismantling the device or stripping any wires. The Combi-Sensor is so sensitive it will detect voltages as low as 20 Volts.

It does this by detecting the associated field that is apparent when a voltage is applied to a conductor. The Combi-Sensor is as simple to use as your household torch, just place the end of the device near the object under scrutiny and press and hold the button on the top of the sensor. If a voltage, be it ac or dc, is present the Combi-Sensor will beep and an indicator LED will light.
What could be more simple?

A great buy at $34.95!

The TESTER PLUS

On first appearances the Tester Plus looks like a modern version of the neon screwdriver of old. However, DON'T judge a book by its cover!

The Tester Plus does everything its neon counterpart did AND MORE!

Not only can you check whether or not a power point is live, the Tester Plus is a ONE-PROBE continuity tester. To check, say, the continuity of a length of wire, all that is required is to hold the Tester Plus screwdriver with your thumb in contact with the metal plate on the side, touch one end of the wire with the tester's probe and the other end with your remaining hand. So easy even Uncle Fester can use it!

The Tester Plus has hundreds upon thousands of applications for the serviceman, enthusiast and professional alike. Battery and semiconductor testing, continuity check, voltage testing, automotive uses, repairing the boat – the list goes on!

How could you miss at $14.95!

AEM is acting as a clearing house for both the Combi-Sensor and the Tester Plus and we have been advised that there are a limited number of units available, SO *GET IN QUICK!*

There are two quick, convenient ways to order one or both of these unique test instruments.

EITHER

Send the coupon with a cheque or money order, to:

AEM Testers Offer,
1st Floor, 347 Darling St.
BALMAIN 2041 NSW.

OR

'PLEDGE your PLASTIC'
by phoning (02)555 1677 during office hours and giving your credit card and address details.

PAMA COMBI-SENSOR

(PAT. PENDING)

MAIN FEATURES

- Solid state reliability
- Safe in use
- Simple in application. Used with equal ease by skilled electricians and housewives
- No test leads
- Handy and useful.

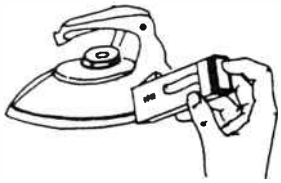
$34.95

Combi-Sensor is equipped with a test light and a sound emitting buzzer, and is operated by two standard AA batteries.

SOME OF THE SUGGESTED APPLICATIONS

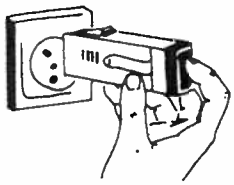
A – Detecting Live Conductors (Voltage Presence Test)
Press your Combi-Sensor slightly to the insulation of the tested conductor and push the button. If the tested conductor is live, Combi-Sensor will indicate it clearly by glowing test light and by continuous buzzing.

B – Testing Connection to Ground



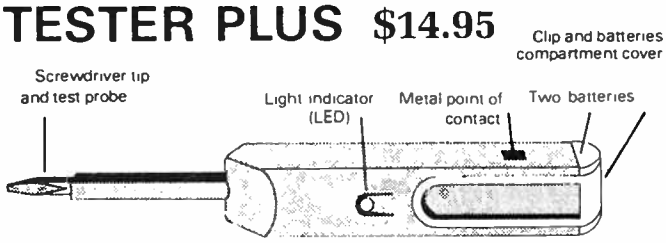
The tested electrical appliance should be switched on. Press your Combi-Sensor slightly to the appliance's surface and push the button. If the tested appliance is not grounded, Combi-Sensor will indicate it immediately by glowing test light and by continuous buzzer.

C – Wall Outlets and Switches



Press your Combi-Sensor slightly to the surface of the tested outlet or switch. Push the battery button. If the outlet or switch is live, Combi-Sensor will indicate it by continuous response of test light and buzzer.

TESTER PLUS $14.95



Yes, please send me the following quantities of the Combi-Sensor and/or the Tester Plus!

..... Combi-Sensor(s) at $34.95 each.

..... Tester Plus(s) at $14.95 each.

plus post and handling $3.00. per order.

I am paying by:

☐ Cheque ☐ Money Order ☐ B/Card ☐ M/Card ☐ Visa

Cheque/Money Order No.:_____

Credit Card No.:_____

Signature:_____
(unsigned Credit Card orders cannot be accepted)

Name:_____

Address:_____

P/Code:_____

Phone No.: (___) _____

Letters

AEM6005 problem

Dear Sir,

I have constructed the AEM project 6005 from a kit which I purchased from Eagle Electronics in Adelaide. Problem: Nearly full negative rail voltage at RV2 and on the output terminal.

Construction deviates from standard as follows: I have used 2SK176 and 2SJ56 MOSFETs in the output stage, and a supply of ±45 V (because of available componentry). A proper ±70 V rail supply will be used later.

Measurements taken across the following resistors with a TMK multimeter show:

R33: 1.25 V
R34: 0.8 V (some concern here)
R27: 1.9 V
R28: 2.2 V
R29: 1.7 V
R30: 1.6 V
R19 and R20: approx. 1.4 V
R6 and R7: 16.5 V

I also took some measurements across R51 — 54 with these results:

R51: 0.31 V
R52: 0.05 V
R53: 0.19 V
R54: 0.05 V

Interesting dissimilarities.

All measurements were taken with the power MOSFET gates grounded.

Some confusion regarding BC639 and BC640 pinouts resulted in complete replacement of those devices. No difference.

I did some in-circuit (power off) tests on all MJE350s and 340s. They appear to be OK. A puzzling aspect concerning Q17 and Q18 symbols in the circuit diagram — are they NPN or PNP? Anything to do with my problem?

I promised my wife that this would be the last AEM project. Never you mind about that, just help me get it off the ground!

I'm getting hungry for good music in the meantime.

Gunnar Sverns,
Nunawading, Vic.

If you have the full negative rail voltage on the output terminal, then either Q21-Q22 are shorted or biased hard on. However, I suspect they're shorted. Check that you haven't somehow shorted the drain and source connections in mounting Q21 and Q22.

*There's no reason to short the MOSFET gates in order to take measurements. If you've shorted the gate and drain on Q21 or Q22 in order to make your measurements, **this** could be your problem!*

The input stage appears to be OK. Your two constant current sources — Q9-Q10 — are OK, according to your measurements, but something's amiss with Q12-Q14; perhaps one of these devices is way outside tolerance, or there's a wrong value resistor somewhere here. Fix this and your voltage measurements around Q15-Q18 will likely be corrected.

Multi-system VCRs?

Dear Sir,

I seek your advice as to whether there is a video cassette recorder available in Australia which enables me to play back movie cassettes recorded in the United States television standard of NTSC and also cassettes recorded in the Australian standard of PAL. (That is, a multi-system VCR.) I wish to purchase a quantity of movie cassettes from America. Therefore, any advice you may be able to give, as to availability of required VCR, would be much appreciated.

P. Richards,
Devonport, Tas.

Well, it's good news! I discussed this with a spokesman from Panasonic Australia who told me that multi-system VCRs are mainly sold through duty-free channels in Australia. Some models will replay US-origin NTSC tapes with output to a standard PAL video monitor or television receiver, while some require a multi-system video monitor or TV set.

Panasonic has a multi-system VCR, model NVG-500, marketed through GEC who have offices in each state. I understand JVC and NEC also have multi-system VCRs.

Power amp query

Dear Sir,

Some time ago I purchased an AEM6000 power amp kit from Jaycar Electronics and took a great deal of care in building it exactly as described in the original project article. However, since completion I have had absolutely no success in getting either the power modules or control electronics to work.

Consequently, some months ago (after much frustration), I gave up and handed it over to a technician who said he would look at it in his spare time. What little I have heard from him since has not been good. Not the least of which concerns the trouble with having fitted "substitute" components supplied in the kit by Jaycar (with completely different pinout — i.e: a 2SK146 in lieu of the ECG461) as the originals are "not readily obtainable", according to the documentation supplied.

Reading the September '88 issue of AEM, I see that the original project as described is not correct in part. Therefore, I would greatly appreciate it if you could detail all errata concerning the project to date — in particular, the amp modules themselves and the faults concerning the 6504 Status Monitors — and any other information which would be of assistance in getting the damn beast going. Having spent over $1000 on it I am eager to try and justify the expense.

Philip Schurmann,
Ayr, Qld

*Experience shows that substitution of the ECG461/NTE461 by the 2SK146 is not wise and, in fact, leads to a variety of difficulties in both setup and operation. Contrary to the statement that the '461 is "not readily available", the local representative for NTE, **Stewart Electronic Components,** keeps them in stock. You can contact them via **PO Box 281, Oakleigh Vic 3166 ☎ (03)543 3733.***

Concerning the errata, this only concerns the 6504 Status Monitor and all the details you require are set out on page 12 of the September 1988 issue. A comprehensive set of voltage measurements is set out on the circuit given on page 48 of the June 1986 issue, and these should assist in setting up and fault-finding.

Servo-feedback adaptor

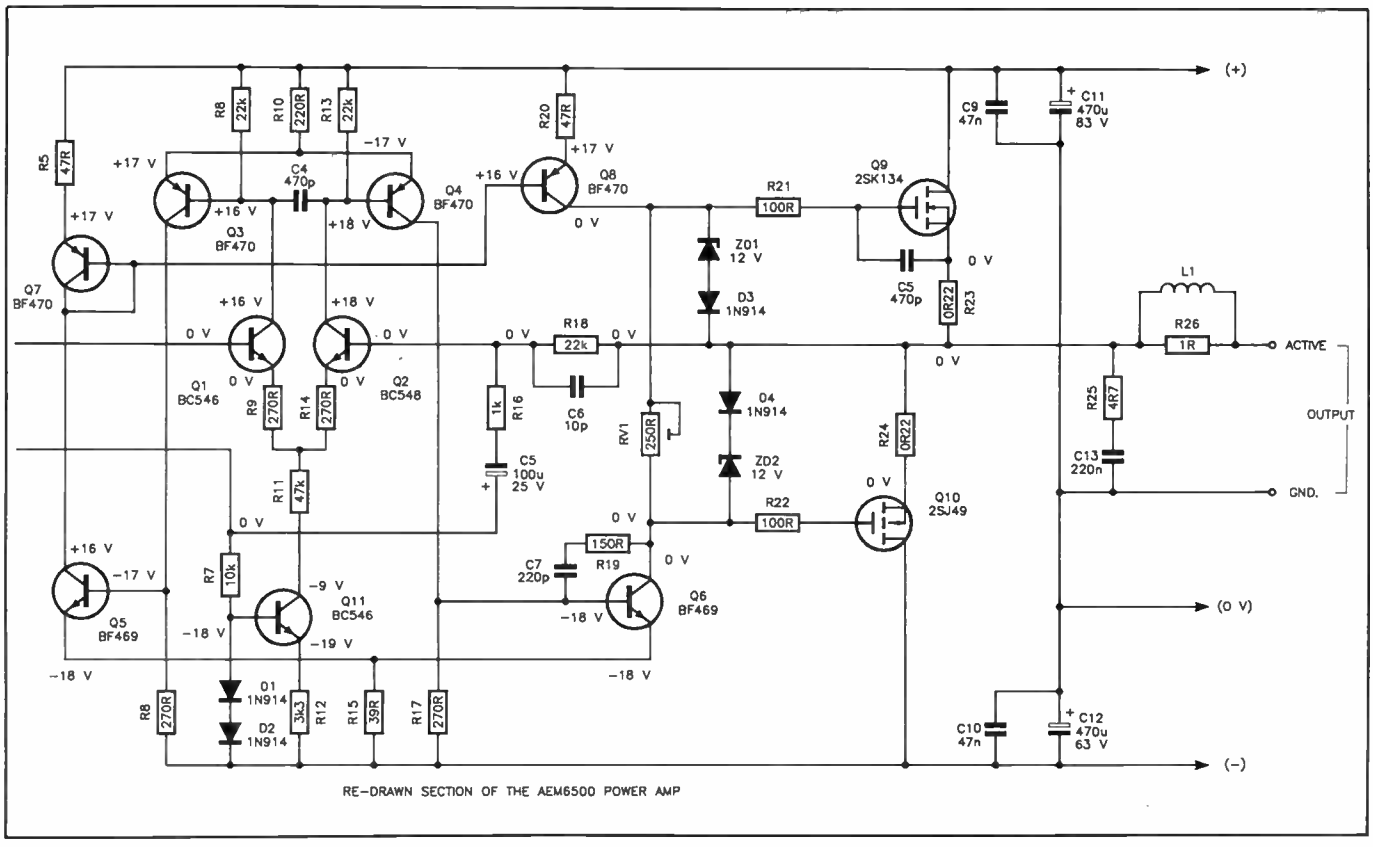
Dear Sir,

Your AEM6006 Servo-Feedback Adaptor appears a most interesting project. While specifically designed for your AEM 6000/6005 amplifier modules, it is undoubtedly adaptable to other amplifiers as well, e.g: the AEM6500. Can you advise how this would be done, and what power supply would be needed?

Mark Butcher,
Norwood, SA.

The AEM6006 is meant for use with dc-coupled amplifiers and thus is not adaptable to amplifiers such as the AEM6500.

If you do wish to try it on another dc-coupled power amp, it may be powered from supply rails ranging from 20 V to 70 V. It connects between the amplifier's speaker output terminal and the negative feedback point (gate of Q2 in the 6000 and 6005). ▷



MOSFET amplifier module

Dear Sir,

You probably don't appreciate receiving letters of this type, but I hope my problem won't take up very much of your time. It concerns the MOSFET amplifier module project published by your magazine in July 1985, which I bought in kit form from Altronics about six months ago in the 100 W configuration.

Although the board was very easy to assemble, I've had no luck in getting it to work. The first power supply I connected it to via 10 Ω resistors (which unfortunately, were 5 W types in the kit) was '45 V, which resulted in the rapid demise of Q5 in a ball of flame, closely followed by R6.

After carefully checking my work against the circuit and overlay diagrams, I repaired the board and tried again with a variable benchtop supply, which I cautiously wound up to ±22 V.

This again caused Q5 and its heatsink to get rather hot and the supply currents were about 100 mA (+ve rail) and 50 mA (-ve rail). The trimpot had no effect on the current drawn from the supply or any voltages around the output stage, which I guess is not surprising since both sides of it remained at O V throughout.

I have enclosed the kit's circuit diagram with numerous voltages I measured. I hope this makes it obvious to you where the problem is, since I'm not familiar with amplifier theory. Have there been any errata published since the original article?

Thanks very much for your trouble.

Michael Warner,
Woodforde, SA.

Flames! — that's a bit of a problem, to be sure. Your voltage Measurements give us a few telling clues. I assume you've only made measurements to 0.5 V accuracy as transistor base-emitter voltages are shown as 1 V.

Firstly, something is dreadfully amiss around Q3-Q4. Their emitters are supposedly connected, but there's +17 V on the emitter of Q3 and -17 V on the emitter of Q4! This indicates two things: there's no connection between the emitters of Q3 and Q4, and Q4 is definitely not biased on.

Further, Q5 is biased on, but Q6 is not. Over half an amp flows through R5 (with 45 V on the "top" end and 17 V on the "bottom"), and consequently through Q5 — no wonder they go up in flames!

While your measurements show Q11 is on, it appears Q1 and Q2 are not biased on. I think you need to make measurements to some better accuracy, preferably to within 0.1-0.2 V.

However, the major clue to your problems lies with the Q3-Q4 voltage measurements. Look for a poor soldered joint around Q4, or a broken track in the emitter circuit.

Roger Harrison

Student seeks CB project

Dear Sir,

I wish to build a CB for my major work which contributes to the HSC. So far, I have been unsuccessful. I was wondering if you could help me.

I have also been told that it is unwise to build it. Is that true?

Brendan Zyp,
Blacktown, NSW

We are not surprised you have not found a project on building a CB transceiver! If such a project were published, it would be unlikely that anyone would be interested in building something that would (a) cost far more than a bought one, (b) be pretty complex when it offered nothing you could not get better from a bought one, and (c) would involve the builder in considerable delay, cost and effort in having it approved by the Department of Transport and Communications — even if such were remotely likely.

As we do not want to discourage you from getting into electronics projects, why not try some other project, such as the AEM3520 Weather Satellite Receiver?

*If you are interested in communications, have you thought of going for an amateur licence? You can have a much more interesting time on the amateur bands than on CB. You have two clubs to choose from: **The Western Radio Club, PO Box 666, Blacktown 2148,** who meet on the first Monday of each month (except January) at*

8 pm at the Blacktown SES Headquarters, 81 Campbell St, Blacktown; or the ***Chifley Amateur Radio Club, PO Box 280, Mt Druitt 2770,*** *who meet each Saturday from 1.30 pm at the Good Shepherd School, Hyatts Rd, Plumpton.*

Fax decoder project requested

Dear Sir,

I have been buying Australian Electronics Monthly since the first issue. The magazine is a fresh change compared to the rivals. I look forward to every issue. Keep up the good work.

I'm writing to suggest a possible project, a simple "stand-alone" fax decoder. Commercial units seem quite expensive. Some are combined with a Morse/RTTY decoder in the one box and as I already own a Morse/RTTY decoder (and printer) I'm not interested in that type. I'm sure others are in the same boat. What do you think?

Terry McCulloch,
Ivanhoe, Vic.

The electronics is relatively simple, it's the software that's the "hard" bit! It would require a receiver to pickup a few limited frequencies (for AXM, AXI, etc), an FSK decoder and electronics to drive a cheap printer. Incorporating Morse/RTTY decoding facilities is comparatively simple and would not involve much extra cost. However, it could be an option. What do other readers think?

Roger Harrison

AEM Elektored

Dear Sir,

Let me say (after reading the July issue editorial), you are right and it's about time!

Now you are asking yourself "what in the heavens is he on about?" Elektor/Price/etc. I think you understand me now.

When you first started out with AEM I slowly started to follow you. I know that you came from E.A. and started a different type of mag. for the hobbyist and that was great as (to me) the others seemed to have got stuck in a rut.

At that time I was looking for a mag. that offered its readers stuff that was inclined towards the low price end of electronics while offering useful projects. I saw AEM at that time as the mag. that offered that type of thing.

However, just as I was starting to get into AEM you went and included Elektor and pushed the price way up. I couldn't justify the extra cost and settled for the other mags. Another reason I didn't buy AEM was due to my also buying Elektor. I did this because they supported my type of computer with projects which you did not reprint, and for the price I was getting what information I required from Elektor.

I know that you will probably never design anything that is dedicated to my type of computer, so Elektor will still be purchased by me. However, I will be looking closer again at AEM with the intention of making it my main electronics/computer mag.

The type of computer I own is called an MSX, made by almost all Japanese electronics manufacturers (also Philips). This system was designed as a standard for all the computer manufacturers so they would be able to interchange hardware among the different brands. This has worked as I am currently using a Sony computer with a Toshiba 3.5" disk drive and have also seen a Yamaha disk drive (double-sided 720K) running in a Toshiba computer.

One further point about the mag., don't change from the square binding method, as this allows easier location and identification of the mag. when it is in my bookshelf.

Damian Wilson,
Chelsea, Vic.

The best connection

Dear Sir,

The excellent article on connectors on pages 107 to 109 of the September '88 issue would also apply to all of the various radio bands both on transmission and reception, besides the 2 m band it was written for. Am I right in this assumption?

I am into communication receivers, VHF and UHF, citizens band transceivers and marine transceivers. I presume I could get improved performance by replacing antenna connectors with "precision" constant impedance connectors, i.e: BNC or Type N series, instead of the UHF SO239/PL259 and TV (PAL) series supplied by the manufacturers?

Regarding the BNC connector, in the last paragraph you state "it's not truly a constant impedance socket". Is this referring to BNC sockets in general or only to the low cost version with the bifurcated (split) pin?

You do not state in the article which type of connector has the lowest losses and is the most efficient? I presume the type N series, and have purchased them to replace the manufacturer's UHF and TV (PAL) series.

There is a new connector recently appeared on the scene called a "TNC". How efficient is this connector?

How about an article in future on the efficiency of connectors and loss ratio with a graph? *Choice* magazine makes very good use of graphs. There's nothing like a graph for clarity.

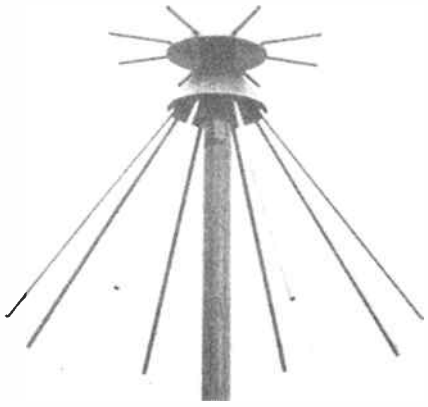
M. Bennett
Marino, SA.

Your assumption is generally correct, although the improvement to be gained by using a "precision" connector would be more noticeable in the VHF and UHF range. On the HF CB and marine bands, there's little to be gained in terms of performance. However, the "better" connectors may have other advantages, such as being weatherproof, offering half-twist lock-unlock connection (BNC), etc. For 27 MHz, Type N connectors are a bit "over the top".:0 The BNC socket with bifurcated pin was the connector I referred to in saying "It's not truly a constant impedance socket".

The TNC connector is hardly "new"; it is a 50 Ω screw-coupling version of the BNC connector and, owing to the increased rigidity of the coupling, has more consistent performance than the BNC. Like the BNC it is designed for use on smaller diameter (6.5 mm) coax. These connectors are now being widely used on cellular radiotelephone equipment. Solder and crimp-type configurations are available.

There are bayonet and screw-coupling connectors for both large and small diameter coax. For the former, the bayonet type connector is known as the "Type C", the screw connector being the Type N. For the small coax, the BNC is the bayonet type connector, the TNC the screw connector. That should make the categories clear!

Roger Harrison



Protecting the Scantenna

Dear Sir,

I am in the process of constructing the AEM3010 wideband scanner antenna project (AEM, July '85). On completion, I had intended to give the antenna and supporting mast a paint finish using an ▷

aluminium primer, followed by two coats of a flat plastic colour.

Is this procedure advisable or would the coating impair the reception performance of this antenna?

Les Jones,
Victoria Park, WA.

*Preserving the AEM3010 discone-type antenna by this method would not affect its performance **provided** you did not apply it to the special plastic insulator that sits between the disc and cone portions.*

The art of radio DFing

Sir,

Ben Furby's article about a useful-sounding RDF receiver and its application was interesting (October '88). "High-tech" satellite navigators are fine, but ye olde RDF still has much to offer, and is far cheaper.

For coastal DF plotting, use air navigation charts which are based on the Lambert Polyconic-Conformal projection, whereas marine charts are Mercator projected. A straight line (such as a bearing) on an air chart almost equals a great circle segment, while bearings often need a "convergence" correction to plot them on a Mercator.

Sailors should use magnetic bearings just as the air navigator does to simplify plots, etc. He can make the lowly RDF sit up and beg, and even provide an approximate distance from a single radio beacon (and without plotting).

Mr Furby's sage advice to first practise with an RDF — it's part science and much art — should have been printed in flaming red neon!

George Lindley,
Redfern, NSW

Thanks for your remarks and valuable advice: they are much appreciated.

Ben Furby says he wanted to stress that when everything else had broken down or was immobilised through lack of power, the DF receiver in the article could perform position-finding, weather, news information and chronometer services for as long as its batteries kept going.

DSE said it has not been able to source any recently in quantities relevant to the Australian market, with changes for the Australian market (that is, inclusion of the CB bands, etc), but has been able to supply one for the New Zealand market which does not have the CB bands.

Roger Harrison

Rejuvenation on the Gold Coast

Dear Sir,

I would like to make a few points on the subject of radio restoration that I hope your readers will find of interest. First, I would like to thank your magazine for

this fascinating and informative column. My trade is in electronics and I have successfully restored some old radios and have more waiting attention, although the Gold Coast is not a good place for collectors.

Restorers may be tempted to junk a lot of their sets to obtain spare parts but it seems to me that there are many spares around already. I would advise collectors to consider saving sets that they may have hitherto regarded as a source of parts — specially valves — and would be pleased to help any restorers in my area.

The circuit and photos of the "High Gain Metz" were very interesting but I think the design is older than suggested, however.

I have a complete book of circuits of Australian radios released in 1938 and they are more advanced than the radio shown. Of the more than 130 models, about half use octal-based valves and almost all use AGC. None of them uses 2.5 V filament valves or utilise the "autodyne" oscillator-mixer circuit as in the Metz.

Some of the more elaborate sets used such innovations as automatic frequency control and dynamic range expansion. I have a radio with the same valve line-up as the Metz and, judging by its cabinet style, dates from about 1933.

I have circuits of the 1948 and 1950 Australian receivers as well as 1938 if anyone is interested in obtaining copies. In ending I must point out a mistake although you probably realise it. A 6B8 is a double diode/pentode and not a mixer/oscillator. I am looking forward to enjoying further columns on vintage radio restoration.

Stuart Irwin,
Labrador, Qld.

Thank you very much for your interesting comments which we appreciate. We should like to hear from other readers with remarks like these. Our associate editor, Ben Furby, says he thinks it was about 1938 when there was sudden interest in AFC, and he asks who remembers how a "magic eye" added to a set's value?

While we are on the subject of restoration, we wonder if there is anyone out there who can do anything about restoring Ben. Now in his sixties, bald, with teeth from the dentist and glasses, Ben has to be helped up the stairs every day, and sat down in front of his word processor.

His dial is a mess with the ravages of age, and he has such a feeble glow we think he's lost emission from all his valves. His resistances have all gone low and his capacities have dried out to about nothing.

When you switch on the power it looks as if his wiring has cracked and he's shorting all over the place. He sounds so muffled and distorted we think his horn has had it too. His knobs have fallen off and we don't really know how to turn him on.

So if anyone has any ideas on restoring Ben, we'd welcome them. He says himself that perhaps some of those bright young female technicians could have a go, as he's sure one of them could restore him to his former powers! Any offers? -Ed.

Anniversary cartridge for Ortofon's 70th

Only 800 of Ortofon's new pickup cartridge, the MC 70 Anniversary Cartridge, will be made. Ortofon said the MC 70 had been developed using the knowledge and expertise gained in making the MC 3000.

Most of the high quality materials used in the MC 3000 are used in the MC 70, where the main differences are a modified rubber bearing and a diamond ground with a slightly different radius.

"Therefore the sound picture will be slightly different from the MC 3000, however with exactly the same high quality," Ortofon said.

Each MC 70 will be numbered, and the number will be engraved on the top off the cartridge, printed on the ceramic plate inside the box lid, on the reverse of the owner's manual, and on the B&K graph giving the specific data.

The "70" relates to Ortofon's 70th anniversary this year.

Australian agents **Scan Audio** can be contacted for details through **PO Box 242, Hawthorn, NSW 3122 ☎ (03)429 2199.**

One of Ortofon's limited series MC 70 cartridges, issued for their 70th anniversary.

Super receiver

Claimed to be the world's most powerful, sensitive and flexible stereo receiver, the NAD 7600 consists of three Monitor Series stereo separates combined on a single chassis.

Operated by infra red control, the unit's power amplifier section is the NAD 2600, rated at 150 W per channel. The phono preamp is the model 1300 preamp, which has excellent sound stage imaging, astonishing resolution of inner detail and wide dynamic range.

Its eight transistor, FET input MM stage is said to be exceptionally immune to RF interference and has a dynamic range of 112 dB.

The MC input is a class A preamp with extraordinary freedom from hiss and hum claiming 10 to 15 dB quieter than many separate pre-preamps. It is said that a moving coil pickup can sound quieter than a high output MM cartridge.

The tuner section claims sensitivity and quietness of the maker's model 4300 tuner. Its FM NR circuit pulls in weak stereo signals with outstanding freedom from noise and distortion.

Manual tuning by knob operates an optical shaft encoder to generate pulses for the digital tuning circuit. Remote volume control actuates a motor on the volume control shaft. This is said to avoid the noise and distortion of voltage controlled circuits often used for remote volume control.

For more, tune into **Falk Electrosound, 28 King St, Rockdale, NSW 2216 ☎ (02)597 1111.**

Another 8 mm video camera

Auto focus, six times power zoom lens with macro and two digital memories for superimposing titles during shooting without editing are among the features of the new CCD-F330 8 mm video camera from Sony.

This makes seven camcorders in 8 mm from Sony, to offer a range with features for all levels.

An auto iris control sets exposures correctly by quickly and accurately adjusting for changing light conditions while the back light function compensates for strongly backlit scenes. The built-in viewfinder shows playback.

There are more features in the S3149 (rrp) camera obtainable from Sony at **33-39 Talavera Rd, North Ryde, NSW 2113 ☎ (02)887 6666.**

Single-disc CD player

Heightened performance is claimed for the Pioneer PD-91 CD player through its twin 18-bit digital to analogue converters (DACs) with eight times oversampling.

This is said to produce effectively better sound quality eight times more accurate than with the conventional 16-bit DAC four times oversampling digital filters.

Sony's new 8 mm Handycam.

Adding 11 regulators and 16 power supplies prevents possible interference caused by simultaneously using other internal components.

All internal components are insulated from external and internal vibration with a laminated pick-up base, honeycomb chassis, large honeycomb insulators, magnetic clamp disc stabiliser, and a coax suspension system with ceramic supports. The power transformer is outside to take hum further away.

Features include time fade editing, auto programme editing and Music Window. Recommended retail price: $1999. **Pioneer at 178-184 Boundary Rd, Braeside, Vic 3195 ☎ (03)580 9911.**

Ortofon powers into amps

Ortofon has released its first power amplifier, PPA 600, which claims a smart and sturdy design, with handles front and back for easy transport, likely to be useful in service as the amplifier is aimed professional users in discotheques, studios and PA.

However, Ortofon said that while the amplifier was originally developed for hi-fi enthusiasts and later modified for production for professional use, it is highly recommended for hi-fi.

Ortofon agent **Scan Audio** can be contacted through **PO Box 242, Hawthorn, Vic 3122 ☎ (03)429 2199.**

A brace of CDs

Said to be the equal of audiophile single disc CD players, the NAD 5170 multi disc player will

New weatherproof speakers from NZ marketing are suitable for outdoor hi-fi sound.

have a six disc magazine compatible with Toshiba and JVC players.

It will have a single-disc drawer, operating independently of the magazine. The player has an enhanced precision 16-bit D-A converter whose most-significant-bit transition is individually tuned on the production line to achieve lowest distortion and best linearity at low signal levels.

The 5170 has a NAD's CDR (controlled dynamic range) circuit that tailors the dynamic range of CDs for comfortable late night listening and for making car/portable tapes.

Playback has quadruple oversampling and two-stage digital filtering, assuring high precision decoding over the full 16-bit dynamic range of the CD. The 5170's price is $1299.

The model 5100 CD player is described as a simplified version of the NAD 5300, but sharing much of its high precision circuitry and production-line quality control. To give high precision decoding over the full dynamic range, the 5100 uses a selected 16-bit decoder, together with two stage digital filtering that operates by way of four times over-sampling.

For precise linear decoding with lest possible distortion at low levels, the translation level for the MSB (most significant-bit) in each decoder is tuned by hand during final testing.

Instead of using two less expensive3nsive decoders, one for each channel, the 5100 uses a single high quality D-A converter to decode both audio channels.

While this could produce an offset as much as 11 µs between L and R, causing the two channels to go progressively out of phase at high frequencies.

The four times over-sampling digital filter reduces this and in the design the output filters produce opposite delays, thus cancelling the remaining offset. Therefore the L and R channels remain in phase at all frequencies.

Recommended retail price is $999. Further bits of information from **Falk Electrosound, 28 King St, Rockdale, NSW 2216 ☎ (02) 597 1111.**

New surround sound amp

Combined with a hi-fi stereo system, input for VCR or a LaserDisc player, the VSA-700 amplifier includes a surround sound processor for Dolby, stadium and simulated surround sound.

There is a VCR noise filter for tape hiss removal on mono VCR playback, and three position acoustic memory. It has a "smart" 68 key remote control that controls all functions.

A multi-function fluorescent display clearly shows what components are being used and the amplifier status. **Pioneer, 178-184 Boundary Rd, Braeside, Vic 3195 ☎ (03)580 9911.**

Weatherproof sound

True hi-fi performance combined with totally weatherproof design are claimed for a range of loudspeaker systems from the USA. A high density inner enclosure is encased in a weatherproof outer shell made of ABS resin, and each speaker driver is made to give long service when permanently installed, in hard conditions.

There are three models in the range, including a sub woofer system. Each speaker has a carbon reinforced woofer cone, a specially weatherproofed tweeter, and high sensitivity.

Designed to mount on walls, under eaves, the Parasound All Weather Speaker comes complete with mounting bolts or brackets. The distributor says the range is ideal for boats, shops, hotels or anywhere good quality sound is needed outdoors where there is rain, sun and dust.

Listen to the distributor, **NZ Marketing, 8 Tengah Cres., Mona Vale, NSW 2103 ☎ (02)997 4666.**

Steering the car stereo by IR

Claimed to be unique to the Philips DC774 car tuner-cassette system is its remote control and SOFAC audio control. Separate control knobs for the main audio functions are done away with.

Instead, the single electronic rotary control — the SOFAC - performs bass, treble, balance and fader. Any of these can be selected and adjusted with the rotary control, which the maker said made a great advance in ease and safety.

The positioning of the control, on the right, improves convenience for RH drive cars.

The SOFAC also controls the volume level when the DC774 is switched on, allowing the sound to increase gradually up to the level set when the system was last turned off.

The 40 W audio output unit can be controlled by the driver or a back seat passenger by the remote control which operates mode selection between radio or cassette, programming, volume and autostore.

The autostore system automatically tunes and stores the eight strongest available stations on FM and medium frequency broadcast band, ready for touch control selection, and also rejects and replaces an unwanted station.

Additionally it has 32 station memory with eight stations each for longwave, medium frequency, shortwave and FM VHF. It has automatic three level search tuning in both directions on all wave bands and up/down touch controls for single step or fast manual tuning.

The cassette autoreverse deck has lockable fast forward and rewind and the MSS (music sensor system) offers repeat and skip. It has Dolby B and C. **Philips at 15 Blue St, North Sydney, NSW 2060 ☎ (02)925 3333.**

Wall speakers find a niche

A series of in-wall speakers meets the growing demand for less intrusive hi-fi, while including what is claimed to be the first genuine high fidelity subwoofer designed to be set in a wall.

KEF's Custom series has been carefully designed for in-wall mounting after the engineers thoroughly examined bass loading, driver mounting and installation ease.

They said they had solved a main problem: edge diffraction, which occurs when sound travelling across the speaker's front encounters any sharp edge or discontinuity. The edge radiates sound, blurring the stereo image.

KEF dealt with this by putting the speaker baffle in the same plane as the wall. Every edge is smooth and continuous, giving a pin-sharp stereo image.

The two way in-wall system uses the space behind the wall for bass loading, providing a low frequency response down to 55 Hz (-2 dB).

However, there is also the 250 mm CR250SW, 95 mm deep, which is -2 dB at 32 Hz.

The Custom Series speakers are in an all white finish but can be match-painted.

The Custom CR200F is a full range two way loudspeaker system comprising a new 200 mm bass driver and 25 mm ferrofluid-cooled softdome speaker. RRP: $799.

The CR200SW subwoofer is designed to go with this system or used separately. RRP: $999.

Speak to **Falk Electrosound, 28 King St, Rockdale, NSW 2216 ☎ (02)597 1111.**

Surge guard

Designed to protect mains-operated equipment from damage from mains-borne surges, the Kambrook surge guard SG10 plugs into a 10 A outlet and has a socket to connect the appliance to be protected.

A neon glows to show when the surge guard is on. Recommended retail price: $24.95. Contact **Kambrook, 44-60 Fenton St, Huntingdale, Vic 3166 ☎ (03)543 2200.**

Kambrook's surge guard protects your equipment against mains "nasties".

Improving your TV reception

Ben Furby

Part 1

You want better TV reception? Then buy a decent antenna. If that doesn't work, try going to live near the transmitting mast! Ben Furby consulted the experts for some practical advice.

THEY ALL SAY it is a case of "first things first". If you are having trouble with your TV reception, take a long, hard look at your personal version of the idiot box. But there is the other aspect to keep in mind: no receiver can be better than its antenna. So if you have a good receiver but cannot get a decent picture, read on to find out more about it all. You may not have to sell up and move, after all.

Design engineer at Matchmaster antenna maker R.J. Waterford and Sons, Mr Robert Waterford, said that some of the old tuners of receivers 10 years old would give a grainy and snowy picture for a 1 mV signal. "Most modern sets you can get away with 10 dB less than a millivolt, which is 50 dB μV," he told AEM. "Older tuners are not as receptive as the newer tuners are."

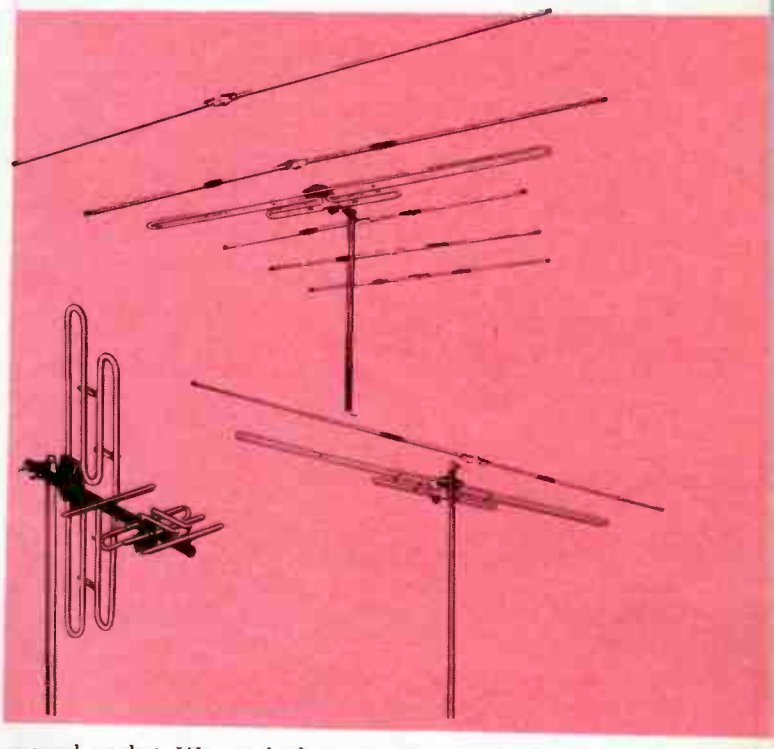
The Director of Engineering at SBS, Mr Bryan Madeley, also preferred today's receivers as having tuners more capable of receiving UHF. "New receivers have better front ends than the old ones," he told AEM. UHF antenna amplifiers? — Mr Madeley said that a 10 year old colour TV receiver was getting to the end of its life. Was the investment in an UHF antenna amplifier worth it just to get UHF for the brief time before a new receiver became essential? And what about a VCR? — Mr Madeley pointed out that demodulating the signal, then modulating a carrier and demodulating a second time did not improve the signal.

At SBS, there is considerable concern to encourage people to move onto UHF since all SBS TV in Australia is on UHF. In Sydney, channel 28 emits 400 kW from the ABC mast at Gore Hill, compared with the 100 kW broadcast by the other channels on VHF. "Antennas are the biggest single problem this station faces because of the large number of people without antennas, particularly in the west of Sydney," Mr Madeley said.

He suggested that made-in-Australia antenna and splitter amplifiers could give good returns because they were designed specifically to take care of local problems. Not surprisingly, Mr Waterford agreed, but had some arguments to back up his opinion. R.J. Waterford and Sons makes about various 200 antennas but does not make amplifiers. Where these are needed in installations the company uses Australian-made GME units.

"There have been imported products that don't tend to cover channel 11 very well in Australia," Mr Waterford said. "In this world you get nothing for nothing, and unless you're prepared to pay, generally speaking the quality of the electronic components, for example, would become inferior. That can be a problem.

"The reason why GME has been so successful in this country is that when we have a problem, we can develop something to fix that problem. By doing this we are in a more specialised market where the overseas manufacturer is looking at a more general market. We can look at a more specialised situation." He said Australia has used TV channels no one else in the world had used.

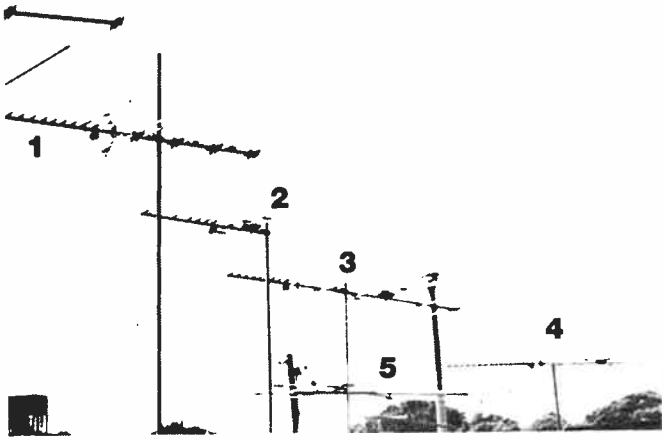


As an example of a local problem solved with Australian resources, a specialised masthead amplifier was designed for the Wollongong-Newcastle area. Channels 7, 9 and 10 had to be amplified but the phased array type of antenna being used was not only a full wave at 7, 9 and 10 but was also about a half-wave at channels 3 to 5. It was quite efficiently picking up the local signals so to have a wideband amplifier in that particular application meant there was cross modulation on to the local channels, hence the special amplifier.

Another problem at Wollongong for people who wanted Sydney signals was the big escarpment around Mt Ousley. This always presented a bad ghost problem for a phased array antenna. "Our Omega 2005 fitted very well into that because it eliminated all the side ghosts," Mr Waterford said.

Antenna considerations

The standard antenna used for TV is a "Hertz", or half wave. In medium frequency broadcasting the usual antenna is a Marconi, or quarter wave. Thus 2FC on 576 kHz at the low end of the band has a quarter wave of 130 m, and this makes a mast ▷



Matchmaster antennas: (1) Dyad Spectra. (2) Dyad Mk I. (3) Dyad Mk V. (4) Dyad Mk VII. (5) Omega 2003.

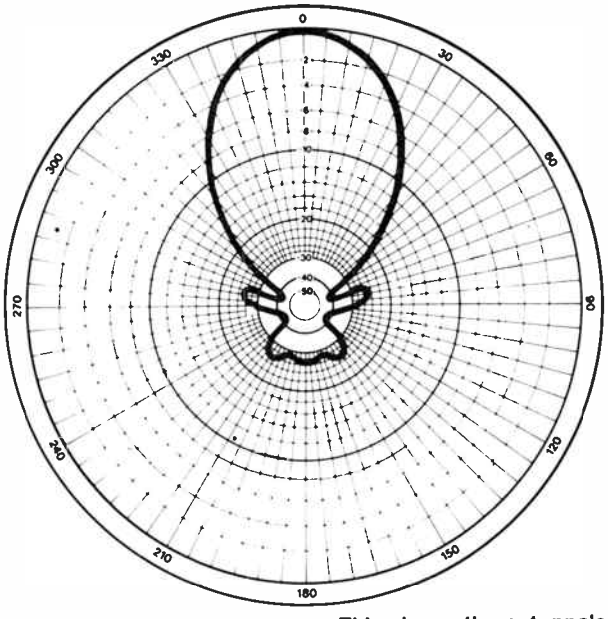
of manageable proportion (with some 'electrical loading' to shorten it). A half wave antenna at this frequency would pose an expensive engineering problem.

In the Marconi antenna, the Earth forms the other quarter wave to make up a half wave overall. Broadcast receivers go very well with full Marconi quarter wave antennas, but it is rather unusual to find this size being used with a domestic antenna, as you can see once you think about it!

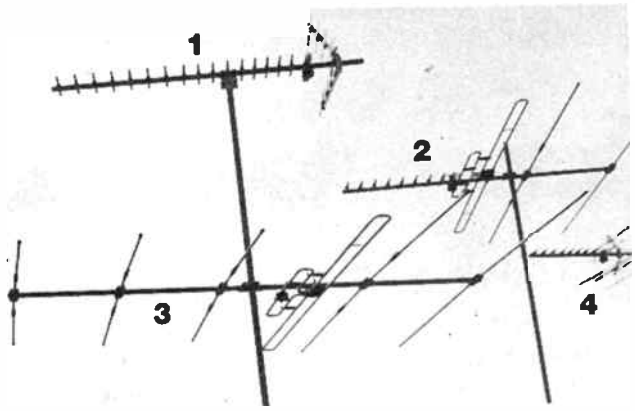
It becomes a different matter at TV frequencies. With the lowest, Channel 0 on 45-52 MHz, a half wave at 45 MHz is 6.6 m, and at Channel 2 (63 to 70 MHz) the half wave at mid-point is 4.5 m. If you split 4.5 m into two, to form a Hertz antenna, as a centre-fed dipole, you have a manageable size.

This is important: a TV receiver costs a homeowner quite a bit of money, and where there is any trouble getting good reception, installing an antenna adds to the cost. A physically large antenna array would not only cost more for materials, transport and handling, but would have to use strong materials to stand winds and weather. This extra weight in turn would add to the mounting and installation costs.

R.J. Waterford and Sons was founded in 1940, and began preparing for TV by moving towards antennas in 1954, two years before TV began in Australia. Mr Waterford claims high quality of manufacture and design in Matchmaster antennas, and makes the point that because Sydney is the most difficult capital



A polar pattern for a TV antenna. This shows the antenna's response to signals from all directions in the horizontal plane.



More Matchmasters: (1) Delta UHF model no. D18/B4 A series. (2) Omega 2005 (VHF). (3) Dyad Mk IV (UHF/VHF). (4) Dyad Spectra (UHF/VHF).

in Australia for TV propagation, it helps design to be headquartered there.

Sydney has more channels than the other capitals, and the worst topography for a TV service. The other state capitals have a convenient hill where the transmitters can look down on their service areas. "In the metropolitan area the main problems people are faced with are ghosting and snowy pictures," Mr Waterford said. "If we start with a ghost, there are two main forms of a ghost: the one from the rear and the one from the front."

He said if your antenna was pointing towards the transmitter, it would pick up the incoming signal, but a reflection from a building or hill behind could bounce a signal back with a later timeframe. "That's what I call the rear ghost."

The forward ghost is where the main signal was coming directly into the antenna but another signal reflecting off a building or watertank on the side went into the front of the antenna, again with a different timeframe. "The forward ghost is where you have to have an antenna highly directional to nullify the ghost, and the best antenna on the market to do that is a Matchmaster 2005 VHF or the Dyad Mk VII in a combination type antenna.

"The reason is that on the radiation pattern the half power beam width is quite narrow and the forward lobe is very clean from extraneous lobes at the side.":0 Mr Waterford said the Matchmaster antennas were based on Dr Rudolph Guertler's "G" design. "What Dr Guertler managed to achieve was that at the VHF high band channels 7, 9 and 10 we have the dipole at the front acting as a half wavelength and then the dipole at the back is three half wavelengths at the high band and a half wavelength at the low. He phased them in very close here and he's phased the three half wavelength section into the half wavelength section while maintaining an impedance of 300 Ω.

"Where a long wire antenna would give you a useless polar pattern for TV reception the front dipole acts as a stub — what we call a fidelity stub — to alter the radiation pattern into a useful shape for the high band and giving gain over a dipole before any parasitic elements are added."

Mr Waterford said Matchmaster also had to use colinear elements where the centre of the colinear excited the single dipole for 7, 9 and 10 while the outer elements of the colinear excited the outer ends of the three half wavelengths long wire section. The advantage was that it got 3 dB more gain than an equivalent log periodic antenna. Such a figure is not to be despised: 3 dB of gain doubles the power.

"We also have a reflector for channel 2 for the low end of the band, and it is coupled with the dipole eliminating any signal overload as channel 2 propagates at such a better rate. As the frequency increases the propagation of the signal decreases in distance. So where you can get long range reception out of, say, 2, 7, 9 and 10, when we get into UHF frequencies the distance

shortens up quite a lot. UHF is line of sight, and if anything obstructs it, that's the end of it."

Mr Waterford said Matchmaster used 12.7 mm seam welded tube and stainless steel screws to overcome deterioration of the antenna, particularly in seaboard locations. Mounting hardware, such as U bolts were zinc dichromate plated. "This is something we've incorporated into our UHF range because of salt buildup, in all the areas they are being used in, in the eastern states, from Melbourne to Cairns.

"With dissimilar metals you do get electrolysis but this is why we use zinc dichromate because it is not such a dissimilar metal to aluminium. With brass, for example, it wouldn't last any time because of the voltages you achieve with those metals."

Matchmaster supplies masts, in single sections of 2.4, 3, 3.7, and 4.5 m. There is a 6 m telescopic mast in two sections as all telescopic masts must be guyed at 3 m intervals, a 9 m in three sections, and a 15 m. Above those heights you need towers which Matchmaster does not supply.

Mr Waterford said that where there was a UHF service people were converting to that because of the better quality. "Electrical interference doesn't affect the higher channels like they do on channel 0 or 2. It's a much better, cleaner picture. If you're in a UHF area it's much better if you go for a UHF antenna, but generally speaking most of Sydney still picks up VHF."

He might have said that UHF antennas are physically smaller and therefore easier to install. There is another consideration as well. The smaller UHF array is less obtrusive, so it does not cause visual pollution as a large VHF array might. However, when the antenna is up and ready to go to work, the question arises of getting the signal to the receiver. This is where the feeder comes in, and the right feeder is vital for good TV reception.

Get the feeder right

If your dipole was a single rod half a wavelength long, you would find if you cut it in half and then fed a radio frequency signal — of frequency corresponding to the length — that as you moved the connections along the rod the impedance changes. If you used a "tuned" feeder, you could connect this up to the antenna at any convenient pair of points, within reason. However, these days untuned feeders such as 300 Ω ribbon and 75 Ω coaxial cable are more convenient to use.

But where you use "untuned" feeders like ribbon and coax you must be careful to connect them to the antenna at the correct impedance matching point, equivalent to their own impedance. This is decided by the size of the conductors, the space between them, and the material keeping them apart.

If you alter any of those parameters, such as putting nails between conductors in flat ribbon, squashing coax, or deforming the cable to make it follow corners too tightly, you will change this impedance and the quality of your reception.

What applies to transmitting antennas applies equally to receiving antennas. The commercially made antenna you buy for your TV receiver will be spaced apart at the break in the middle of the dipole to give a standard impedance of 300 Ω to match the impedance of ribbon cable. Flat ribbon competes well with coax at lower frequencies, up to about 200 MHz, where channels 9 and 10 are, but beyond that attenuation increases greatly. In other words, the cable's impedance goes up as the frequency rises.

So when you want to clean up your antenna for UHF, and especially the higher channels such as 50 to 69, which will be used at Wollongong, coax becomes a must. But if you are using flat ribbon, there are some points to watch for. Ribbon cannot be taped or run down a metal mast, or clipped to a metal roof gutter. Running down the mast, it has to be held away from it on stand-off mounts, to at least 50 mm away. The point is that the feeder must present the right impedance to antenna and receiver, and its impedance is a function of the diameter of the conductors and the space between them.

Proximity to metal or any other conductor — remembering that wood and concrete are conductors when damp — upsets the impedance. Changed impedance means a mismatch at antenna and receiver, which means the amount of energy transferred falls off greatly. Also, when using ribbon, twist it to maintain the "balance". About once every 100 mm is enough.

If you are not installing an antenna but have been inspired by this article to take a fresh look at your present electro-magnetic wave catcher, look carefully at connections. Water reaching wire will speed up oxidising in the wire. Unlike silver oxide, which is as good as a conductor as its pure metal, the oxide of copper is not helpful at conducting. So water seeping into the cable and under terminals does not help your TV reception.

As well as taking a long hard look at your present feeder, take a long, hard scrape at any wire to clean it up. You can waterproof for the future by smearing a sealing compound like "Silastic" over a joint. Replace the whole thing if the weather and old age have got to it.

However, back to coax. Be careful that when you buy coax for a TV installation, it is 75 Ω and not 50 Ω. You might not notice any difference by looking at it, but an antenna or receiver looking into the wrong impedance coax will see a lot to go wrong. Usually you will have a "balun" to match the 300 Ω impedance output of your dipole to the 75 Ω impedance of the coax.

The balun actually does more than change the impedance. In a coax cable, the wire at the centre is one conductor, and the braid or shield on the outside is the other conductor. But the outside shield is connected to earth, so if you connected a coax cable to your dipole — after adjusting the gap for a 75 Ω impedance - you would have earthed one side of it, through the coax shield. The balun therefore also changes the unbalanced coax at 75 Ω to a balanced output of 300 Ω: balanced to unbalanced - "balun" — or vice versa.

If anything, it is even more important to stop water getting into coax. Rifa in Melbourne has a line of waterproof coaxial plugs and sockets for antennas running around outside in the rain or spray. Otherwise, liberally smear a silicone sealant such as *Silastic* on external connections.

Get your order for the length of coax right the first time when you are buying it. It will be cheaper to get two or three metres longer than you need, in a feeder of say, 20 m, than to have to scrap it all and start again because you ended up 186 mm short!

If your receiver is an old one with only a balanced input for ribbon and you have used coax, you will need another balun at the receiver. And if your installation is flat ribbon and you have proudly brought home your brand new vidiot box to find it has only a coax input, you will have to introduce the antenna to your new pet by way of balun before the two will begin speaking to each other.

There is also more to coax than getting the impedance right: Mr Waterford stresses that good quality coax is essential for good reception with least loss. See the table of losses per 100 m in two different coaxial cables, and how the losses change with frequency. This makes the point that as well as insisting at the shop you want 75 Ω coax and nothing else, you must also insist on the least-loss cable, and bring all your credit cards to prove it. ▷

Frequency MHz	dB attenuation per 100 m	
	Cable A	Cable B
50	6.2	6.81
100	8.7	9.72
200	11.8	13.89
500	19.0	22.36
650	22.0	25.67
850	25.0	29.57

If you were using VHF only you could notice little difference between either cable. But at UHF you would lose signal. That could make the difference between making it worthwhile to watch the film *The Bikini Shop* and not enough to catch all the interesting bits. Unfortunately, you'd never really know just how much of life's rich tapestry had got away from you that night.

The Gladesville Amateur Radio Club, transmitting 12 hours colour TV each week from its own station at Lane Cove in Sydney on channel 35, is particularly conscious of cable loss as frequency rises. "Most cable loses you the 6 dB gain you get from your antenna," Mr Keith Cunliffe of the club told AEM. So much does the club appreciate the importance of this that it makes good quality coax available at cost to people trying to receive the station's educational programmes.

Now you have been introduced to the loss of signal in the cable as well as the loss to your pocket, you have found a powerful argument for keeping the feeder length as short as possible. With coax, note you do not have to mount it away from the antenna mast or other conductors, but can tape it or clamp it to the mast or metal down pipe. As you will see in a moment, all you have to do is be gentle with your clamps, and not think you are practising for the next Olympics in wrestling.

You must also be careful of the colour of the coax you buy. Not that there is a complete designer range of colours to choose from! Some cables deteriorate quickly under the action of weather and the Sun's UV radiation. Matchmaster's experience was that black was the only colour to stand up to Australia's intense sunlight and high UV. Mr Waterford said cables with a colour jacket tended to leach out the colour, even with a UV stabiliser in it.

Beware of traps for young players with coax. Mr Waterford talks of the danger of compressing the coax with saddles, or introducing sharp kinks which alter the electrical characteristics of the cable and therefore its impedance.

"One job we did had 1200 outlets. It was an early UHF installation, and therefore was more critical than VHF, but the installer was unaware of the problem. He couldn't get the system to run until he eased off the pressure on the saddles and gained 10 dB per outlet — it was very costly!"

It's the sort of thing you shouldn't have to mention but everyone has to start somewhere and there may be some people putting up coax for the first time without really knowing what it is all about. If you are in that category, do not drive nails through coax to tie it in place to the house. The nail may effectively short the outer to the inner conductor, and just as effectively shorts any hopes of television; on that antenna, at any rate.

Oh, and it's no use trying to use that cable even if you have pulled out the nails. You have opened the inner secrets of your coax to the elements, so its back to your local coax supplier for another lot. Just think of all the good you are doing for those nice cable suppliers.

Another Australian hazard is our big birds, like the cockatoo and the galah. "I remember phoning Taronga Park Zoo to find out the weight of a cockatoo," Mr Waterford said. "They average three-quarters of a kilo, so we could work out our stress rating." You are therefore reassured that if you see a row of cockies or galahs surveying the world from your Matchmaster, this eventuality was taken into account in its design. If you get a ghost on the picture that comes and goes like the ghost of Hamlet's father, it may not really be a ghost but a galah going and coming on the dipole.

Hazards and handicaps

Now that we have stressed the importance of feeder care, watch out for stress on your brick chimney, if you want to use that for your mast mount. Matchmaster can supply a two-armed chimney bracket that can spread apart and distribute the load. For short masts up to about 2.5 or 3 m a single bracket is adequate. Beyond about 3 m you should use a double bracket. This is because the mass of the antenna at the end of a mast becomes a powerful lever that tends to want to crush the chimney.

Then there is hazard from power lines. An antenna should be mounted well away from the power overheads to the house, so if it falls it will not fall across the power lines. If your power doesn't disappear with a bang as the pole fuse blows, you might go off with a bang yourself if you got up to adjust your set when the picture goes mad and the antenna electrifies the set. You cannot risk letting the feeder cable get across the power leads. And finally, a good reason for keeping the antenna away from the power lines is so the installer does not get mixed up in the 240 Vac when he is putting up or adjusting the antenna.

If you are the installer your wife and children may not like it, even though your insurance premiums were paid up. You might not like it either, unless, of course, you had a death wish.

At SBS, Bryan Madeley adds another piece of advice on putting up an antenna, which is to try a UHF antenna in different positions around a house, and also to vary the height up and down. The variation between different positions, a phenomenon known on VHF but more apparent with UHF, can mean the difference between almost no signal and a strong one. Mr Waterford suggests people proposing to get a new antenna should refer to the polar patterns, provided by the manufacturers.

If the receiver is close to separate transmitting masts you may have to rotate the antenna to get best reception from each. Such a situation occurs in Sydney's residential suburb of Lane Cove, next to Artarmon where the channels have their transmitting masts which are on different sites.

"Buy one with a broader polar pattern," Mr Waterford said. "In such places we sell our Dyad Mk I, which gives good high gain on channel 28 and at the same time presents a broad E plane, polar pattern, on 2, 7, 9 and 10. By doing this, even though the signals are not coming in at E maximum, we are getting quite a high radiation level at that angle." Melburnians spreading among the lower Dandenongs might be looking for a similar solution, as they get closer to the transmitters.

For metropolitan use Matchmaster has developed a back screen for its Omega type antenna. This increases the front-to-back ratio even more, because the antenna is of colinear construction. "Then by adjustment we can eliminate not only bad forward ghosting but also back ghosting by that particular screen," Mr Waterford said. "A little bit of personal adjustment in your particular situation may find you can eliminate the ghost by polar adjustment."

FM from your TV antenna

Matchmaster has a combined TV/FM antenna for the five Sydney channels as well as a separate FM antenna range. This is because FM reception on most combination antennas is of reasonably low gain. "I doubt if you'd find anything on the market that would beat our Mk VII which has got about 3 dB gain at FM," Mr Waterford said.

"This isn't like our FMG2 which has 7 dB gain, so what you're looking at in an FM/TV combination antenna is a compromise, because the more frequencies you have to cover the less power you can generally obtain at each frequency. What is achieved is to go for the most on 2, 7, 9, 10 and 28 because these are all multiples of a half wavelength compared with each other.

"Because FM is not in the harmonic pattern it's more difficult to get a higher gain for it." Mr Waterford said that FM in Sydney was quite powerful but the FM enthusiast would probably want a separate antenna. Matchmaster or its distributors can advise prospective antenna buyers. "They're welcome to ring our company because each situation is different. If they ring through to our sales department they can get advice on antennas and amplifiers."

GREAT READER OFFER!

HANDY 'POCKET' TESTERS

FEELING TESTY?

If so we have just the thing for you.

AEM, in conjunction with Aliette Pty. Ltd., are able to offer two incredibly useful and unbelievably priced test devices.

The PAMA Combi-Sensor

This unique device allows you to test whether or not a particular device or conductor is live. WITHOUT dismantling the device or stripping any wires. The Combi-Sensor is so sensitive it will detect voltages as low as 20 Volts.

It does this by detecting the associated field that is apparent when a voltage is applied to a conductor. The Combi-Sensor is as simple to use as your household torch, just place the end of the device near the object under scrutiny and press and hold the button on the top of the sensor. If a voltage, be it ac or dc, is present the Combi-Sensor will beep and an indicator LED will light.
What could be more simple?

A great buy at $34.95!

The TESTER PLUS

On first appearances the Tester Plus looks like a modern version of the neon screwdriver of old. However, DON'T judge a book by its cover!

The Tester Plus does everything its neon counterpart did AND MORE!

Not only can you check whether or not a power point is live, the Tester Plus is a ONE-PROBE continuity tester. To check, say, the continuity of a length of wire, all that is required is to hold the Tester Plus screwdriver with your thumb in contact with the metal plate on the side, touch one end of the wire with the tester's probe and the other end with your remaining hand. So easy even Uncle Fester can use it!

The Tester Plus has hundreds upon thousands of applications for the serviceman, enthusiast and professional alike. Battery and semiconductor testing, continuity check, voltage testing, automotive uses, repairing the boat – the list goes on!

How could you miss at $14.95!

AEM is acting as a clearing house for both the Combi-Sensor and the Tester Plus and we have been advised that there are a limited number of units available, SO *GET IN QUICK!*

There are two quick, convenient ways to order one or both of these unique test instruments.

EITHER

Send the coupon with a cheque or money order, to:

AEM Testers Offer,
1st Floor, 347 Darling St.
BALMAIN 2041 NSW.

OR

'PLEDGE your PLASTIC'
by phoning (02)555 1677 during office hours and giving your credit card and address details.

PAMA COMBI-SENSOR

(PAT. PENDING)

MAIN FEATURES

- Solid state reliability
- Safe in use
- Simple in application. Used with equal ease by skilled electricians and housewives
- No test leads
- Handy and useful.

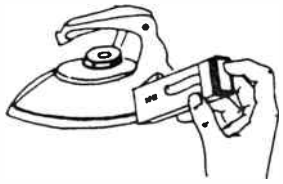
$34.95

Combi-Sensor is equipped with a test light and a sound emitting buzzer, and is operated by two standard AA batteries.

SOME OF THE SUGGESTED APPLICATIONS

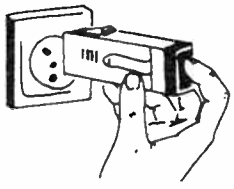
A – Detecting Live Conductors (Voltage Presence Test)
Press your Combi-Sensor slightly to the insulation of the tested conductor and push the button. If the tested conductor is live, Combi-Sensor will indicate it clearly by glowing test light and by continuous buzzing.

B – Testing Connection to Ground



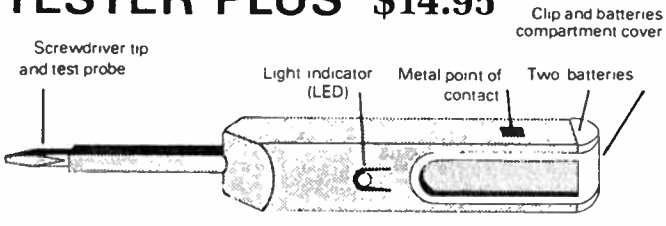
The tested electrical appliance should be switched on. Press your Combi-Sensor slightly to the appliance's surface and push the button. If the tested appliance is not grounded, Combi-Sensor will indicate it immediately by glowing test light and by continuous buzzer.

C – Wall Outlets and Switches



Press your Combi-Sensor slightly to the surface of the tested outlet or switch. Push the battery button. If the outlet or switch is live, Combi-Sensor will indicate it by continuous response of test light and buzzer.

TESTER PLUS $14.95



Yes, please send me the following quantities of the Combi-Sensor and/or the Tester Plus!

. . . . . Combi-Sensor(s) at $34.95 each.

. . . . . Tester Plus(s) at $14.95 each.

plus post and handling $3.00. per order.

I am paying by:

☐ Cheque ☐ Money Order ☐ B/Card ☐ M/Card ☐ Visa

Cheque/Money Order No.:_____

Credit Card No.:_____

Signature:_____
(unsigned Credit Card orders cannot be accepted)

Name:_____

Address:_____

P/Code:_____

Phone No.: (___) _____

Tape levy to be rushed through Parliament

Ben Furby

Both the record industry and Australian artists are on the brink of tapping a source of money that they have not worked for, as the Federal Parliament rushes into law the levy on blank audio tape as this issue of AEM goes through the printers.

BENIGNLY, the government appears to give with one hand while it takes away with the other. On the one hand, Canberra acknowledges the real world by legalising home taping that has been with us since cassette recorders made it possible: but that was only 25 years ago.

This quarter-century delay to face up to technological progress contrasts with the speed with which the legislation was programmed to be despatched within two or three weeks, late November-early December.

The Attorney-General, Mr Lionel Bowen, said in a press release about the blank tape levy: "This scheme will bring the law in line with common consumer practice, and remove the current unenforceable and unrealistic law preventing home taping."

The spokesman for the Australian Audio and Video Tape Association (AAVTA), Mr Ian Prosser, said it was needed to clear the air.

"It's been happening ever since cassettes were around, 25 years ago, why not make it legal?

"That's the other side of the coin."

Royalties

Boost for Australian Music Industry, the Attorney-General's press release is headed. Boost it is, with the industry getting its hands on money earned by others.

"The royalty will be largely distributed amongst copyright owners in Australia and other countries which operate similar royalty schemes," the minister's press release said.

Fair enough too, perhaps. But: "Whilst a number of countries operate these schemes, the major foreign suppliers of music (the USA and the UK) do not."

Says Mr Prosser, "The interesting point is that you may not want to copy one bit of Australian music, you may want to copy UK or USA music, but you still have to pay a levy.

"There's no reciprocal arrangement with the UK and USA, the world's biggest musical producers.

"The levy is virtually for Australian copyright owners only.

"If you're not copying any Australian music at all, you've got no reason to pay the levy."

Aust. out of step

Both the UK and the USA looked at the idea of levying blank tape, even drafting legislation. Then the politicians saw the reality of the problem and dropped the idea. So where the British and the Americans, after testing the water, feared to tread, Australia is not only rushing in but diving into the deep end, if mixed metaphors may join this mixed-up issue.

Mr Prosser wants an inquiry by the Copyright Tribunal, the body empowered by the Federal Parliament to set, collect and hand out the levy, to quantify just what is at issue.

"No one has ever told anyone how widespread home taping is, and its effect on the music industry," Mr Prosser told AEM.

"They say it's widespread and having an effect but that's only words and no one's ever quantified the problem.

"That's the one thing, to clear the air, that's needed to happen."

The Attorney-General's press release, dated May 24, said the new scheme had resulted from a major review by the Attorney-General's Department of home taping and audio-visual copyright laws, in consultation with all interested parties. These included copyright owners, consumers, tape importers and suppliers.

We stand to be corrected, but AEM has not been made aware of submissions being invited to this departmental inquiry, nor have we seen the report on which the legislation is apparently based, together with evidence, as requested by Mr Prosser. Note that no one supports cheating artists — Australian or overseas — out of due rewards.

"You could put up the price of the originals — it's probably what they'll be doing, anyway," Mr Prosser said.

He said the Federal Opposition had doubts that this was the best way to collect the levy.

The Attorney-General said the industry had agreed to set aside 15% of revenue from the new royalty as partial funding for a non-profit Australian contemporary music development company, which was being established by the government to foster Australian music and young Australian musicians.

"You may be helping punk rockers," Mr Prosser said.

If you are buying tapes as part of making a living by your profession, trade or avocation, you may not be too keen to be forced into supporting punk rock.

In a democracy, it might be seen as fairer to let those support punk rock who want to, and those who want grand opera to contribute towards it. However, one should not be forced to give to one you would rather see go away, like punk rockers and heavy metal would probably like to see happen to grand opera.

The government does acknowledge that audio tapes might be used for purposes other than illegal copying.

Technology outpaces the legislators

The portable tape recorder is a marvellous gift from modern technology to make our workload or study load lighter, for ex-

ample: students recording lectures; language students recording pronunciation exercises and examples: journalists interviewing: dictation: correspondence among friends and relations; telephone message machines: personal archival experiences; voice note-taking in the field: and musicians recording their own music, for pleasure or practice.

Have you ever seen a blind person taking notes of proceedings at a meeting? When you see him using a tape recorder for this, again you realise what good technology has done, in this case for the disadvantaged. None of these uses of tape is illegal, nor cheating Australian or overseas artists.

Illegal, but without any other alternative, are audio time-shifting radio broadcasts, and obtaining unobtainable recordings. For example, has anyone been able to buy a pressing of Australian pianist Dick Hughes' first record in the last couple of years?

Not a chance. The record company withdrew them and re-used the plastic. So how do you legally get a copy of this Australian musician's work?

Here the music companies opt out of the chore of carrying slow-moving record stock on their shelves, but getting a royalty when you manage to copy a friend's disc on to your tape. This is not having your cake and eating it too, so much as not having record stocks but getting paid for them even so.

"In acknowledgement of the fact that not all blank tapes are used for purposes which might involve a breach of copyright, the legislation will include specific exemptions and refunds to safeguard institutional users (e.g: schools and institutions for the blind) and individuals who do not copy relevant copyright material, from paying the royalty," the Attorney-General said.

Creating electronic media created a dichotomy that our legislators seem unable to grasp. You can buy a newspaper, read and reread it 20 times over, or 100 times in the next 10 years. No one gets you for copyright infringement, no matter how often you do this.

But if you record a radio or TV newscast, and play it back — if only once — you have broken copyright. If you timeshift radio or TV programmes, you have infringed copyright.

Now suppose you have been interviewed or given a talk on your local radio station. AEM's understanding of the present position is that it is illegal to have a friend record you. You might want the tape to criticise your performance and look for ways to improve your on-air style, You might want a record in case controversy arose about what you said, and you want a reference of not only exactly what you did say, but - importantly with the spoken word — how you said it.

Or you just might want a souvenir of your moment of radio glory that you could bequeath to your grandchildren. But: you would have the glorious inner glow that you had helped the Australian music industry through the levy you paid on the blank tape.

Audio, but not video

Now blank videotape is not levied, while audio will be. Where is the logic here? — Probably home camera recording is far less common than audio non-infringement uses are, but one gets off and the other does not.

More study called for

It is against this background that Mr Prosser's call for more study into the problem begins to highlight the illogicality of Parliament's tape levy proposal.

The form in which exemptions will be allowed by the Copyright Tribunal have yet to be set: in other words, Parliament is handing power to the Tribunal but seems to have abrogated its duty of safeguarding the people from unrestricted exploitation.

Mr Prosser said that to get exemption from the levy it appeared individuals would have to sign a statutory declaration.

"It's a bit heavy-handed to get a refund for a $2 cassette."

A spokesman for the Attorney-General told AEM the legislation had exempted microcassette tape from the levy.

"Most dictation, for example, is done on microcassette, not on standard tape."

However, microcassette tape is usually expensive, at about $5 or more for a cassette. So anyone wanting to keep something that had been recorded on a microcassette would dub it on to a cheaper standard cassette, and reuse the more expensive micro.

Such a practice would not infringe copyright or cheat Australian performers, if the original was personal material, but it could incur the levy if the exemption process had not been followed.

In another aspect the legislation possibly has not been fully thought through: it appears that travellers returning to Australia with blank tapes will not be charged with the levy by Customs. This could conceivably take a small amount of business away from Australian tape makers, distributors and sellers.

"I think it's a loophole," Mr Prosser said.

"I think you could get away with that.

"There's nothing in the legislation to stop that."

Yet a levy imposed by Customs would penalise a journalist returning from an assignment overseas who had bought some tapes locally to record more interviews than he had expected.

Of course this would encourage Australians to spend precious overseas exchange on audio tape at retail prices. Had they bought blank tape in Australia, the overseas expense would have been confined to the wholesale price, and then in many cases for bulk buying. Also, 8 mm videotape used for PCM hi-fi recording is exempt from the levy.

"How many people have got that?" the Attorney-General's spokesman said.

"We look at that as a long way down the track.

"We're talking about things that are widespread to the point of being accepted and are acceptable practice, which is obviously the normal blank tape on those 45, 90 and 120 minute cassettes."

With Parliament putting the legislation into effect, legitimate users are now left with putting their trust in the Copyright Tribunal to administer their powers with justice.

AAVTA spokesman, Mr Prosser: "On behalf of the association, it's probably best to push this inquiry.

"I think that's the main point, to quantify the problem, and quantify the effect on copyright articles.

"And one of the problems to quantify is to work out the best way for compensation.

"I think that's really what an inquiry should do."

Living media — a high fidelity lifestyle

Ben Furby

Once "hi-fi" used to be a 10 watt mono amplifier, a record changer for 78s, and a tuner or radio plus an enormous loudspeaker in a huge cabinet.

TIME MAY HAVE CHANGED the technology and the perception of what constitutes hi-fi, but while it has certainly become accepted as very much a consumer product, that may not be the "limit" of the technology's application. At Sydney hi-fi dealer, Len Wallis Audio, you can get everything the technology has to offer and integrate it into your home and your lifestyle; I said *everything* the technology has to offer, down to and including — literally — the kitchen sink!

Len's "Living Media" concept not just sets out to put hi-fi in the home, but also to change the whole lifestyle.

Basically it can be a system where whatever is on the hi-fi in the living room is available in other rooms in the house or flat, with the volume controllable separately in each room.

Ultimately it can be different programmes in each room, controllable by remote controllers that do not change what is going on in the other places. Waterproof speakers extend the system to the spa, the swimming pool, bathroom or the BBQ.

"Australia leads the world in this respect," says Len Wallis, who told AEM that the system was designed and made in this country. He said remote controls were becoming more prevalent and nowadays people expected remote controls.

"Most manufacturers now produce remote control devices.

"The more integrated the better. People have remote controls for the VCR, TV and CD player and they want it integrated into one.

"It does give you increasing flexibility.

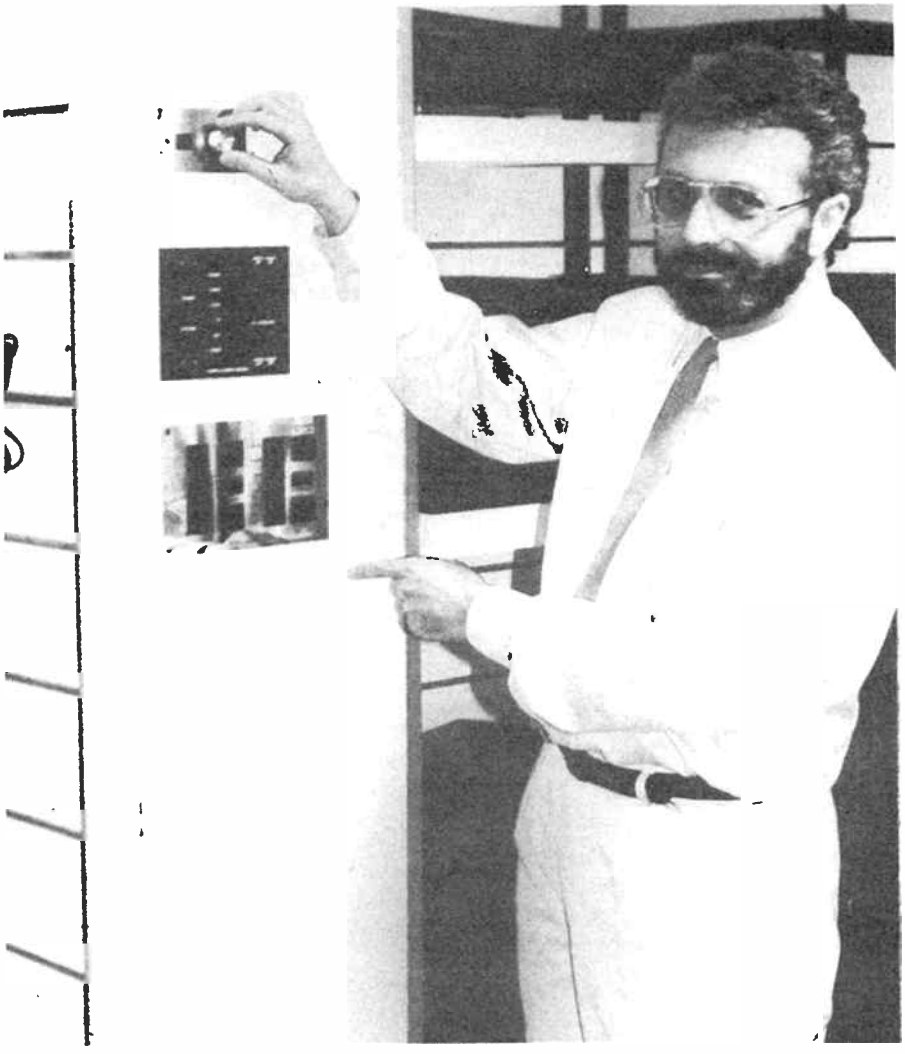
"There's nothing you can't do on a remote control, you can even change phase."

The trend in a lot of homes, Mr Wallis said, was that people did not want to be dominated by hi-fi. The same applied in surrounding rooms. People did not want speakers protruding on stands or from walls.

This carried on further: as well as speakers set flush in the wall, Mr Wallis said, his company was installing flush speakers into walls and painting them, so as to colour them the same as the room décor.

"There's a lot of attention being given in trying to integrate the system, which is what makes us different from most people."

Speakers were available to mount in ceilings and match down lights where



Living Media manager Doug Isaac shows the control panels in alternative styles that fit into the wall of a room to control programmes and parameters such as volume.

Shallow speakers need little depth to mount in a wall and not seem obtrusive.

these were fitted in the ceiling.

Mr Wallis said there were the audio specialists who sold hi-fi, which sounded good but often clashed with everything around it. The alternative was people who sold systems that looked good but that was where it ended.

"It's a wonderfully designed, but dreadful sounding product."

Mr Wallis said his company could now adapt a good quality system into a design-conscious environment, even down to panels to match the walls.

"We're not selling a hi-fi system but a way of life."

The service begins by offering a wide range of best quality hi-fi and video, together with components specially designed for built-in applications such as speakers that fitted into walls or ceilings, outdoor speakers, multi-play tape decks, or stacking CD players.

This was engineered to be controlled from any place in the house, and it extended to cover a range of other services. These could include starting the jets in the spa, checking who was ringing the doorbell through the monitor camera, or turning lights on and off.

"It's probably the world's most sophisticated and elegantly simple remote control system," said Living Media general manager Doug Isaac.

The system and service can supply discreet background music systems for commercial buildings, including an override public address system if wanted.

"We can do the lower quality background systems although they're still higher quality than competitors can offer," Mr Isaac claimed.

Mr Wallis pointed out a two-cabinet Meridian CD player, and said it had a preamplifier with other inputs for using with a TV receiver or other programme sources.

"Because it's a preamp, if you use a pair of active speakers on stands or in the wall, you're getting extremely good sound.

"It's a very high quality product in a very small package."

Even sub-woofers are available for unobtrusively mounting in walls and ceilings.

"These aren't the traditional car speaker type," Mr Isaac said.

"They are totally innovative concepts which use the cavity as their enclosure — these are particularly effective in Surround Sound rooms in creating a real cinema effect."

Mr Isaac added that Len Wallis Audio stocked a complete range of surround sound products to suit every application and budget.

"Amplifiers are available hidden inside speaker cabinets and others for skirting boards.

"With a Living Media system, the traditional rack of electronics need no longer dominate the room."

As well as having the hi-fi range and the various levels of remote control designs Living Audio has a team of installers whose ability Mr Isaac said was commensurate with the quality of the systems they installed.

"Our installation is the best, we've got some of the best people around," he said.

"They can put cables in places you'd never believe — I don't know how they do it."

Also, Living Media offers a two-year guarantee on the work, and always a complete back-up service.

However, Mr Isaac is proud of Living Media's cabinet-making service.

"Every cabinet is designed and built individually, and we can work from either the client's drawings or our own.

"By manufacturing in this custom-crafted way we are not confined to conventional cabinet design. The possibilities of shape, texture and colour are virtually endless — even irregular spaces, under stairs for example, can be turned into useful, usable, beautiful cabinets to house TV, hi-fi or anything else."

Mr Issac said old-fashioned craftsmanship, such as dovetailed drawers, were on the cabinet building programme.

"We can do any finish, such as lacquers in a rainbow of colours or metallic or marble effects — there's no limit to the finish you can have.

"Slide-away drawers, pull-out rotating TV supports, motorised TV raising mechanisms are just a few of the quality features available in a Living Media cabinet."

Yes, but what about the kitchen sink?

"You start off selling them a hi-fi cabinet and finish off just about selling a complete house — even tables, kitchens or whatever!"

Precision LCR meter covers 20 Hz to 1 MHz

Believed to be the first LCR meter with a 20 Hz to 1 MHz range, the HP 4284A can test components and materials to commercial and military standards in such areas as R&D, production, quality assurance and incoming inspection.

For improved testing efficiency, error-free instrument setups can be quickly loaded from the memory card. The large, easy-to-read LCD and softkey menus simplify operation. These facilities can lower costs.

With a basic accuracy of 0.05% the meter has six full digits of resolution for all measurement parameters. The constant test-signal-level feature controls the applied test signal at the device for demanding military tests.

Optional equipment can be added to customise the HP 4284A for different applications. For high volume testing, an optional handler interface and built-in comparator can be combined with component-handling equipment.

An optional scanner interface along with an HP 3235A switch/test unit is aimed at environmental chamber testing. Test fixtures for axial, radial and chip components also are available. Contact **Hewlett-Packard, 31-41 Joseph St, Blackburn, Vic 3130 ☎(03)895 2895.**

Subminiature connectors

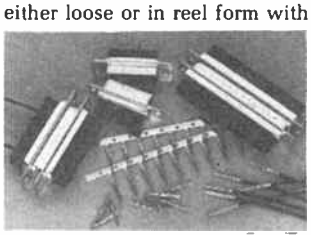
Said to be comprehensive and competitively priced, a range of D subminiature connectors includes ones with crimp removable contacts, insulation displacement plugs and receptacles, accessories and pc board receptacles.

The crimp removable connectors are in nine to 50 circuits and are usable with all standard accessories. Crimp contacts are either loose or in reel form with three styles of selective gold plating which accommodate conductors of 0.8 to 20 to 28 AWG.

Accessories include plastic and metallised hoods for screwlocks, cable back shells for clip and retainer attachment and a slide latch assembly.

The connectors are UL tested and approved, meet industry standards for I/O applications ands will mate with other makers' connectors that comply with prevailing standards.

The distributor can supply hand crimp tools and semi-automatic machines to match. More details from **Utilux, ☎ (02)50 0155.**



New Molex subminiature crimp connectors, from Utilux.

Temperature stable materials

Temperature stable hi-Q dielectric resonators from Trans-Tech have variable dielectric constants for microwave frequency applications from 500 MHz to 30 GHz, with Q claimed as high as 10 000 at 10 GHz.

Trans-Tech's temperature stable resonators are in standard shapes of discs, cylinders and assemblies for TVRO/DBS, GPS, microwave filters, radar detectors, DROs and telemetry.

More details are obtainable from **Benmar, GPO Box 4048, Sydney NSW 2001. ☎ (02)233 7566.**

PC board designer service

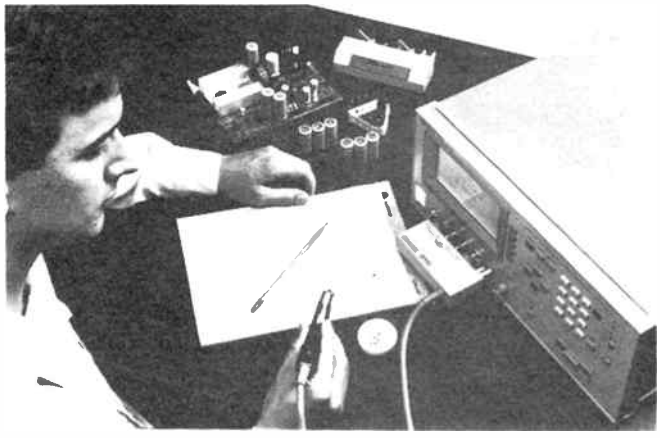
Sydney pc board design office Electri-Board Designs has added a Racal Redac CADSTAR to its CAE facilities. The company has developed a communications bridge between the CADSTAR system and the existing Visula system.

If a design begun on the CADSTAR develops an unfrozen complexity, such as an autoroute stalling, or its output needs change, it can be immediately transferred to the more powerful Visula system without loss of time or data.

Any company using CADSTAR, REDCAD or ORCAD can now send Electri-Board Designs a netlist or incomplete pc board design on a floppy disk and it can transfer to the Visula to finish the job.

If the designer has a problem which can be solved or run more efficiently on a bigger capacity system he does not have to begin again from scratch.

Inquiries to **Electri-Board Designs, Eden Park Estate, 31 Waterloo Rd, North Ryde NSW 2113. ☎(02)888 6925.**



HP's new 4284A LCR meter can measure a wide range of components over the range 20 Hz to 1 MHz.

Thermal imaging more practical

Heat detection devices said to be so sensitive they make thermal imaging more practical for many applications are tiny and potentially cheaper than present ones and easier to make.

Suggested uses are medical imaging scans for disease diagnoses, factory monitoring and automation, earth resource mapping, environmental heat loss measurements, and night vision applications in aircraft or ground vehicles.

Activated by non-visible light given off as heat, the detectors work in the 10 micron infra red region where room temperature objects emit most radiation.

The experimental devices are made of gallium arsenide, instead of the present mercury cadmium telluride: a compound less stable, more expensive and harder to work.

The devices might be made in systems that monitor hospital patients' blood flow, diagnose cancer, identify objects in the dark, or see through fog and smoke.

Because 10 micron wavelengths can travel for kilometres through the atmosphere, satellites equipped with them might be able to locate underground mineral deposits by taking IR "colour" pictures of the vegetation above them.

For more information contact **AT&T Australia, Westpac Plaza, 21st level, 60 Margaret St, Sydney NSW 2000. ☎ (02)221 3055.**

Washers to keep out the wet

Washers designed to fit most electrical fittings and go between the fitting and the box, panel or chassis are said to be liquid, dust and oil tight when properly installed.

They install easily because they seal off on the perimeter and not on connector threads.

A high grade aluminium alloy retainer controls compression and does away with squish out.

These sealing washers are said to meet Nemra 3R, 4, 6 and 13 requirements. They are UL listed and CSA certified. Six sizes fit NPT hubs from 12.7 mm (½") to

50.8 mm (2").

The Heyco washers are distributed by **Nylon Products Australasia, 350 Torrens Rd, Croydon Park SA 5008. ☎ (08)268 2644.**

New packaging material

Toughness, flexibility and wet or dry strength add to traditional packaging products by Tyvek Spunbonded Olefin. Made from high density polyethylene fibres, the sophitisticated spinning and heat consolidation process produces a tough, durable sheet.

The material is said to be chemically inert, non-linting, flexes well and to have an easily tailored permeability. It can be printed, slit, folded, die cut, perforated, laminated, glued, stamped or sewn.

Uncoated Tyvek is being used in industrial, military and electronics packaging and controlled atmosphere, mineral sample and specialty applications.

An Australian innovation combines Tyvekj with aluminium foil and PE (polythene) film. The laminate offers low water vapour penetration, superior strength and durability, puncture resistance, excellent printability, antistatic protection and heat sealing, the makers claim.

Wrap up the information at **Du Pont, PO Box 2086, St Kilda West, Vic 3182. ☎(03) 529 2033.**

Space saver cermet trimmers

A high performance single turn cermet potentiometer for pc board mounting, the VR 780 series, is 9.5 mm square and available in resistances from 10 Ω to 2M. They are rated at 0.5 W at 85° C.

The potentiometers have an exclusive metal glaze element ensures longer life and at the same time gives better resolution. The whole body has sealing that has recently been improved and O ring to stop contamination.

It is said to be ideal for wave soldering and immersion cleaning. The low profile construction with a body depth of 4.9 mm allows closer board spacing in all three configurations.

IRH Components has details. **32 Parramatta Rd, Lidcombe, NSW 2124. ☎ (02)648 5455.**

More technology, less hiss

Single-ended noise reduction technology embodied in dbx's 563X Silencer is said to be able to reduce or audibly eliminate constant hiss with little or no sacrifice of overtones.

It is simple and easy to use with a slider action that can reduce or audibly eliminate hiss with little or no sacrifice of treble overtones.

The 563X has one channel of one-step noise reduction, and in cleaning up programs over a continuous and unchanging hiss "floor" its sliding filter design is generally unobtrusive and effective, regardless of the hiss level.

Suggested applications include sound contractors to small bands, complex midi setups to recording studios, duplication processes and theatres with large PA audiences.

Amber Technology distributes the dbx Silencer in Australia and is found at **Unit B, 5 Skyline Pl., Frenchs Forest NSW 2086. ☎ (02)975 1211.**

More mini measurement books

Intuitive introductions to the sometimes complex subjects of theory and measurement techniques are linked to explanatory illustrations to give an excellent introduction for the non-specialist in three primers "Human Vibration", "Measuring Light" and "Measurement Microphones".

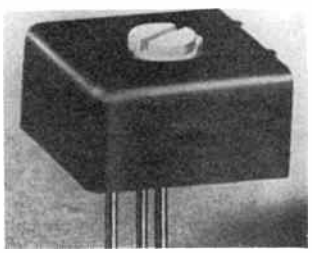
These add to a series said to be accessible and comprehensive with a pronounced educational slant, and which have become popular with a wide readership.

Human vibrations is the study of vibrations the body is exposed to, some detrimental, and therefore there is interest in measuring and analysing them.

The primer on measuring light has 34 pages answering basic questions and after an introduction on the nature of light, explains basic concepts of photometry.

Measurement Microphones introduces design features and operating principles of measurement microphones and explains technical jargon and specifications as well as the construction of the microphones.

Details from **Brüel & Kjaer's, PO Box 177, Terrey Hills NSW 2084. ☎ (02)450 2066.**



IRH's new cermet trimmers.

Fibre splicer

A micro fusion splicer which can splice single-or multi-mode fibres is said to be easy to use and inexpensive. It was designed to replace mechanical splicing on single mode fibres, and may be used on long lines for restoration work or for new installations on subscriber loop and corporate networks where single or multi mode fibres are involved.

The splicer is 147 x 100 x 40 mm and weighs 0.5 kg. This small size and weight are said to make the unit ideal for on-site use.

It reduces the cost of splicing, and with its own battery can give up to 100 splices between charges, the makers claim. All splices are said to show long term splice stability.

Splice into **Fanner-PLP, 150 Briens Rd, Northmead NSW 2152 ☎ (02)683 6388.**

Gould logic analyser

Design, debug and test in microprocessor applications are uses of the K115 logic analyser, which provides 32 or 64 channels at 20 MHz for state and timing in 8-, 16-and 32-bit applications. It has a direct link to either four or eight channels at 5 ns, or eight or 16 channels at 10 ns.

A software system "trace control" is said to eliminate the need for time consuming hardware reconfiguration, allowing change from state to timing by simple pushbutton control and linking to high speed for more precise timing measurements.

Through trace control the K115 records bugs to track complex problems with no time lost between levels.

An Auto Comparison feature makes logic analysis and testing more productive by comparing with the B memory for errors. The error may be held in memory or automatically transferred to the built-in disk drive. The B memory can be edited on-screen and a "help" button provides step-by-step operating instructions for the task being performed across the bottom of the screen.

The analyser has a comprehensive microprocessor analysis package (MAP) which simplifies setup and problem definition for disassembling major microprocessors, with a user-definable disassembler available for custom microprocessors.

A full 23 lines of data are available on the screen ands the built-

in disk drive provides automatic testing and saves data and set-up information, to save reprogramming repetitive tasks.

What is claimed as a unique noise margin analysis feature verifies circuit operation over a selectable range logic levels increasing test productivity significantly.

The unit can interface with an IBM PC with the Smartpak option.

The analyser comes in five modular configurations to expand easily as needed. Parameters, Centrecourt, **25 Paul St North, North Ryde NSW 2113 ☎ (02)888 8777.**

Programmable audio analyser

Virtually all the measurement capability needed for audio and telecommunications is combined in the Amber 5300 Programmable Audio Analyser.

It measures signal level with a wide choice of units, weighted and unweighted noise, narrow band level with a choice of bandwidths and total harmonic distortion.

The maker says its wide choice of measurement features enable it to satisfy almost any international standard of measuring noise.

A computer interface ensures the accuracy of units conversions in measurement values. An IEEE-488 GPIB interface is supplied as standard and a RS232 serial interface capability is optional.

A range of options, mostly field-installable, is available to enhance the basic performance.

More from **Amber Technology, PO Box 942, Brookvale NSW 2100 ☎ (02)975 1211.**

Smart monitor

A self-calibrating colour monitor is described as the first intelligent high resolution colour graphics display. Said to be based on a completely new concept in display technology, the calibrator is equipped with a microprocessor, memory and RS232 communications.

It reports its colour settings to a host computer, accepts commands for new settings from the host and calibrates itself in about two minutes with a colorimeter.

The monitor uses all-digital sweep and gain control circuits rather than analogue amplifiers and sawtooth oscillators. All setup parameters, such as colour drive, parabola, trapezium,sweep size, linearity, phase and frequency are microprocessor-controlled.

It can be seen as an answer to rendering colours accurately, in conditions of aging components, conflicting colour perceptions by operators, and varying illumination. Therefore it can store setup information for different operators in its memory.

It contains software to run its own calibration routines, where the software works out the changes to give true colour values. It can read ambient light and correct for it automatically.

The agent for the Barco Industries' "Calibrator" is **Trace Technology, 200 Rouse St, Port Melbourne Vic 3207 ☎ (03)646 5833.**

Opto sampling head

Said to be the first off-the-shelf instrument designed to work integrally with an oscilloscope to convert optical signals with bandwidths from dc to 6.4 GHz, the Tektronix S-42 optical sampling head is a fully calibrated instrument.

It can be used with any Tektronix 7000 series oscilloscope with a 7S12 or 7S11 sampling plug-in.

The head was designed for research, design and making of high speed optical components and systems. It is specifically designed for engineers using oscilloscopes in: measuring risetimes; modulation bandwidths, dynamic ranges and signal aberrations on LEDs, laser diodes and optical transmitter modules; characterising pulse dispersion in optical waveguides and fibres; inspecting digital optical pulses to ensure they meet FDDI, SONET and other communications standards; and capturing and characterising high speed signals.

The S-42 has a pulse response of 55 ps (full width, half maximum) with optical signal inputs of up to 25 mW peak and 5 mW average power.

The sampling head's 1000 to 1700 nm spectral response suits it for analysing telecommunications systems where optical signals at 1300 and 1550 are common.

Sight it at **Tektronix, 80 Waterloo Rd, North Ryde NSW 2113 ☎ (02)888 7066.**

Surface mount pc connectors

The Molex 71308 series of dual row straight pin header connectors is made with a breakaway style housing which is also stackable side to side and end to end on unbroken edges for surface mount application.

The new S-42 optical sampling head from Tektronix.

This allows the most flexibility for designing connectors.

The tin or selectively gold plated brass alloy pins are drawn from 0.64 mm² wire which provides a four sided smooth interface and mates with female connectors on 2.54 mm grid.

The 71395 series surface mount, vertical dual-row pc board connectors are designed for parallel and perpendicular board stacking and for pc board to harness and pc board to chassis connections.

These connectors mate with 2.54 mm grid male connectors and have tin or selectively gold plated phosphor bronze terminals.

Connect with **Utilux, 14 Commercial Rd, Kinsgrove, NSW 2208 ☎ (02)50 0155.**

New portable Tek CRO

Advanced built-in measurement automation and simplification features are claimed for the 2432A in the Tektronix 2400 series oscilloscopes.

This unit offers pushbutton setup, including on an unknown signal; pushbutton measurement and readouts; building and running measurement sequences; and pass/fail waveform testing, using a limits envelope.

Automation features such as these improve measurement repeatability and free skilled labour to perform more demanding tasks. They improve confidence in test and measurement results.

It allows full scope automation at the probe tip, so that all adjustments do not have to be made on the front panel. This feature delivers fingertip control, so saving time and simplifying measurements, says Tek.

Full details of the 2400 series from **Tektronix, 80 Waterloo Rd, North Ryde NSW 2113 ☎ (02)888 7066.**

Serial interface for video editors

The VSA 24 serial interface unit was developed specifically to interface the Soundcraft Series 200BVE audio editing console to almost any video editor or switcher on the market.

Originally designed to interface with a Sony BVE900 editor, the 200BVE already offers a parallel interface capability to a Sony 9000 editor as well as Convergence and Calloway systems.

The design of the VSA 24 allows the 200BVE to match crossfades between the mixer and video machines, providing true "audio follow video", and also to control audio effects quite independently from the video editor.

By eavesdropping on the communication links between the editor and the vision mixer, the VSA 24, in the standard AUTO mode, will listen for any editor commands and follow them using the editor's start point and fade rate information, allowing the audio from the two video machines to crossfade at exactly the same time as the video.

Each VSA 24 unit in AUTO mode will respond to crossfade information from up to eight video source machines, with additional units allowing a larger mixer to track up to 24 machines.

For independent audio crossfades there are three Fade Law patterns available: linear, logarithmic or offset linear. Each can be set up and fired for any two of 24 channels by using either the MANUAL mode, giving a rotary-controlled crossfade, or the LOCAL mode for a crossfade rate determined by a fade time switch block.

The third option of using the EXTERNAL switch allows a trigger input behind the unit to begin a crossfade, as well as the rate's being determined by the Fade Time switch block.

Three front panel settings allow the user to choose FROM and TO channel numbers as well as a crossfade rate between the two.

Each of the "manual" modes will drive up to 24 channels on a 200BVE, with the STEREO control linking the desk channel in pairs. The unit is 19" rack mount and takes up one unit of rack space.

Fade up to **Jands, 578 Princes Hwy, St Peters NSW 2044 ☎ (02)516 3622.**

Shielded interconnectors

Said to have significantly changed technology over existing shielded connectors, the Molex Semcon Shielded Electro Magnetic-Compatible plug and receptacle interconnection system for rounded and flat cable is a new style 1/0 connector.

The patented two piece Molex SEMCONN System is fully shielded against EMI/RFI for high speed data busing.

The high data rates of information which the programmable keyboards on pcs are capable of transmitting and receiving, so-called "enhanced" keyboards, now on the IBM and Compaq ranges, mean that with these shielded connectors the user can connect and disconnect the cable while maintaining interconnection integrity.

The connectors are designed to have a low insertion/extraction effort, and to maintain the interconnection integrity when used in low signal data lines, have 50 µinches of selective gold plate in the contact area. **Utilux, Kingsgrove NSW 2208 ☎ (02)50 0155.**

Calculator line expands

Three scientific calculators broaden Hewlett Packard's line for students. The HP-20S and HP-22S add to HP's algebraic-entry calculators, while the HP-32S is designed for students who prefer RPN (reverse Polish notation) machines.

RPN is HP's traditional entry system that makes calculating and programming easier by requiring fewer keystrokes than algebraic entry.

Recommended retail prices (tax free) of the calculators are: HP-20S, $82; HP-22S, $105; and HP-32S, $123.

By using common parts placed with robots, the new models are built on one production line, saving manufacturing space. It also increases quality by relieving staff from repetitive tasks.

New, denser ICs allow more features in the calculators. The plastic cases and keys are produced with the latest technology, four colour, plastic moulding techniques.

The colours are injected into the mould together, and the keys and feet are moulded at the same time as part of the case. The parts do not have to be moulded separately and assembled later.

HP is offering two optional companion books with keystrokes to solve common problems in specific topics: Science Student Applications for the HP-22S; and Engineering Applications for the HP-32S. **Hewlett-Packard, 31-41 Joseph St, Blackburn, Vic 3130 ☎ (03)895 2895.**

Hewlett Packard broadens its calculator range with three new scientific calculators.

Broadcast mixer

Said to be tailor made for broadcasting: the Stereomixer is for public affairs, talk shows, music and commercial dubbing, remote broadcasts, auxiliary production, on-air and even stereo news.

The mainframe housing uses less than 18 cm of rack space, or can come with hardwood panels for desktop use.

The designers, Pacific Recorders, created four separate input modules for all conceivable requirements. Also, accessory modules can be accommodated.

All eight positions in the mainframe are universal, accepting any combination of input and accessory modules.

Despite its compact design, the Stereomaster has regular sized control knobs and buttons.

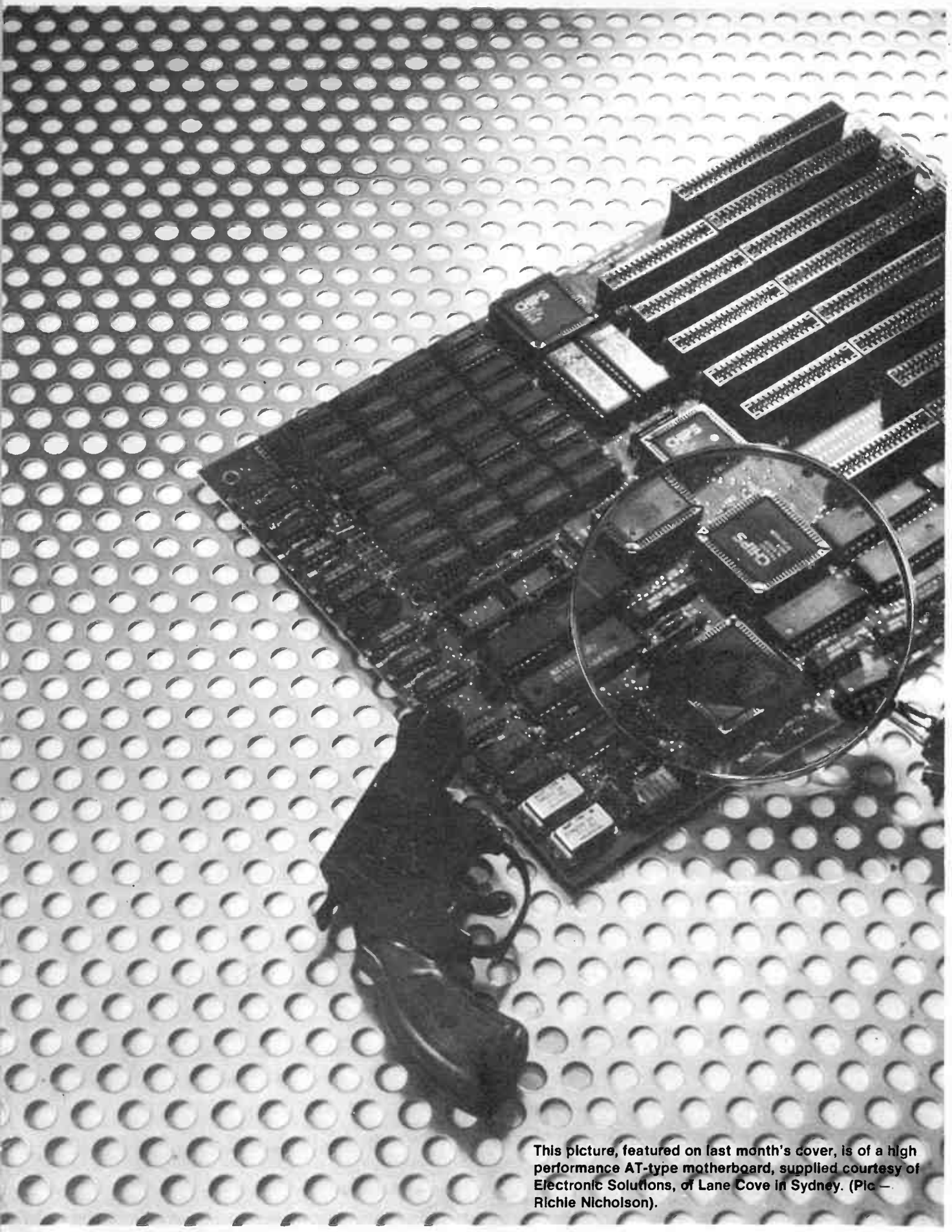
Mix it with the agent, **Amber Technology, PO Box 942, Brookvale NSW 2100 ☎ (02)975 1211.**

Mentor for AWA defence

AWA Defence and Aerospace's factory at North Ryde, Sydney, has installed 24 CAD workstations from US electronic automation designer Mentor Graphics.

The $1.3M order followed a year's selection process when four workstations were tried by AWA. The Mentor Graphics workstations had advanced design, ability to create large technical documents, and the company has local support services.

The systems will first be used for the Nulka ship defence system, and the Jindalee Over The Horizon Radar. They will also be used on AWA's local area network (LAN) project, which is already working with the NSW Police Communications Centre, and the advanced fibre optics communication system (AWA FOCS) designed for the army.



This picture, featured on last month's cover, is of a high performance AT-type motherboard, supplied courtesy of Electronic Solutions, of Lane Cove in Sydney. (Pic — Richie Nicholson).

Introduction to troubleshooting personal computers and other microprocessor equipment

Part 2

Graeme Teesdale

In servicing analogue electronics, we often need a signal generator. In microprocessor systems, you've got one built in - the microprocessor!

ONE OF THE FIRST dynamic checks that can be made in a ROM-based microprocessor system is a software check using a *checksum calculator*. On power-up, some systems complete a checksum calculation on the ROMs and check the result against a value stored in the memory, or display the answer on an LED or LCD display or VDU. If an error results, the system should fail power-up tests.

Most ROMs are in fact EPROMs. As these are a charged gate arrangement programmed for logic '0', in time (a number of years) the charge will return to the substrate or channel level resulting in a logic '1' at that memory location instead of a logic '0'. Thus, the original checksum will be changed.

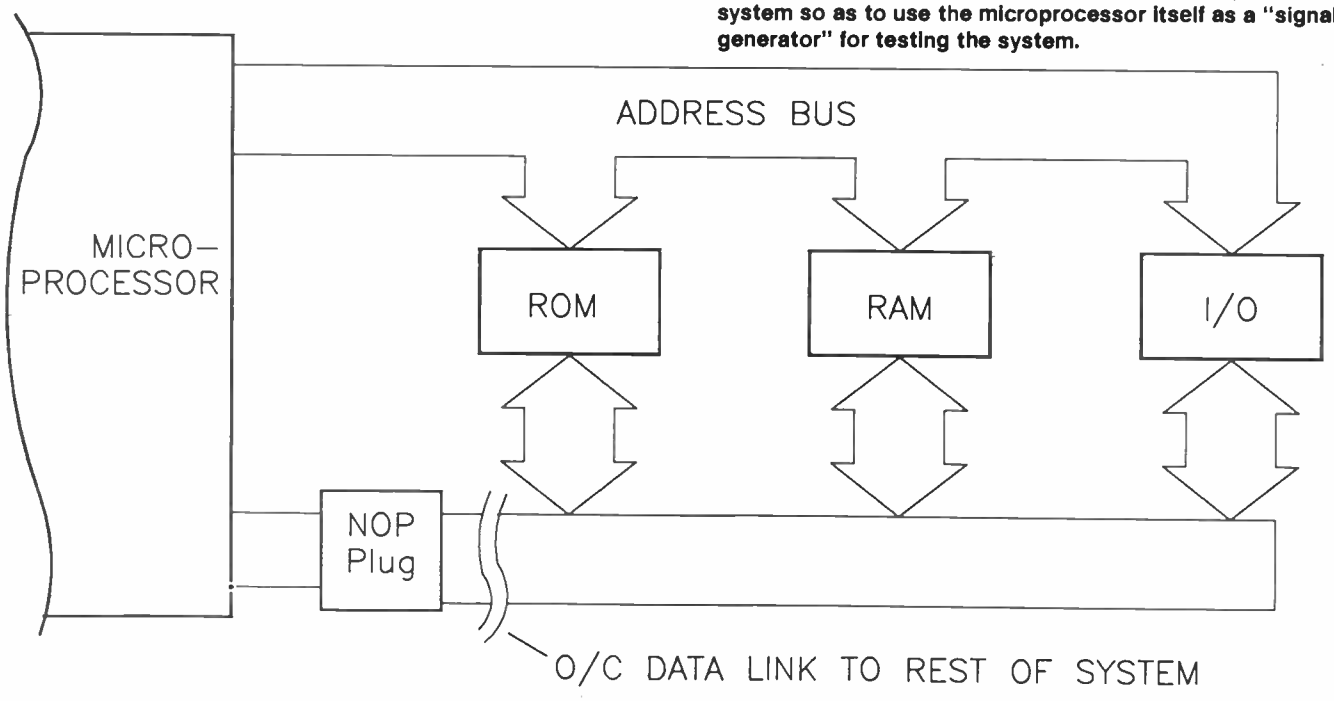
The output from a Checksum Calculator is in the form of a two or four digit hexadecimal (hex) number. *What is a Checksum Calculation?* Generally the '1's' are totalised up to make a decimal or hex number. Two digit checksums which carry no rollover are not always totally reliable. They detect single error bits OK, but multiple errors may provide the correct checksum.

It is good practice to make copies of EPROMs as backups in the same way as it is necessary to backup on disk-based systems. EPROMs can be compared to find the faulty location, and it is often only necessary to re-burn to cure the faulty location. Most EPROM burners have checksum calculators as part of their functions and often, EPROMs have the checksum printed on the label covering the window. If the EPROM checksum compares with the number printed on the label, we must try other approaches to locate the problem.

Using the CPU as a signal generator

Debugging a microprocessor-based system at real-time speeds can be extremely difficult when equipment is limited and static ▷

Figure 14. Installing a NOP instruction in a microprocessor system so as to use the microprocessor itself as a "signal generator" for testing the system.



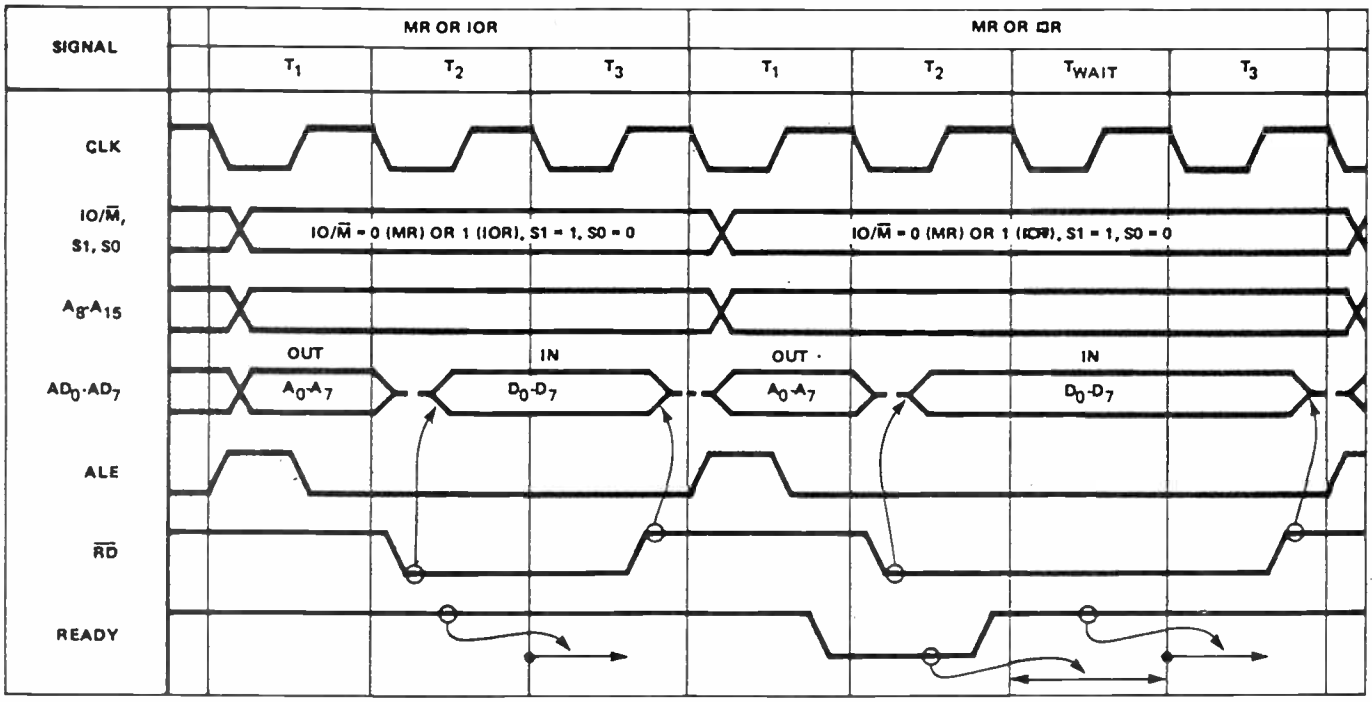


Figure 15. Timing cycle of the 8085, important when applying the NOP instruction to an 8085-based system.

tests yield no faults. A simple way is to break the microprocessor loop by isolating the CPU from its software or removing it completely and driving the rest of the system from a "simulator box". Where the CPU is soldered into the pc board, cycle stealing or Bus tri-state can be used. An example is using the Hold or tristate line to disable the CPU from the rest of the I/O and memory system.

Every microprocessor instruction set contains a No Operation (NOP) instruction. This instruction causes the CPU to complete a memory fetch cycle, no execute cycle and increment the program counter. If every time the CPU carried out a memory fetch cycle it obtained a NOP instruction the address bus would continue to increment from 0000H to FFFFH, roll over and repeat. (H — stands for "hexadecimal", hex for short; the arithmetic notation commonly used for microprocessor systems).

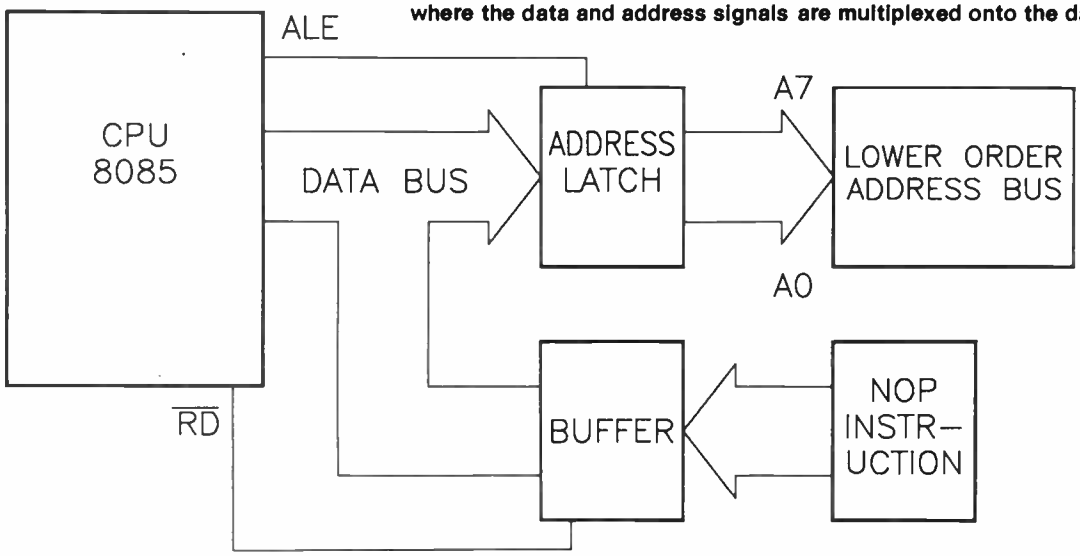
In essence, the CPU has been turned into a signal generator. Using the CPU as a signal generator allows the checking of a number of hardware devices, like the address decoder for example. The address decoder outputs can be checked as the address bus increments through the memory map, something which is extremely difficult to check when the system software is running at real-time speed. It also allows checking of address lines, demultiplexing of the data bus if it is used and some control lines around the pc board. For example, read/write shorts to ground and adjacent lines or open circuits can be detected more readily using an oscilloscope or logic analyser.

Installing the NOP instruction

In microprocessor systems not using a multiplexed address/data bus the CPU can be removed and an adaptor board added in which the microprocessor chip is re-inserted. The data bus is isolated from the system data bus and strapped to achieve the NOP instruction. For example, with Motorola processors it's 01H. The technique is illustrated in Figure 14

To implement this with the microprocessor having a multiplexed data bus, such as the Intel 8085, is slightly more complex. The data bus lower order address lines need to be connected to the system bus during the T1 part of the timing

Figure 16. Block diagram of how a NOP instruction is applied to an 8085-based system, where the data and address signals are multiplexed onto the data bus.



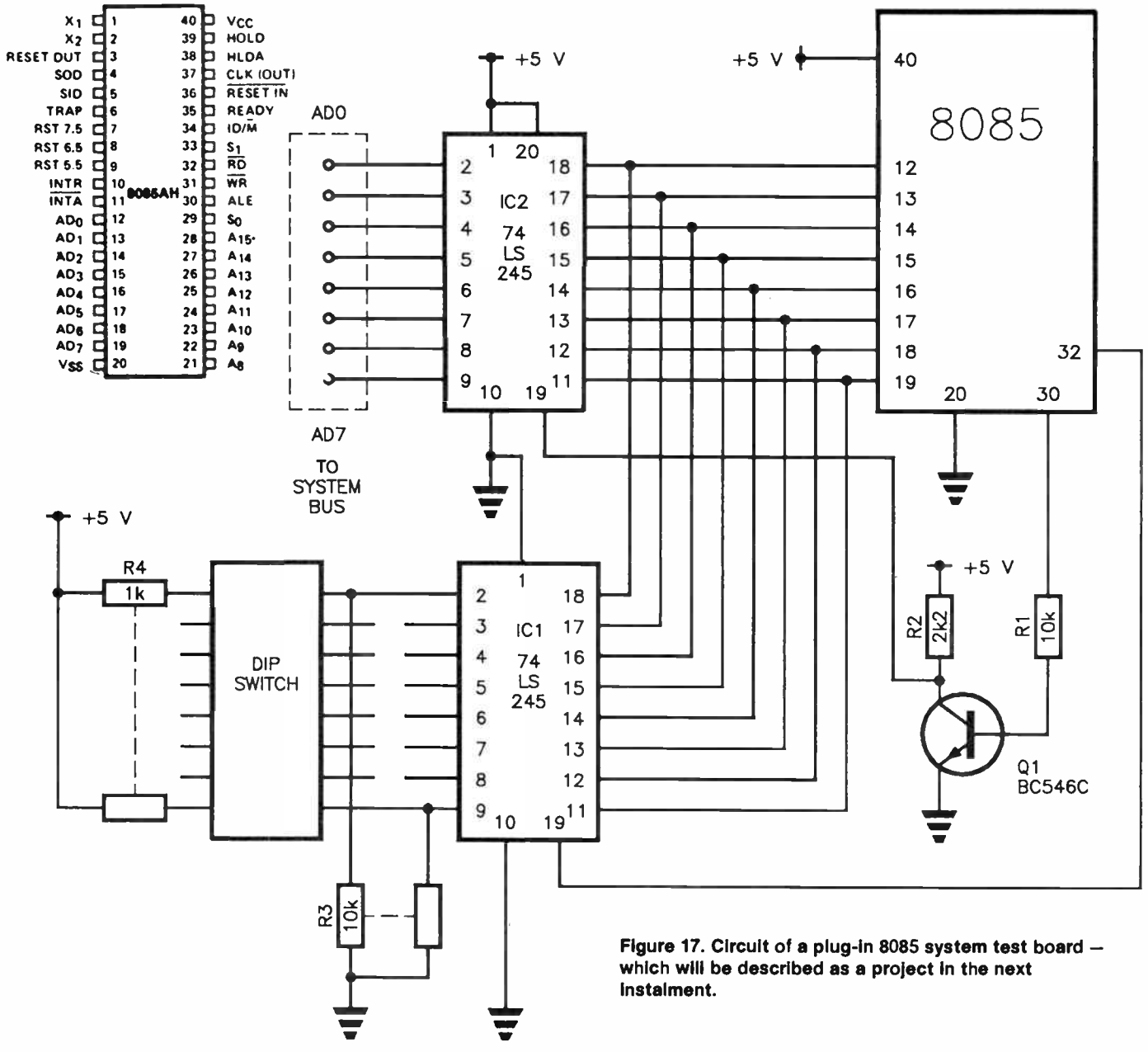


Figure 17. Circuit of a plug-in 8085 system test board — which will be described as a project in the next instalment.

cycle (see Figure 15), but isolated on the memory or I/O read or write cycle.

When isolated, the microprocessor data bus will contain the necessary NOP instruction. The block diagram in Figure 16 shows how the NOP is applied to the 8085 microprocessor.

After a master RESET, the first cycle is an instruction fetch cycle. Firstly, during the T1 period the address buffer is enabled by ALE allowing the lower order address information on to the address demultiplexer on the main data bus. The next two periods, T2, T3 and RD (Figure 14) are strobed low by the CPU. A second buffer is enabled by placing the NOP instruction on the 8085 data bus. During this time, the 8085 is isolated by the first buffer from the main bus. The cycle continues to repeat, incrementing the address bus. Figure 17 shows a practical circuit for a plug-in test board, the construction of which will be described in the next instalment.

How the circuit works

The 8085 in the system under test is removed from it's socket and inserted into the test board socket. A 40-way cable with a DIP header plug on each end links the test board to the now-empty 8085 socket on the system under test.

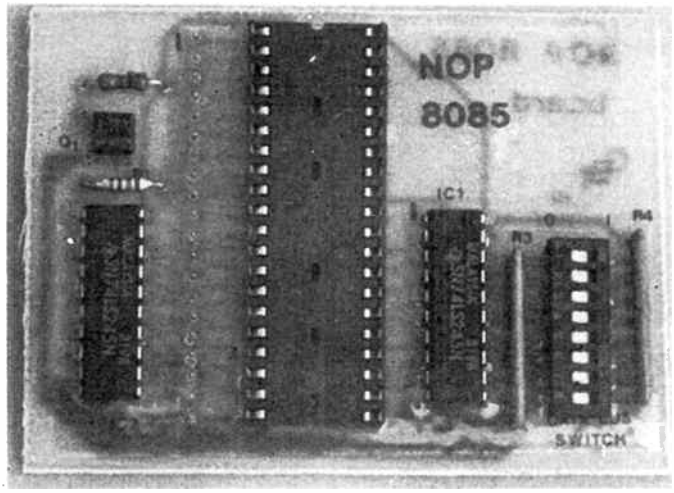
The first bi-directional buffer, IC2 — a 74HCT245, has a fixed direction by hard wiring pin 1 (the direction pin) to +5 V. The output enable (tri-state) pin (19) is connected to the output of a transistor inverter. It is necessary to use a transistor to invert the normally active-high ALE pulse from the 8085. (See Figure 15).

During the first timing cycle of the 8085 (T1), when ALE (pin 32) is high, pin 19 of IC2 is low, connecting the AD0 — AD7 (low order address lines) to the main board data bus.

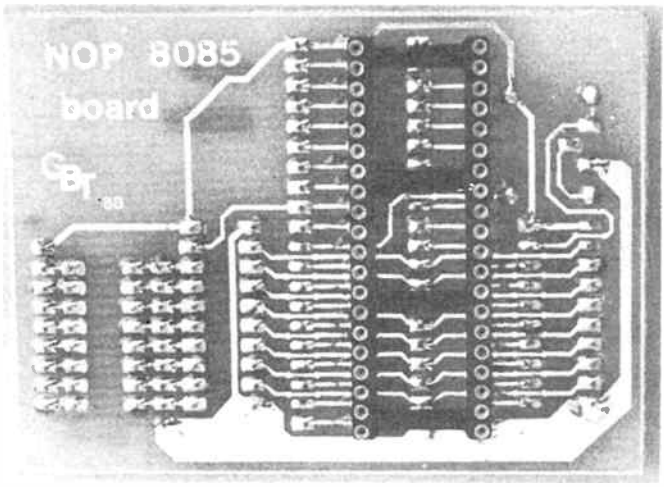
During the following two cycles, T2 and T3, pin 30 of the 8085 (RD) is low allowing the second bi-directional buffer, IC1 - also hard wired in one direction (pin 1 to 0 V) to place the settings of the DIP switch onto the 8085 data bus. The pull-up and pull-down resistors allow the use of a single changeover DIP switch package which may not be a break-before-make type.

The input to IC1 (the "read" buffer) is from switches as this allows you to change from a NOP instruction to, for example, a PORT OUTPUT instruction, such as D3H. The cycle for this instruction contains a Memory Fetch, Memory Read and I/O Execute cycle. As a result of this instruction, the following control lines are active: RD, WR, IO/m, and the state code lines S1 and S0.

In this way, the number of "signal generator" outputs has ▷



Topside view of the 8085 plug-in test board. The 8085 is removed from the system under test and placed in the socket you see hear. The DIP switch at right allows the instruction to be altered from NOP to other useful instructions, such as "port output" (D3H). The board measures 80 x 55 mm.



Trackside view of the 8085 plug-in test board. The socket here permits connection of a DIP-header cable linking the test board to the 8085 socket on the system under test.

been increased. The short (in relation to clock cycles) repetitive pattern allows the use of an oscilloscope to trace the address and control lines around the board which is being tested. Under normal program conditions the non-repetitive nature of most control lines makes it very difficult with a 'scope to check for shorts between lines and other faults. Under such conditions all one can say is that activity is happening.

This test board can easily be changed to suit other types of microprocessors. The NOP, or similar instructions, only test the sequential nature of the microprocessor and exercise certain control lines. To test the memory and I/O devices, other techniques are required. I'll explore these in the next instalment, describing another "tool" you can build yourself.

"Reading" your oscilloscope

Roger Harrison

Part 2

Taking measurements of a signal's characteristics and deriving other parameters from these is a very important application of a 'scope. There are quite a few 'tricks' you can turn with your instrument, to reveal many things about a waveform and consequently about a circuit's performance.

KNOWING just a few basic parameters of a sine wave, having read their values with your 'scope, there are many more of its parameters you can derive. Knowing the peak amplitude, or the peak-to-peak amplitude, having read it directly from the graticule, you can readily calculate the RMS and the average values. The various relationships between the average, peak and RMS parameters of a sine wave, and how to derive each from the others, is illustrated in the accompanying table.

Using this table, you can generate a range of *derived* measurements of amplitude parameters from the *direct* measurements taken from your 'scope graticule. Using this table, you can check your derived measurement by working back through the relationship. e.g: for a 100 V peak sine wave, the *overoge* value is 63.7 V. To get back to the peak value, the table says to multiply 63.7 by 1.570, which yields 100.01 V (to two decimal places accuracy). Note also that frequency is a derived value taken from a period measurement.

Taking your pulses

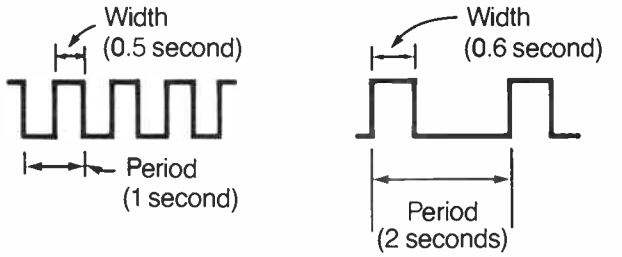
The parameters of a pulse can be important in many different applications, including digital circuitry, radar, video circuitry and data communications equipment. Apart from period and amplitude, important pulse specifications include repetition rate, the duty cycle or duty factor, transition times on the rising and falling edges, overshoot, etc.

This table shows the relationship between the various parameters of a sine wave and how to calculate derived values from direct measurements. Note the inclusion of conversion values applicable to rectifiers (capacitor input type).

CALCULATING WAVEFORM PARAMETERS

To Calculate This Amplitude	Multiply This Known Value	By This Conversion Factor
RMS	AVG	1.110[a]
		2.220[b]
	PEAK	0.707
	P-P	0.354
AVG	RMS	0.900[a]
		0.450[b]
	PEAK	0.637
	P-P	0.318
PEAK	RMS	1.414
	AVG	1.570
	P-P	0.500
P-P	RMS	2.828
	AVG	3.140
	PEAK	2.000

[a] For full-wave rectification
[b] For half-wave rectification



Width/Period × 100 = N%
Duty Cycle = 50%

Duty Factor = 0.3
Duty Cycle = 30%
Repetition Rate = 0.5 per second

These idealised waveforms show how various pulse waveform parameters are derived, and the relationship between them.

Firstly, the *repetition rote* is how often a pulse occurs and is the term used instead of frequency. It is readily derived from the reciprocal of the period between successive pulses —

$$\text{repetition rate} = 1/\text{period}$$

Repetition rate is quoted in *pulses per second.* So, if the period is in milliseconds, the repetition rate is quoted in thousands of pulses per second; if the period is in seconds, it's in pulses per second. For example, in the accompanying illustration, the period between pulses on the waveform at the right is two seconds, so the repetition rate is 0.5 pulses per second.

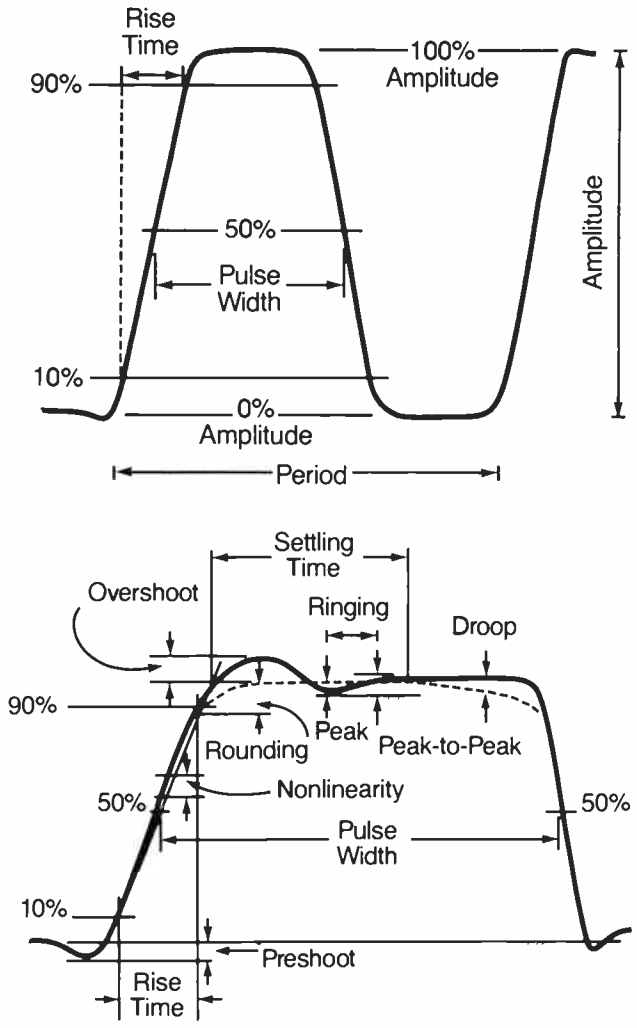
Duty cycle is expressed as the *rotio of pulse width to signol period,* expressed as a percentage. For true square waves, the duty cycle is always 50%, as you can see from the waveform at the left in the accompanying illustration. For the rectangular waveform at the right, the duty cycle is —

$$(0.6 \div 2) \times 100 = 30\%$$

Duty factor is another way of expressing duty cycle, but *os o decimol.* Again, using the same illustration, the duty factor of the left hand waveform is 0.5 (square wave), while for the signal on the right, it's 0.3.

Mark-to-space ratio is a measure of the pulse width to the period *between* the pulses. For square waves, it's always 1:1. For the signal on the right in the illustration, it's 0.6-to-1.4, or 3:7.

All of the foregoing are parameters of the pulse train, what of the parameters of a pulse alone? Any pulse is *never* perfectly ▷



Showing how the various primary and secondary parameters of pulse waveforms are measured. Note that not all of the characteristics shown here will necessarily be present on all pulse waveforms.

rectangular. The three primary characteristics of a pulse waveform are: *amplitude, rise time* and *pulse width. The amplitude is measured from the 0% to the 100% points of the pulse. Rise time is measured on the leading edge of a positive-going transition, between the 10% and the 90% points. Fall time is measured the same way, only on a negative-going transition. Pulse width is measured between the 50% amplitude, or trace displacement, points.*

Note that, with the oscilloscope Y amplifier set for direct coupled (dc) input, any displacement of the base of the pulse above or below the trace reference level represents a dc offset. That is, if for example, the base of the pulse rose one minor graticule division while the attenuator was set at 10 V/div, the dc offset would be +1 V.

There are another eight parameters that can be measured to fully describe the characteristics of a pulse waveform, as shown in the drawing here. *Preshoot* is a change of amplitude in the opposite direction that precedes the rising edge of the pulse. *Overshoot* and *rounding* are changes that occur after the initial transition. *Ringing* is a series of amplitude changes — usually in the form of a damped sine wave — along the top of a pulse, generally following the leading corner. All of these are expressed as a percentage of amplitude.

Settling time expresses how long it takes the pulse to stabilise at its (average) maximum amplitude. *Droop* is a decrease in amplitude of the top of a pulse over time, usually seen just before the negative-going edge of the pulse. *Non-linearity* is any deviation of the rising or falling edges of the pulse from a straight line drawn through the 10% and 90% amplitude points.

Measurement tips

When measuring time or amplitude parameters of a waveform, there are a few techniques you should learn to make the task easier and more accurate.

Time measurements are best made using the centre graticule line. When taking time related measurements on a single cycle of a waveform, the vertical amplitude and horizontal width controls should be adjusted to obtain a conveniently large display, occupying as much of the screen as possible.

For period or pulse width measurements, the Y amplifier should be ac-coupled to centre the trace about the horizontal centre graticule line; remember, pulse width measurements must be made at the 50% amplitude point. When looking at a single pulse, for best accuracy it should occupy as much of the screen width as possible. When measuring the period of a waveform, it is best to display a number of cycles across the screen, as detailed at the end of Part 1. Note that, in time measurements, the sweep must be calibrated, but the Y amplifier may be uncalibrated, so you can use your variable sensitivity control to set the trace amplitude on-screen.

For absolute amplitude measurements, the trace should occupy as much of the screen height as possible. The Y amplifier must be calibrated, but the sweep may be uncalibrated. Use the horizontal position control to position the trace about the centre vertical graticule line.

For relative amplitude measurements, such as rise time, overshoot, droop etc on pulse waveforms, the sweep must be calibrated but the Y amplifier can be uncalibrated. Note that the Y amp should be ac-coupled. Use the trace position and vertical sensitivity controls to place the pulse bottom and top on the 0% and 100% vertical graticule marks, if your 'scope has them. Otherwise, work out suitable vertical scale positions and adjust the controls to suit. Your horizontal position control can then be used to position the waveform so that it crosses a vertical graticule line at the 10% marking. This allows rise time and other related parameters to be easily and accurately read off the graticule.

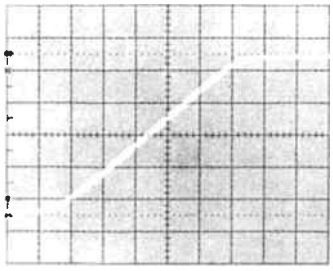
Rise time is then related to the graticule markings and the sweep rate control setting. Say the sweep is set at 10 µs/div and there are seven minor graticule divisions horizontally between the 10% and 90% points on the trace. The rise time is thus seven microsesonds.

To make sure your trace is properly centred, switch the Y input coupling to GND before making a measurement and centre the sweep baseline if necessary.

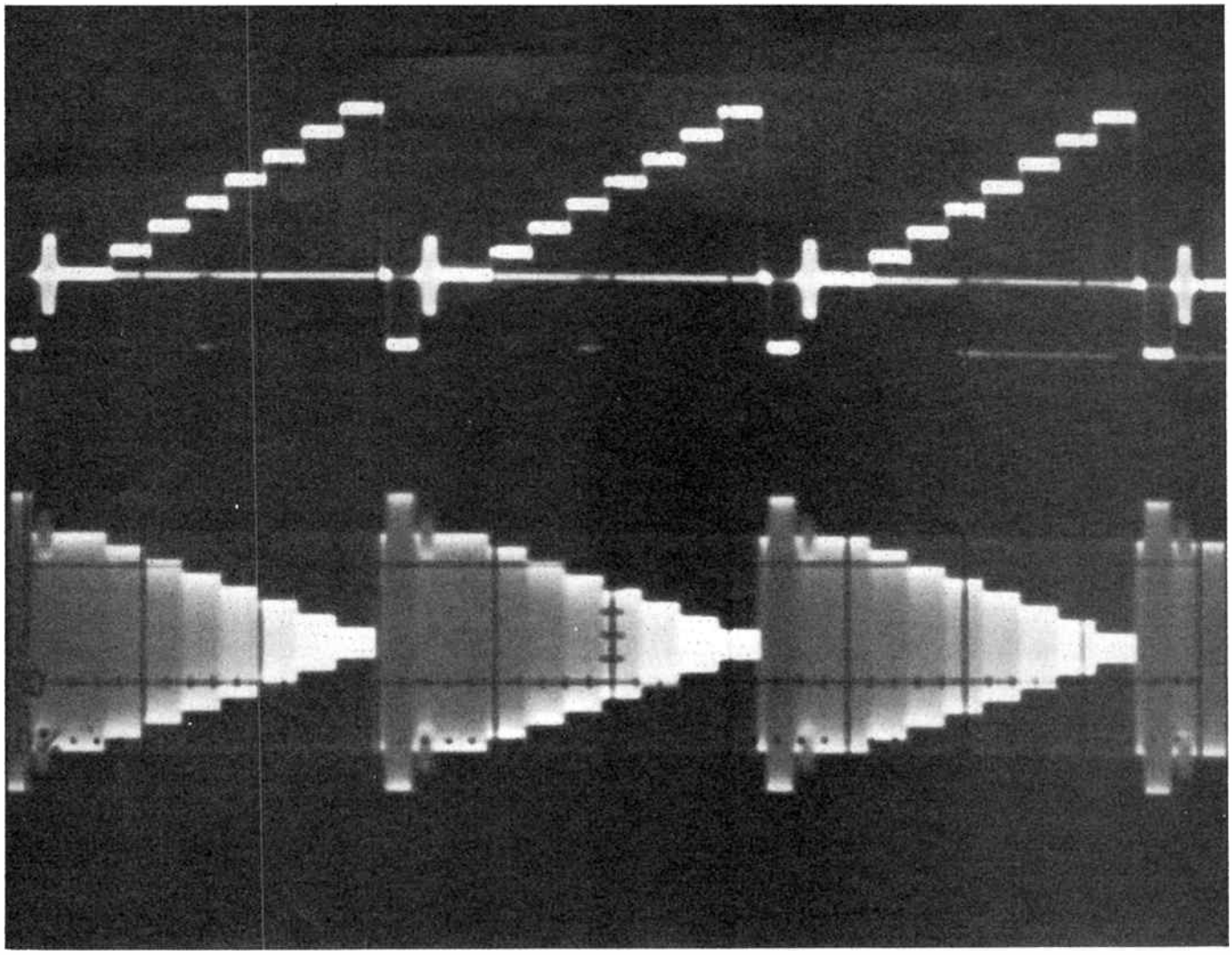
Triggering controls can play an important part in making these measurements. If your 'scope has the facility, use AUTO triggering on the positive slope and no triggering delay, then adjust the trigger level control to get as much of the leading edge of the waveform as possible on screen.

Video viewing

The PAL composite video waveform comprises two fields, each containing 312½ lines, the two fields being "interlaced" on the screen of the TV set or video monitor. many oscilloscopes offer



Lining-up a pulse waveform for rise time measurement. The bottom and top are set on the 0% and 100% graticule marks and the waveform positioned horizontally so that it crosses a vertical graticule at the 10% marking.



"TV triggering", to simplify viewing video signals. Some 'scopes will only allow triggering on the field frequency at some sweep speeds and triggering on the line frequency at others. However, many of today's instruments provide both triggering facilities at any sweep speed.

Your 'scope's triggering controls will feature a TV FIELD and a TV LINE trigger mode selection. The FIELD mode will allow the instrument to trigger at the field rate of the composite video signal, on either field 1 or field 2. Since the triggering circuitry cannot distinguish between the two fields, it will trigger alternately on the successive fields and the display will be confusing if you look at one line at a time.

To prevent this, use the 'scope's HOLDOFF control to add more holdoff so that the sweep triggers on every second field. With a dual-channel 'scope, you can switch the VERTICAL MODE to display BOTH channels. This will make the total holdoff time for one channel greater than one field period. Then you can use the other channel's position control to put the display off-screen to avoid confusion.

It is also important to select the trigger slope that corresponds to the edge of the waveform where the video synchronisation (sync) pulses are located. Picking a negative slope for triggering on TV or video sync signals will show as many sync pulses as possible.

To display the line portion of the composite video signal, use the TV LINE trigger mode. You can obtain a stable display by triggering on the horizontal sync pulses. It is usually best to select the blanking level of the sync waveform so that the vertical field rate will not cause double triggering, producing a confused display.

Note that the video signals produced by many of today's personal computers do not correspond to the frame and line frequencies of the PAL TV and video standard, so the above techniques do not apply in this field.

Well, that wraps up this basic guide to "reading" your oscilloscope. Display and measurement techniques involving multi-channel displays, X-Y and Z axis measurements, etc are another step above basic instrument techniques and are best left for another article and another time!

We gratefully acknowledge the assistance of Tektronix Australia for supplying material used in the preparation of this feature.

Meet the mixing desk

Robert Azzopardi

The signal has made its way from the stage and arrives at the next point in the signal chain: the mixing desk.

MIXING DESKS come in a wide variety of sizes, features, prices and abilities to inflict hernias. (You can lift a *Tapco Entertainer* 10-channel desk with one hand, a Yamaha 32-channel desks accommodates several roadies in extreme discomfort!) Despite all of this, the fundamentals are the same and perhaps the best approach is to have a general anatomy lesson.

Figure 1 shows the general layout of one channel of a mixer panel, at left, its corresponding input panel (typically on the rear apron of the desk), at top right. Starting from the top: First comes the *input*. This can be a 3-pin XLR or phono jack (for "line signals") or both. Insert points (the lower socket) will be discussed later. *Phantom power* typically supplies +48 V on pins 2 and 3 with pin 1 ground, for powering DIS and condenser microphones. Set this little switch accordingly.

At the very top of the channel panel are the MIC/LINE and PAD switches. The first of these selects either microphone-or a line-level signal path. The 20 dB pad provides attenuation to "tame" high level signals fed in from DI's (e.g: a synthesiser) or microphones (e.g: a drum signal).

The input GAIN control varies the amount of signal allowed into that channel on the desk. On some desks, a PHASE REVERSE switch is fitted. This reverses the signal polarity on one line in situations where there are two mics on one particular instrument and you are experiencing problems with signal cancellation.

The classic case is when miking a snare drum top and bottom. One mic picks up compression waves, the other rarefactions - the summed signal may, as a result, suffer phase cancellation (i.e: it might sound like a sheep sneezing which may or may not be the sound you're after!). Changing the microphones' phase with respect to each other can make a big difference.

Next in line is the EQUALISATION , or "ee — kew" (EQ), section. This can vary from simple LOW and HIGH controls to what may seem a bewildering arrangement of quasiparametric controls; LO — MID — HIGH controls could be described as the basics. Typically, the low and high sections are of the "shelving" type, while the mid frequencies are controlled by a "peaking" type circuit.

What is "shelving"? In the case of the HIGH control, for example, everything above say 5 kHz is boosted or cut by the appropriate amount (see Figure 2). Similarly, for bass, everything below 100 Hz will be cut or boosted appropriately.

In the case of "peaking" circuits, a band around a centre frequency is either cut or boosted. For example, a centre frequency of say 3 kHz may be chosen for "high mids".

A variation on this theme is the "Quasiparametric Eq". Here, one control picks the centre frequency while the other does the cutting/boosting. On some Mega $ desks "Q" (sharpness of the peak, in crude terms) can also be varied. As an example, take the EQ section of a Soundtracs M-series desk in Figure 4.

The EQ BYPASS switch is another fancy, but useful, option. Does taking all the

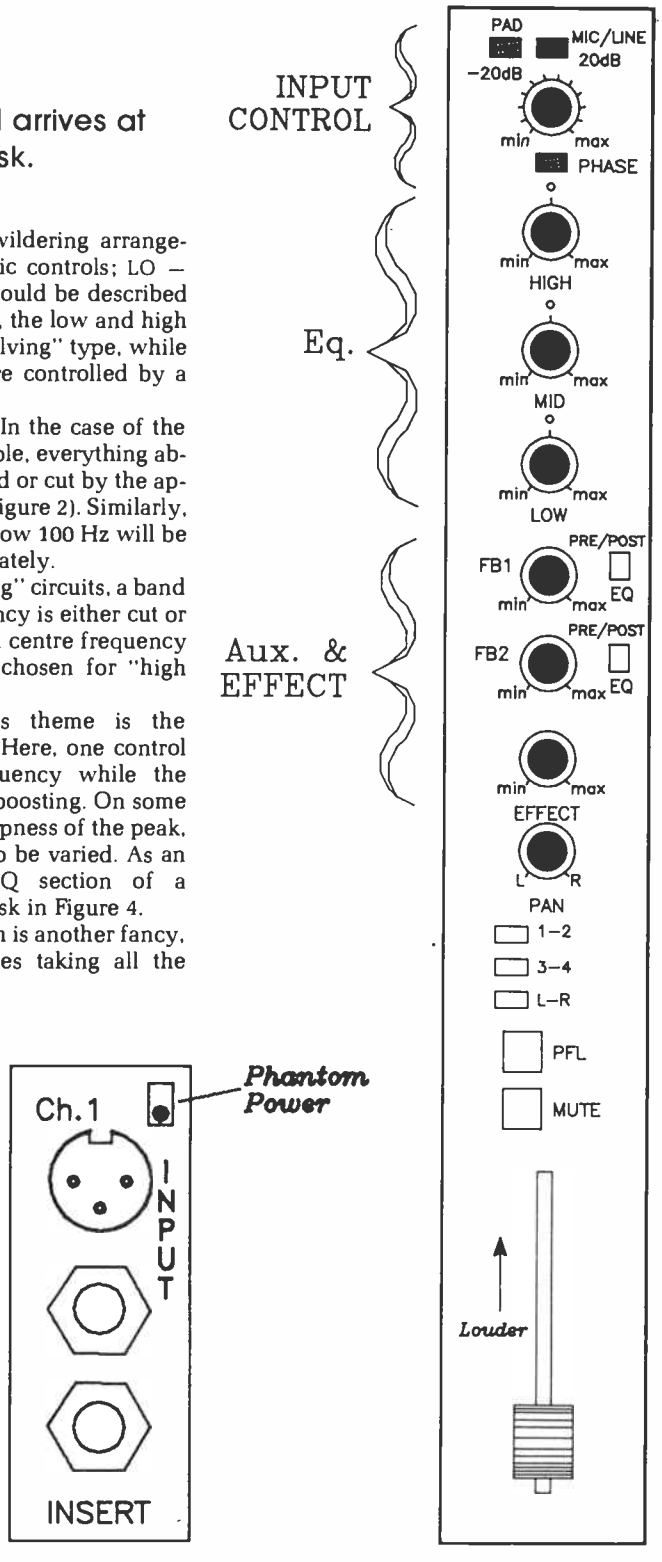


Figure 1. Typical control panel of one input channel on a mixing desk. Your typical input socket panel is shown at right.

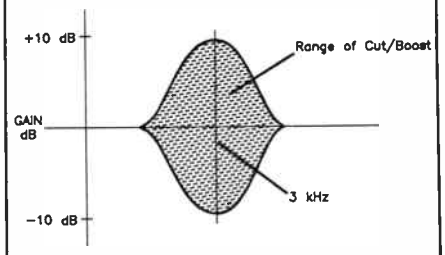


Figure 2. "Shelving" EQ, typical response.

mids out of the singer's voice help mask the fact that they really can't sing? Well, this switch will help you decide.

Insert points

Now is probably a good time to delve into the mysteries of insert points. You have a problem! The drum kit is close-miked with one mic per item. However, the tom mic keeps picking up the snare and so

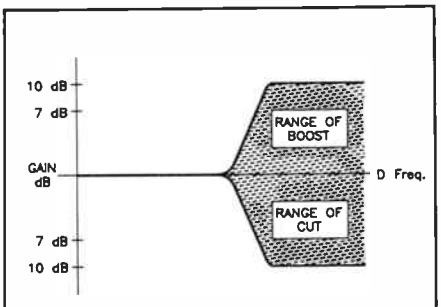


Figure 3. "Peaking" EQ, typical response.

forth, with the result it all gets a bit blurred and sounds nothing like Phil Collins on *Face Value*. (This is, of course, ignoring the facts that the drummer has not changed his skins for two years, and has a snare drum virtually obscured by beer coasters and gaffer tape!)

Part of the remedy is a *noise gate*. This is, in essence, a level activated switch — when the signal input reaches a certain threshold, the gate "opens up" and allows the signal through. When the signal level drops below the threshold the gate "closes". By setting the threshold control appropriately, "spill" (or any other noise) can be minimised. The trade-off is, you do lose a small amount of your wanted signal during gating.

The insert point allows an *effects device*, such as a noise gate, to be patched into the signal chain of an individual channel. The insert point is usually after the equalisation stage — "post EQ."

An insert lead is shown in Figure 5. Typically, insert leads are not labelled so, to identify which is which, the alternatives are either to "buzz" them with a meter (continuity test) or else find the right one by trial and error. Either way is easy.

AUXILIARY SENDS tap off a portion of the signal from the channel for monitoring purposes. Usually, two foldback sends are found on an average desk. Some desks allow auxiliaries to provide signal from either before or after the equalisation section. Auxiliaries may also be post fader (that is, the channel fader has to be up for them to operate).

EFFECTS SEND is another auxiliary, used for mixing-in an amount of signal from an external effects processor (e.g: a reverb or digital delay). Some "cheaper" desks have a built-in spring reverb as the "effect" control varies the amount of reverb mixed in. New desks now have built-in digital reverb. Technology catches up very quickly!

Using the PAN control (analogous to BALANCE in a stereo), the channel can either be assigned to a subgroup or directly to left/right outputs. For example, your drum channels can all be assigned to one subgroup, enabling the overall level of the drum kit to be varied without touching the individual channels. Similarly, vocals can be assigned to another subgroup, and so on. The subgroups are then fed into the master output.

PFL stands for *pre-fader listen* and allows you to monitor individual channels through the headphone output of the desk. The channel fader does not have to be up for this to operate (as the name implies). On some desks this is called SOLO.

MUTE shuts off the channel — very useful when the bass players' harmonies just aren't happening. This is normally post fader.

FADER — the *louder* control! Ideally, faders should be silky smooth in operation. Unfortunately, they also have an unbelievable affinity for cigarette ash and Bourbon and Coke (Bourbon and Coke is a very common injury in Rock and Roll - the "no-drinks" signs commonly plastered on mixing desks are there for a very good reason! They may only be ignored by roadies and the sound engineer's girlfriend!)

The more expensive desks have faders which have their tracks and contacts vertically mounted and these fare much better than their poorer, horizontal cousins. Contact sprays alleviate the problems, but in the long term can make matters worse because of the lubricants which they may contain (these eventually act as a base for "grunge" to collect on).

The output section

The output section of the desk consists of the *subgroups* and the *master*. Subgroups may have individual EQ facilities, as well

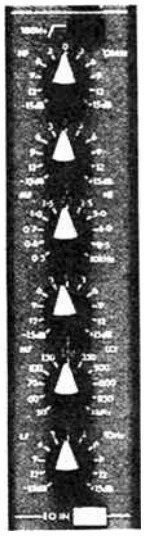
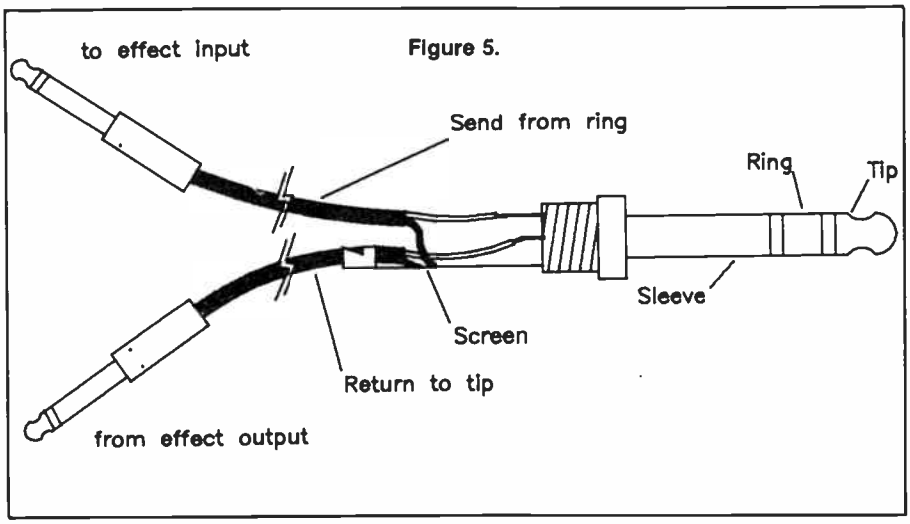


Figure 4. Soundtracs M-series mixer panel.

as auxiliaries of their own. The pan (short for "panorama") control assigns the particular subgroup to the left and right master outputs. The function of the left and right master faders is obvious.

There are many features incorporated in output sections of various desks. First, there are the *auxiliary level* controls. These act as masters for the sum signal

— to page 86. ▷



NOTICEBOARD

This special page is for the benefit of readers, to help you make better use of your magazine.

Please check this page **every month** as notices **will** be changed often.

Back Issues

If you are looking for a particular back issue, it's simple, just write to us: **AEM, 1st Floor, 347 Darling Street, Balmain 2041 NSW** and state which issue(s) you need, enclosing a cheque or money order for $4 for each back issue.

It is wise to state which particular article or project interests you in the issue(s) you have specified, because if we don't have the issue in stock, we can send you a photostat of your specified article or project. We are unable to process back issues by credit card, unfortunately, unless the order is above $10.

GOT OUR RIGHT ADDRESS?

Most important! It has become obvious to us that a lot of readers are still addressing mail to our old addresses (there are three variations) so will you make sure that you have our new address, phone and fax numbers?

AEM
1st Floor, 347 Darling Street,
BALMAIN 2041 NSW.
Ph. (02)555 1677. Fax: (02)555 1440

NOTES & ERRATA

AEM2521 Power Supply, Sept. '88: The lead from the earth terminal on the front panel should NOT be labelled 'H'; it connects to the mains earth ONLY. The pole of SW3 is correctly labelled H and goes to H on the pc board.

PROJECT LEVELS

In general, with our projects we include a panel indicating the "level" required for successful construction. This is included only as a guide, the three levels we show being: "beginners",."intermediate" or

LEVEL: We rate this construction project as suitable for:

BEGINNERS

If you've had little or no experience in electronics construction, you should be able to successfully complete this project.

Technical Enquiries

Please, only after 4.30 pm EAST.

If you were a fly on the wall in our office you would notice that the people who answer these enquiries do not sit all day with baited breath awaiting your call. In actual fact they are crucial members of our team and are expected to do 'some' other work during 'normal' business hours. So please, while we are happy to answer your technical enquiries we also have a magazine to get out. After all, isn't that how you found us in the first place?

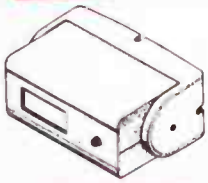
Published by: Kedhorn Holdings P/L (inc. in NSW), wholly owned by Roger and Val Harrison, 1st Floor, 347 Darling St, BALMAIN 2041 NSW. **Typeset by:** Photoset Computer Service P/L, 195 Elizabeth St, SYDNEY 2000 NSW. **Printed by:** Offset Alpine Printing, cnr Derby & Wetherill Sts, SILVERWATER 2141 NSW. **Distributed by:** Network Distribution Co., 52-54 Park St, SYDNEY 2000 NSW. *Cover Price $3.95 (maximum and recommended Australian retail price only; recommended New Zealand price NZ$5.60). Registered by Australia Post, Publication No. NBP 7435. ISSN No. 0815-5046.

Special Offers

We pride ourselves in making available to you special opportunities to purchase interesting products at a special price.

Mostly, we act as a clearing house for orders and have to contend with the usual SNAFU's. Fortunately, they're not too prevalent. If you have a problem with an order, kindly write or call and give us your full name address and ordering details, and most importantly, your phone number. We'll do our level best to sort it out and inform you.

MERRY CHRISTMAS



PASSIVE INFRA RED DETECTOR

Compact P.I.R. with adjustable corner or wall mounting bracket, dual pyroelectric infra red sensing element gives a coverage 2 x 14 zones 2m high and 10m wide

- Sensitivity adjustment control
- Detecting range 12-15 metres at 90 degrees
- Detecting zones 9 long (up), 5 short (down)
- LED indicator for walk test (can be disabled)
- Shielded against RF interference
- Relay output NC or NO at 30V (AC-DC) 0.5A max
- Integral NC tamper switch
- Operating voltage 10.5 - 16V DC
- Current 20mA with LED 25mA

Cat. S15075 **$145**

RCA GOLD PLATED PLUGS AND SOCKETS

For those who need the ultimate in connection. Essential for laser disc players to get that fantastic sound quality.

Plug Cat. P10151 **$2.95**
Socket Cat. P10150 **$2.25**

VERBATIM DISK SPECIALS!

ALL PRICES PER PACK 10 DISKS

DESCRIPTION	1-9 packs	10+ packs
3½" 1S/2D	$39.95	$37.95
3½" 2S/2D	$46.95	$43.95
3½" 2S/HD	$99.00	$89.00
5¼" 1S/2D	$22.00	$21.00
5¼" 2D/2D	$26.00	$24.00
5¼" 2S/4D	$75.00	$70.00
5¼" 2S/HD	$41.00	$39.00

"NO BRAND" DISKS

Now you can buy absolute top quality disks that are probably the cheapest in Australia! They even come with a lifetime warranty! So why pay 2-3 times the price for the same quality?

Packs of 10, 2S/2D without boxes, or brand name, just their white paper jacket, and index labels. (5¼" disks includes write protects)

5¼" 2S/2D DISKS (DOUBLE SIDED)

10+ DISKS	100+ DISKS	1,000+ DISKS
$6.75	$6.50	$6.25

(ALL PRICES PER 10 DISKS)

5¼" HIGH DENSITY (DOUBLE SIDED)

10+ DISKS	100+ DISKS	1,000+ DISKS
$23.95	$22.95	$21.95

(ALL PRICES PER 10 DISKS)

3½" 2S/2D DISKS

10+ DISKS	100+ DISKS	1,000+ DISKS
$23	$22	$21

(ALL PRICES PER 10 DISKS)

DB25 CONNECTOR SPECIALS!

TYPE	1-9	10+	100+
9P	$0.70	$0.60	$0.50
9S	$0.70	$0.60	$0.50
9C	$0.60	$0.50	$0.40
15P	$0.70	$0.65	$0.60
15S	$0.70	$0.65	$0.60
15C	$0.70	$0.60	$0.50
25P	$0.70	$0.60	$0.50
25S	$0.75	$0.65	$0.60
25C	$0.70	$0.60	$0.50

DB 25 CRIMP SPECIALS!

Type	1-9	10+	100+
Female	$2.95	$2.50	$1.95
Male	$2.95	$2.50	$1.95

QUALITY 3mm LEDS

Cat. No.	Col.	1-9	10+	100+
Z10140	Red	$0.15	$0.12	$0.10
Z10141	Grn	$0.20	$0.15	$0.12
Z10143	Yllw	$0.20	$0.15	$0.12
Z10145	Ora	$0.20	$0.15	$0.12

QUALITY 5mm LEDS

Cat. No.	Col.	1-9	10+	100+
Z10150	Red	$0.08	$0.07	$0.06
Z10151	Grn	$0.15	$0.12	$0.10
Z10152	Yllw	$0.15	$0.12	$0.10

CANNON TYPE CONNECTORS

	1-9	10+
P10960 3 PIN LINE MALE	$3.90	$3.50
P10962 3 PIN CHASIS MALE	$3.00	$2.50
P10964 3 PIN LINE FEMALE	$4.50	$3.90
P10966 3 PIN CHASIS FEMALE	$4.95	$3.95

BELL WIRE

Red and white twisted Conductors. 2 x 1 strand 0.17mm Sheath O.D. 2 x 1.35mm Cat. W

1-9 rolls	10+ rolls
$19.00/m	$17.50/m

5¼" DISK STORAGE (DD100-L)

Efficient and practical. Protect your disks from being damaged or lost!

Features...

- 100 x 5¼" disk capacity
- Smoked plastic hinged lid
- Lockable (2 keys supplied)
- High impact ABS plastic base
- Contemporary design

C16020 ..... only $15.95

ECONOMY TRANSFORMERS

	1-9	10+
2155 240V 6-15V 1A Cat. M12155	$9.95	$8.95
2156 240V 6-15V 2A Cat. M12156	$14.95	$13.95
2840 240V 9V CT Cat. M12840	$5.95	$4.95
2851 240V 12-6V CT 150mA Cat. M12851	$5.95	$5.50
2860 240V 15V CT 250mA Cat. M12860	$5.95	$4.95
6672 240V 15-30V 1A tapped Cat. M16672	$14.95	$13.95

10W HORN SPEAKERS

White durable plastic, 8 ohms

Cat. C12010 **Normally $11.95**

1-9	10+
$7.95	$6.95

NICADS!

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

Size	Desc.	1-9	10+	100+
AA	450 mA H	$2.95	$2.75	$2.50
C	1.2 A H	$9.95	$9.50	$8.95
D	1.2 A H	$9.95	$9.50	$8.95

RACING BATTERY PACK QUICK RECHARGER

Fast charger for 7.2V NiCad batteries

Input: 12V DC cigarette lighter, fuse protected

Output: standard racing pack lead and terminal to suit S15025 and Tamiya 7.2V batteries

Charge Time: Standard charge is 15 minutes for 7.2V batteries

0-30 minute timer.

M23528 ..... $39.95

7.2V NICAD RACING BATTERY PACK

Suits most Tamiya and other brand remote control cars, toys, and models

SPECIFICATIONS:

Voltage: 7.2

Charging Current: 130mA

Nominal Capacity: 1300mAH

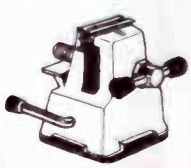
Charging Time: 15 Hours

S15025 ..... $49.95

CAR ANTENNA BOOSTER

- In-line installation
- 12V boosts 100%

Cat. A12073 ..... $7.95



MINIATURE HOBBY VICE

- Lever operated suction grip base for instant mounting and portability
- Mounts on smooth non-porous surfaces
- Ideal for holding components and other small light objects

Cat. T12458 ... only $6.45

STEREO WIRELESS TRANSMITTER

This unit was developed to allow portable compact disc players to be used in cars by transmitting the headphone output signal directly in to your stereo FM car radio. It will also transmit any mono/stereo signal from any headphone output to any FM receiver.

SPECIFICATIONS:

- Input 3.5mm stereo phone plug. Impedance 32 ohm
- Mono/stereo switch has plug mounting clip
- FM Transmission approx. 90-35MHz (Tuneable 89-91MHz)
- Range 15 metres. (below 15mV/m at 100 metres)
- Power 1.5V AAA size batteries (100 hours continuous use)
- Size 72 x 38 x 21mm

A16100 ..... $69.95

CAR AUXILLIARY STOP LIGHT

Avoid rear end collisions with this simple and proven method. A very cheap form of "insurance"! Simple to install with self adhesive rubber mounting. 12V DC and 2 metre cable.

A12090 ..... $12.95

ABLEC SUPER TOOL

A versatile 12V electric tool for...

- Sanding
- Engraving
- Grinding
- Polishing
- Cutting
- Drilling
- Milling
- Erasing, etc

Features:

Operates on safe, low 12 volts from mains electricity via AC adaptor (supplied). Light and easy to handle with touch switch and lock for continuous running. High torque motor. 10,000 R.P.M. Can drill 2mm holes in steel. 2 year guarantee.

Contents:

- 12V Super Tool
- Plugpack AC adaptor
- 1 spherical milling cutter
- 1 wire brush
- 1 grinding wheel
- 4 drill bits, 0.6, 0.8, 1.0, 1.2mm
- Set of 5 chuck collets
- 6 eraser sticks
- Instruction sheets

Cat. T12300 ..... $64.95

GOLDSTAR 20MHz COMPOSITE MONITOR

X14514 GREEN... only $89
X14516 AMBER... only $89
10 OR MORE $85 EACH

GOLDSTAR 12" TTL MONITOR

X14500 GREEN... only $99
X14502 AMBER... only $99
10 OR MORE $95 EACH

RANGE

METEX M-3650 MULTIMETER

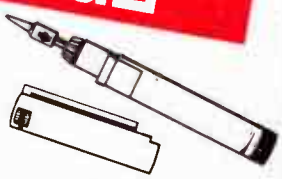
20A, 3½ digit frequency counter multimeter with capacitance meter and transistor tester.

This spectacular, rugged and compact DMM has a bright yellow high impact plastic case. It features a frequency counter (to 200kHz), diode and transistor test, continuity (with buzzer), capacitance meter, up to 20 amp current measurement and comprehensive AC/DC voltage, current and resistance ranges.

CHECK THESE FEATURES...

- Push-button ON/OFF switch
- Audible continuity test
- Single function, 30 position easy to use rotary switch for FUNCTION and RANGE selection
- Transistor test
- Diode test
- Quality probes
- ½" High contrast LCD
- Full overload protection
- 20 Amp
- Built in tilting bail
- Capacitance meter
- Instruction manual

Q91550 .... Normally $165
Special, only $129



PORTASOL PROFESSIONAL

- Four tools in one: Blow Torch, Hot Blow, Hot Knife
- No Cords or batteries
- Heavy duty, tip temperature adjustable up to 400°C
- Equivalent to 10-60 watts
- Hard working. Average continuous use 90 minuters
- Refills in seconds
- Powered by standard butane gas lighter fuel
- Range of easily replaceable screw tips included
- Includes metal stand for the soldering iron when working
- Cap features built-in flint for igniting Portasol tip
- Includes snap case for storage

Cat. T12639 ..... $89.95

PANEL METERS GALORE!

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

Cat.No.	Description	Price
Q10500	MU45 0-1mA	12.50
Q10502	MU45 50-0-50uA	12.50
Q10504	MU45 0-100uA	12.50
Q10510	MU45 0-5A	12.50
Q10518	MU45 0-1A	12.50
Q10520	MU45 0-1A	12.50
Q10525	MU45 0-20V	12.50
Q10530	MU52E 0-1A	14.50
Q10533	MU52E 0-5A	14.50
Q10535	MU45 VU PMetre	14.95
Q10538	MU65 0-50uA	16.95
Q10540	MU65 0-1mA	16.95
Q10550	MU65 0-100uA	16.95
Q10560	MU65 0-20V	16.95

FREE STANDING, FOLD UP MAGNIFIER

An economically priced, hands free magnifier, lets you take care of all those tricky fine detailed jobs so often encountered in electronics, or any of many other practical uses such as home, work, hobbies etc.

Cat. T10020 **Normally $14.95**
SPECIAL, ONLY $12.95

ROD IRVING ELECTRONICS

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

CLAYTON: 56 Renver Rd
Phone: (03) 543 7877

SOUTH AUSTRALIA:
Electronic Discounters P/L,
305 Morphett St, ADELAIDE
Phone: (08) 212 1799
NOTE: PRICES MAY VARY INTER STATE DUE TO FREIGHT COSTS

MAIL ORDER:
Local Orders: (03) 543 7877
Interstate Orders: (008) 33 5757
All Inquiries: (03) 543 7877

CORRESPONDENCE:
P.O. Box 620, CLAYTON 3168
Telex: AA 151938
Fax: (03) 543 2648

MAIL ORDER HOTLINE 008 335757

(TOLL FREE, STRICTLY ORDERS ONLY)

LOCAL ORDERS & INQUIRIES (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 – $199	$7.50
$200 – $499	$10.00
$500 plus	$12.50

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

All wholesale and sales tax exempt inquiries to:
RITRONICS WHOLESALE,
56 Renver Rd, Clayton.
Ph. (03) 543 2166 (3 lines)

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

MasterCard VISA

TV plugs, sockets, cables and assorted accessories

So you've decided to get out in the sunshine and do some running repairs to the decrepit TV antenna installation. About time, too!

For a comprehensive range of plugs, sockets, cable, splitters, switches, antennas, tuners, amplifiers, adaptors — you name it! — you *must* have an Arista catalogue (as reviewed by Ben Furby in our November issue).

From pages 72 through 83, you'll find a wealth of information on products you're likely to need for the job.

Catalogues cost $2.50 post paid if you send your negotiable instrument and nicely begging letter to **Arista, PO Box 191, Lidcombe NSW 2141.** Or phone **6(02)648 3488** and ask for the address of your near Arista stockist.

While you're at it, get their leaflet, *Arista Solutions, No. 2*, which covers TV accessories.

Tandy also stocks a variety of TV antennas an accessories, including plugs, sockets, cables, switches, couplers and splitters, sold under the *Archer* brand name.

Last, but by no means least, we must mention Dick Smith Electronics. Their "enthusiast" catalogue sports two pages of TV antenna and accessory products for the do-it-yourselfer or home handyman. Pick up a catalogue at any DSE outlet.

Sturdy solder sucker

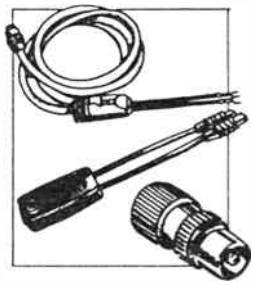
Melbourne retailer, All Electronic Components, has just put in stock a remarkable little solder sucker, ideal for servicing, pc board repairs and experimentation.

It features a sturdy plastic handle and an easily replaceable Teflon nozzle assembly.

It is operated by a pushbutton pressed with your thumb. The spring-loaded plunger then retracts, drawing the molten solder from the area of pc board track adjacent to where you've applied your hot iron tip.

Priced at just under ten dollars, there's no excuse for any workshop not to have one!

Contact **All Electronic Components, 118 Lonsdale St, Melbourne Vic 3000. ☎1381.**



Mitsubishi RF power modules

If your curiosity has been whetted by our data sheet on the Mitsubishi M57716 430-450 MHz RF power amp module published in this issue, boosted by the "worked example" in the AEM3515 Colour ATV Transmitter, then you'll be asking "where do I get it?"

Well, it's possible we could help you there. A range of Mitsubishi "block" RF power amp modules is stocked by **Stewart Electronic Components** in Huntingdale, Melbourne.

Mitsubishi manufacture an interesting and extensive range of such devices, and it's worth perusing their data book on the subject: but be warned! — they're as scarce as rocking horse droppings. However, the ever-helpful staff at Stewart may be "able to help in your enquiries". Contact **Stewart Electronic Components, PO Box 281, Oakleigh Vic 3166. 6(03)543 3733.**

Spare 7.2 V NiCad packs

For R/C car fans, you should have at least one spare 7.2 V NiCad battery pack — so you can have one battery in your car and one on charge or awaiting usage at any time.

Rod Irving Electronics is stocking a 7.2 V NiCad pack, complete with special locking connector. It fits all Tamiya and similar style cars. At $49.95 it's a small price to pay to keep that racer running! Contact **Rod Irving Electronics, PO Box 620 Clayton Vic 3168. ☎008 335 575.**

Melbourne-based Rod Irving Electronics' newest store — 74 Parramatta Rd, Stanmore in Sydney! It's located but a few blocks from Stanmore station and a brisk walk from Sydney University, near the corner where Johnston St, Annandale crosses Parramatta Rd. (Pic courtesy of our Melbourne correspondent, Ian Boehm!)

PROJECT BUYERS GUIDE

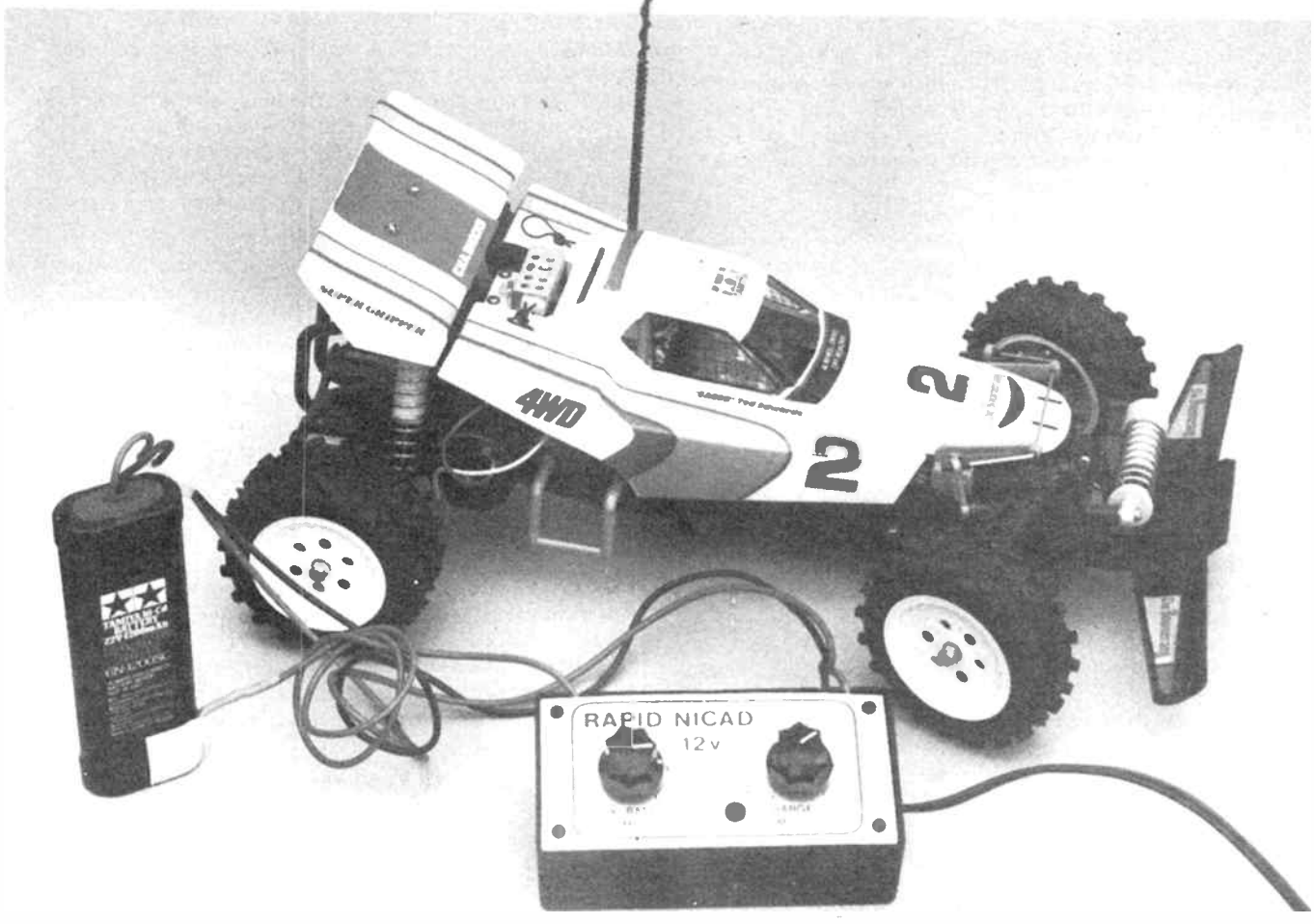
Parts for the **AEM9506 Fast NiCad Charger n are all common stock items at most electronics retailers and constructors should have no difficulty sourcing requirements. Printed circuit boards may be obtained through JWD Electronics in Sydney, All Electronic Components in Melbourne and Eagle Electronics in Adelaide.**

Kits for the AEM9508 Proximity/Motion detector are obtainable from Dick Smith Electronics stores. For constructors using parts on hand and wanting to source parts you may not have, you'll find pretty well all components are commonly stocked items. Again, pc boards are obtainable from JWD Electronics in Sydney, All Electronic Components in Melbourne and Eagle Electronics in Adelaide.

Kits for the **AEM3515 Colour ATV Transmitter** are being marketed by the authors; see the panel in the article. Kits may also be ordered through the magazine in Sydney.

A temperature and time controlled fast NiCad charger for R/C models

Graeme Teesdale



Keeping those 7.2 V NiCads charged for your radio controlled cars etc, is a constant chore. This nifty project charges those batteries in quick-fast time, but makes sure they don't overheat and are not overcharged.

OUR DECEMBER 1986 issue contained an article entitled *This rapid NiCad battery charger works from 12 Vdc supply.* AEM Project 9503. This project was very popular because it was portable and operated from a 12 V car battery; the charging period was switchable and the charging current was continuously adjustable up to a maximum of five amps.

"Boomerang" 4WD radio control car courtesy of Toy Traders, Sydney.

A 'time-out' feature is *essential* to protect the battery from overcharging. During charging, NiCads heat up as a result of the electrochemical process that goes on. Excessive heat build-up will cause distortion of the battery case and cell damage.

Since we designed and published the AEM9503, some changes have occurred in the design of NiCad batteries for radio controlled cars. The current trend is to charge the battery until it reaches a temperature in the range of 40 to 50 °C, rather than rate charging (that is, so many milliamps for so many ▷

hours — the usual way). Many batteries now have a hole in one end in which a temperature probe, or sensor, can be inserted.

In view of this, we thought the time was right to have a new look at the design of chargers for this type of application and incorporate some new features. The following article contains an examination of temperature control, adjustable charging currents for different types of batteries and adjustable charging time. With this design you can choose to set the charge either by rate or maximum battery temperature.

Design features

The previous design used a pulsed charging current, the pulse width being varied by the front panel output current control. A panel meter was used to measure the average current of the output waveform. On this design, the meter has been deleted to reduce the cost and the current-setting potentiometer is a preset control. Once the charging current you require is set, there is no longer any requirement to adjust it. You can add a current meter and a standard potentiometer instead of the preset control if you wish.

Like the AEM9503, this new design derives its power from a vehicle battery or other 12 Vdc (nominal) supply. A three terminal regulator is used to provide a regulated supply rail for the electronics. As something around 8 V was required, I used a standard 5 V regulator was used with its reference pin biased-up so as to give 8 V on the output.

The circuit provides a pulsed charging current to the NiCad being charged, the average charging current being a maximum of 5 A, determined by the on:off charging current ratio.

One or two BUZ71A FETs (Q1, Q2) are used to switch the battery charging current on and off. For charging currents up to 3 A, only one FET need be used; up to 5 A two FETs are used (they are connected in parallel).

A ramp, or sawtooth oscillator, involving IC1c, and a com-

I housed the charger in a small 'jiffy' box, the type which has an aluminium front panel, although the style with a plastic-lid may also be used. The leads to the 12 V source at seen at the right, while the NiCad battery and thermistor leads are seen attached to the battery. Note that the thermistor temperature sensor is seen taped to the battery here. Other battery types have a hole for inserting a temperature sensor.

CIRCUIT OPERATION

The circuit employs a '324 quad op-amp, a 4541B programmable timer, a three-terminal 5 V regulator and a BUZ71A FET or two.

The ramp, or sawtooth, oscillator section consists of op-amp IC1c and surrounding components. The non-inverting input, pin 10, is biased to half supply by R1 and R2. When power is first applied, C1 is discharged initially and looks like a short circuit. This holds the inverting input at 0 V and thus IC1c's output is high. C1 then starts to charge from IC1's output via R7. When the voltage on pin 9 exceeds the half rail value on pin 10, IC1c's output switches low, allowing C1 to discharge via R7.

Now, R6 provides positive feedback around IC1c, forcing its output to swing from 0 V to +8 V (that is, rail to rail). The output waveform, at the junction of R7-C1, is close to a sawtooth and this is applied to the inverting input of op-amp IC1a, pin 3.

IC1a operates as an open loop comparator, comparing the reference voltage set on pin 2 with the voltage of the ramp applied to pin 3. The voltage divider formed by R10-RV3-R11 sets the comparator threshold or set-point. The output on pin 1 swings abruptly towards the supply rail when the voltage on pin 3 exceeds the set-point voltage on pin 2. This provides a pulse output on pin 1, the on-to-off ratio of which can be adjusted by adjusting the set-point voltage with RV3.

The pulse on:off ratio range is from 10% to 95%, determined by R10 and R11. This potentiometer sets the maximum charging current because the pulse output from the comparator drives the FET switches, Q1 and Q2, on and off. When the pulse on:off ratio is small, the charging current is low because the current flows for only a short period each cycle. When the ratio is high, the charging current is high because the current flows for a longer period each cycle.

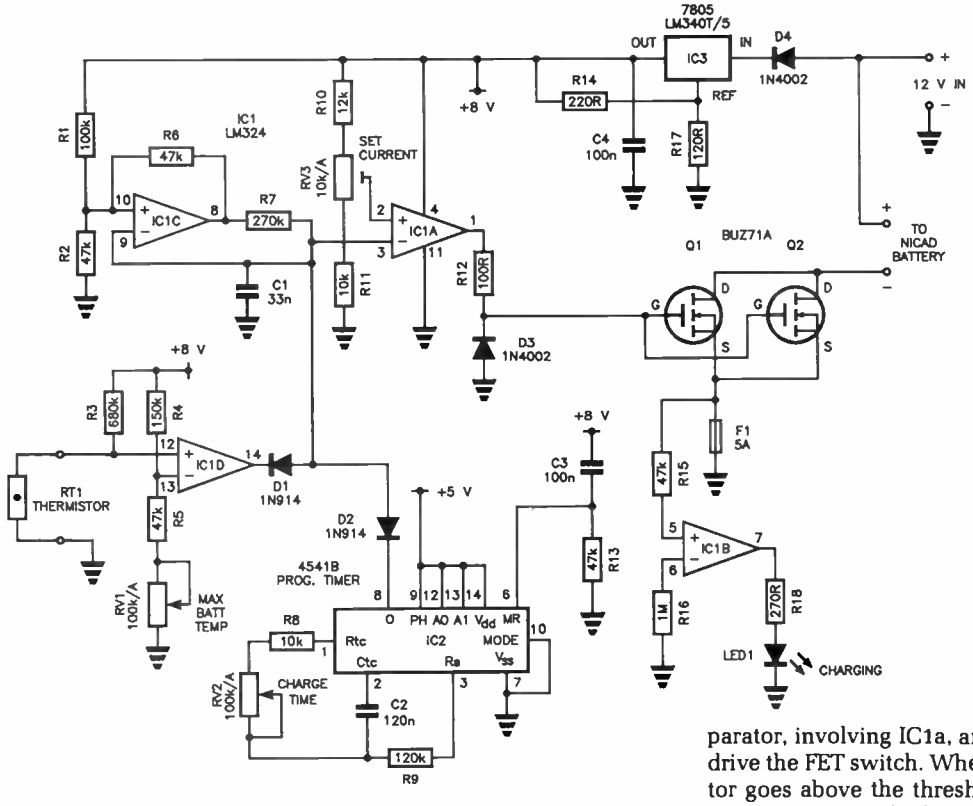
In the previous design, a bipolar transistor was used as the series switching element to pulse the battery charging current. But in this design, one or two power BUZ71A MOSFET devices are used. Power MOSFETs offer the advantages of fast switching times (and thus low heat N dissipation), ease of parallelling, and low drive power requirements.

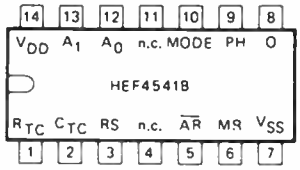
The BUZ71A is a common N-channel enhancement mode MOSFET. To switch the device on, the gate-to-source voltage must exceed the threshold value of 3.0 V. When the device is switched on it has a static resistance of 0.16 Ohms. Here, to reduce dissipation of a single device when average charging currents above 3 A are required, the pc board has been laid out to take a second device in parallel. The positive temperature coefficient of the channel allows the devices to be connected in parallel without the need for "balance" resistors in series with the sources.

Diode D3 is used as a negative cycle clamp for the FET gates. R13 is used to limit overshooting the gate switching current.

Op-amp IC1b is connected as an open loop non-inverting amplifier and its output drives the charging indicator LED, LED1. The non-inverting input is connected across the fuse which is in series with the FET source leads. It only takes approximately 20 mV drop across the fuse to drive pin 7 to maximum output (+8 V). The lower resistance to ground on the non-inverting input ensures that with no charging current flowing the inverting input leakage current produces a greater voltage on pin 6 than on pin 5. No charging current results in 0 V on pin 7; that is, LED1 off.

To limit the maximum positive voltage input swing on the FETs, the circuit is operated from a regulated supply set to approximately 8 V. This involves a three-terminal 5 V regulator IC3, a 7805 or LM340T/5. Resistors R14 and R17 "jack-up" the reference pin so that the output voltage is raised from the normal 5 V to about 8 V.





parator, involving IC1a, are employed to generate the pulses to drive the FET switch. When the output level of the ramp oscillator goes above the threshold of the comparator, the comparator's output goes high and turns on the FET switch. When the ramp oscillator's output goes below the comparator's threshold, ▷

Now we get to those parts of the circuit which control the charge to the battery.

The programmable timer, IC2, is a 4541B. This consists of a 16-stage binary counter, an on-board oscillator with external resistor-capacitor timing components that determine the oscillation frequency, and automatic power-on reset logic. Pins 13 and 12 program the binary counter for different division ratios:

A_0	A_1	number of counter stages n	$\frac{f_{osc}}{f_{out}} = 2^n$
L	L	13	8 192
L	H	10	1 024
H	L	8	256
H	H	16	65 536

Here both these pins are hard wired high (to the positive supply rail), giving a division ratio of 1:65536. The divided output is available at Output O (pin 8), the phase of which is controlled by the phase input (PH) pin 9. If the phase input is logic 0 (low, or 0 V) the output is initially low after a reset. A logic 1 (H) sets the output high. Pin 9 is hard wired to the +8 V supply so that after a reset, diode D2 is reversed biased allowing the ramp oscillator to run.

This chip has a Master Reset (MR) on pin 6. A logic 1 on this will cause an internal reset and with the mode pin also low, will set the timer for single-cycle mode. Power-on reset is achieved by components R13 and C3. When power is first applied, C3 is discharged and looks like a short circuit. This applies +8 V (a logic 1, here) to pin 6. C3 then charges via R13, quickly reducing the voltage on pin 6 to 0 V (logic 0), this sequence resetting the timer.

The 4541B's oscillator frequency is determined by R8 + RV2 and C2. The function of R9 is to minimize the influence of the chip's input protection diodes on pin 3. RV2 allows for a variable frequency output, providing a variable timing period of between about two minutes and 20 minutes maximum using a 100k potentiometer and a value for C1 of 120 nF. The value of R9 is non-critical, any value from 10k to 1M will work. R8 is inserted to meet the manufacturer's minimum value requirement for timing resistance.]

At the end of time period, the output on pin 8 will go low, forward-biasing D2. This will clamp the output of the ramp oscillator low (in effect, D2 shorts C1 to ground), stopping oscillation.

The temperature control charge-limiting circuit involves op-amp IC1d. This is connected as an open-loop comparator. The inverting input (pin 13) is connected to a voltage divider chain comprising R4, R5 and RV2. This combination gives a voltage at pin 13 swing of between approximately 1.9 V and 4.2 V.

The thermistor, RT1, has a resistance of 680k at 20 °C. It forms part of a voltage divider with R3, the junction of R3 and RT1 controlling the voltage on the non-inverting input of IC1d (pin 12). At 20 °C, the voltage on pin 12 is about 4.1 V.

When RV2 is adjusted to give a voltage on pin 13 less than that on pin 12, the output on pin 14 will be high, reverse biasing D1. As the battery temperature rises, the NTC thermistor will lower the voltage at IC1d's non-inverting input (pin 12), causing its output to swing low, forward biasing D1 and clamping the ramp oscillator off.

Any NTC thermistor can be used, just measure its resistance at 20° and 50° C and select a value for R6 to give approximately 4 V on pin 12 of IC1 at 20 °C. If, at 50° the voltage on pin 12 is substantially above or below 1.9 V, vary the value of R5 so that the voltage on pin 13 is the same as that on pin 12. You may then need to vary R4 so that the voltage on pin 13 is around 4 V with RV1 at maximum resistance. This will slightly upset the pin 13 voltage with RV1 at minimum resistance, but with a bit of juggling you'll be able to get the required range.

the comparator's output goes low, turning off the FET switch. Adjusting the comparator's threshold (with RV3) will set the period for which its output turns on, and thus set the average charging current.

The charging current can be cut off by cutting off the ramp oscillator's output. A temperature sensor circuit, which senses the battery's temperature, and a timer are used to do this.

A *thermistor* is used as a battery temperature sensor. A thermistor is a device that varies its resistance in a predictable way with change in temperature. In this case, its resistance decreases with increasing temperature, that is, it is said to have a *negative temperature coefficient* (NTC). The thermistor is connected to a comparator, involving IC1d, the threshold of which is adjusted by RV1. When the thermistor reaches a temperature such that its resistance causes the comparator to operate, the ramp oscillator is cutoff by the comparator's output.

Here, the comparator is adjusted to operate when the battery reaches a maximum temperature of about 50 °C. The MAX BATT TEMP control can be set so that charging cuts out at temperatures less than that if desired.

Time-limiting the charging period is accomplished with a programmable timer IC — a 4541B (IC2). This incorporates as oscillator and a divider. The output of the divider is used to turn off the ramp oscillator. In this circuit, the 4541B's divider is set to give a fixed division ratio of 1:65 536. The oscillator frequency then determines the period, which can be adjusted by RV2, giving a minimum of three minutes and a maximum of 30 minutes. The 4541B features power-on reset. To charge a new battery after you've finished charging one, all you need do is briefly disconnect the 12 V supply.

A "charging" indicator LED is included. It comes on when a battery is charging and goes off when the charging has stopped, either by the battery reaching the set temperature, or when the set charge period is reached. There is a 5 A fuse in series with the FET switches. The voltage drop across this fuse during charging is amplified by an op-amp, IC1b, the output of which drives the CHARGING LED.

A diode in series with the 12 V input's positive supply lead is included to prevent damage should the battery leads be inadvertently connected in reverse.

Construction

It was decided to house the project in a low-cost 'jiffy' box of the type that has an aluminium front panel or plastic lid. A layout for the front panel is reproduced here, from which a Scotchcal escutcheon can be made. If you've bought your project as a kit, this may be supplied.

If you have a jiffy box with a plastic lid and you're using a Scotchcal, cut the Scotchcal around the edge of the outer line. Outside this line are the screws for securing the lid. Using your Scotchcal, or a copy of the full-size front panel layout here, mark out the position of the front panel holes. Drill or punch 10 mm holes for the pot shafts and a 6 mm diameter hole for the LED bezel.

As the pc board is mounted off the front panel, drill the 3 mm holes in it, then lay the board on the front panel and mark the hole position. Drill 3 mm holes, if a plastic lid is used, and use a 6 mm drill to countersink them so the countersunk screws will fit flush with the surface. These screws will be behind the Scotchcal.

When an aluminium panel is used, use a centre punch to produce a small 'cone' in the metal so the screws sit flush with the front surface (as they'll be behind the Scotchcal). Use 20 mm-long M3 countersunk screws. Add nuts to the three screws. Metal lid versions may need to have a washer to allow for the cone shape so that the nut has a seat.

You can now apply the Scotchcal label. Take your label and soak it in a saucer of water, wet the front panel, peel off the Scotchcal backing and position the label on the front panel. The water will permit you to slide it around to get the exact position.

View of the thermistor assembly, used to sense the battery temperature. The connections are sleeved in heatshrink tubing, then the whole assembly sleeved with more heatshrink tubing for protection and rigidity.

Smooth the Scotchcal in place with a sponge, making sure you get rid of any bubbles by working them towards the panel's edge.

The potentiometers and LED bezel can be mounted once the label is dry. First cut the potentiometer shafts short to suit the type of knob you wish to use.

Next, tackle the assembly of the pc board. Visually check your pc board and see that the following component's holes are 1 mm diameter: D1, D4, RV3, LM340/7805, BUZ71A power MOSFETs, and potentiometer leads. Also check that the input/output lead holes are 1.6 mm diameter. The rest can be 0.8 mm in size. Complete a visual check on the board, looking for open circuit tracks and shorts between tracks or pads.

The board is best assembled by starting with the smaller axial-lead components. Be careful of diode polarity orientation. To make checking easier, lie all resistors with the tolerance band at the same end. The board contains two links. Use a small length of tinned copper wire or trimmings from resistor leads. When ready, solder the fitted components and trim the leads.

Next, add the fuse holder and the trimpot, RV3. Fit the 5 A fuse in the holder. Fit and solder the LM340/7805 and the BUZ71A FET(s). Make sure you push the three-terminal regulator down to the shoulder on the leads, and push down the BUZ71A FET(s) and bend it out to put the metal tab(s) level with the edge of the board. The three-terminal regulator must stand straight up, ensuring the metal tab does not touch the heatsink.

Add 12 mm plastic spacers to the 20 mm bolts protruding from the front panel. Insert the LED into the board from its *copper side*, making sure it's the correct way round, and temporarily place the pc board onto the bolts secured to the front panel. Press the LED into the bezel and solder the LED's leads.

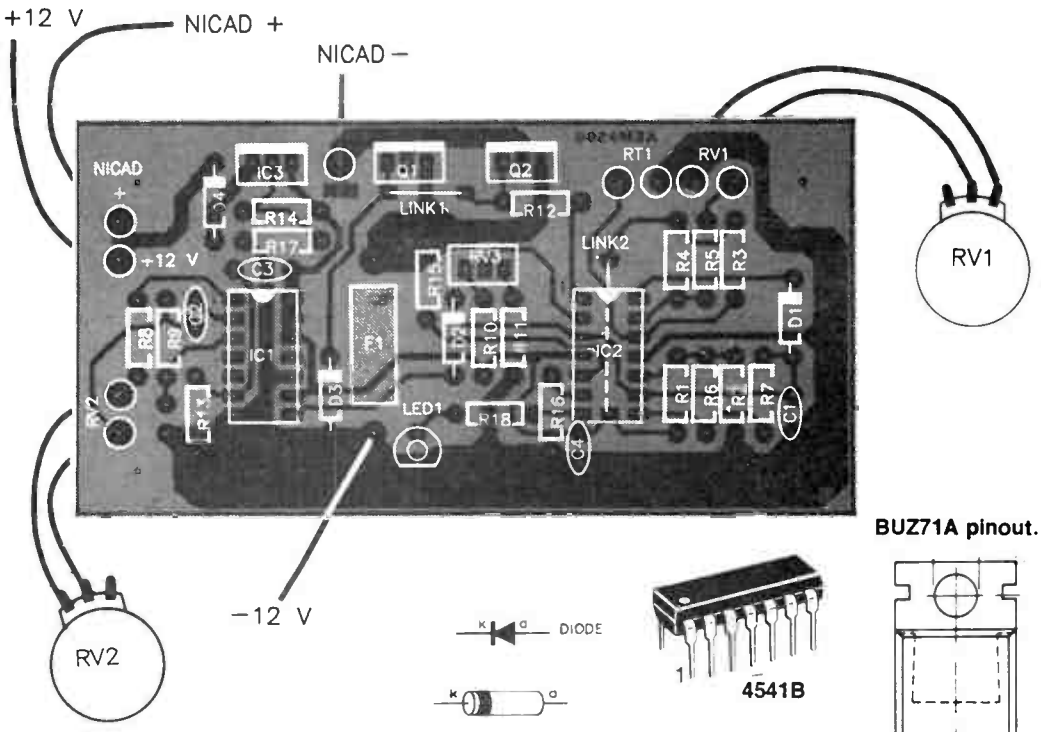
Take the board from the mounting bolts, then fit and solder the input and output leads to the batteries. For the 12 V input I used figure-8 "auto" cable and heavy duty (23 x 0.2 mm) red (for positive) and black (for negative) hookup wire for the NiCad connection.

Then wire-in the lead for the thermistor. Circular audio cable is suitable for this latter task. A length about 400-500 mm should suffice. Attach the thermistor to the other end, using heatshrink tubing to make it more rigid and prevent the leads shorting.

Wire the potentiometers to the pc board. I used figure-8 flex with one lead marked with a stripe in order to identify which connection was which.

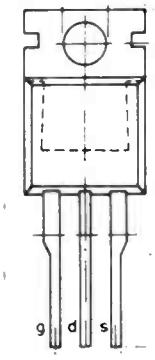
Lastly fit and solder the ICs. IC2 is a CMOS type, so take the appropriate precautions. Handle it by the ends, between thumb and forefinger and avoid touching the pins during insertion. Solder the ground and supply pins on each IC first; pins 11 and 4 on IC1 and pins 7 and 14 on IC2.

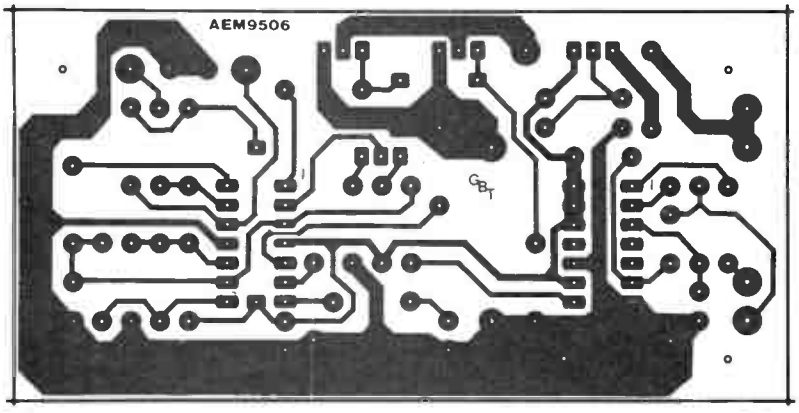
Remount the pc board to the front panel. Cut and fold a small piece of 18 gauge aluminium, 40 mm by 50 mm, and fold one edge at 90°, 10 mm wide along the 40 mm edge. Place this with the 10 mm 'foot' on the front panel (foot under the pc board) and the other end against the MOSFET(s), and mark and drill 3 mm holes. Bolt the heatsink onto these devices. Later you could glue heatsink to the front panel to take the stress off the device legs.



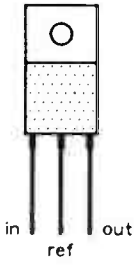
Component overlay, showing placement of the parts. See that the semiconductors are inserted the right way round.

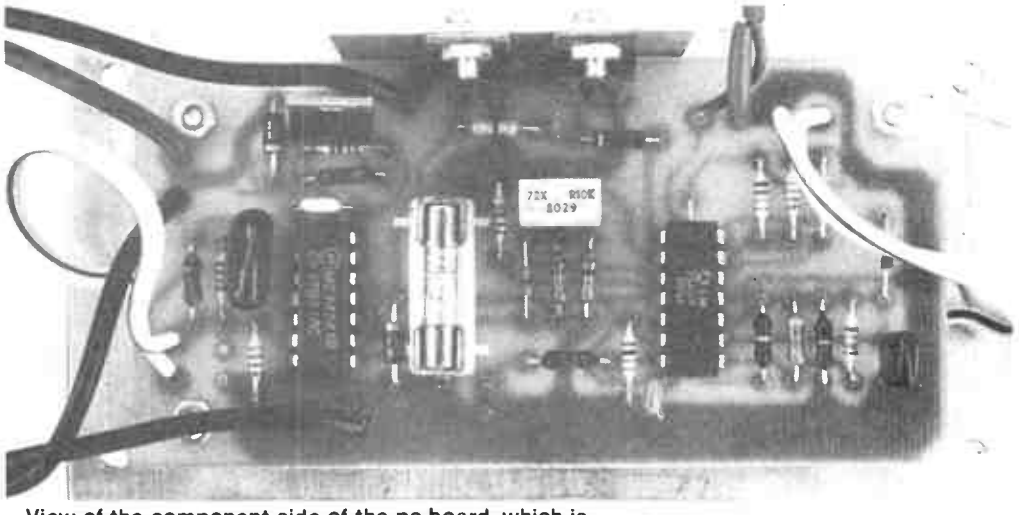
BUZ71A pinout.





POSITIVE REGULATOR 78xx





View of the component side of the pc board, which is mounted to the front panel. Note the heatsinking arrangement for the two FETs.

AEM9506 PARTS LIST

Semiconductors

D1, D2..... 1N914
D3, D4..... 1N4002
LED1.... TIL220R 5 mm red LED
IC1 ..... CD4541B or HEF4541B
IC2. . .L M324, CA324 or µA324
IC3 ..... 7805 or LM340T/5
Q1, Q2..... BUZ71A

Resistors all 1/4 W, 5%

R1 ..... 100k
R2 ..... 47k
R3 ..... 680k
R4 ..... 150k
R5, R6 ..... 47k
R7 ..... 270k
R8 ..... 10k
R9 ..... 120k
R10 ..... 12k
R11 ..... 10k
R12..... 100R
R13 ..... 47k
R14..... 200R
R15 ..... 47k
R16..... 1M
R17..... 120R
R18..... 270R
RV1, RV2..... 100k/A (lin.) pots
RV3..... 10k/A (lin.) vertical mounting trimpot.

Capacitors

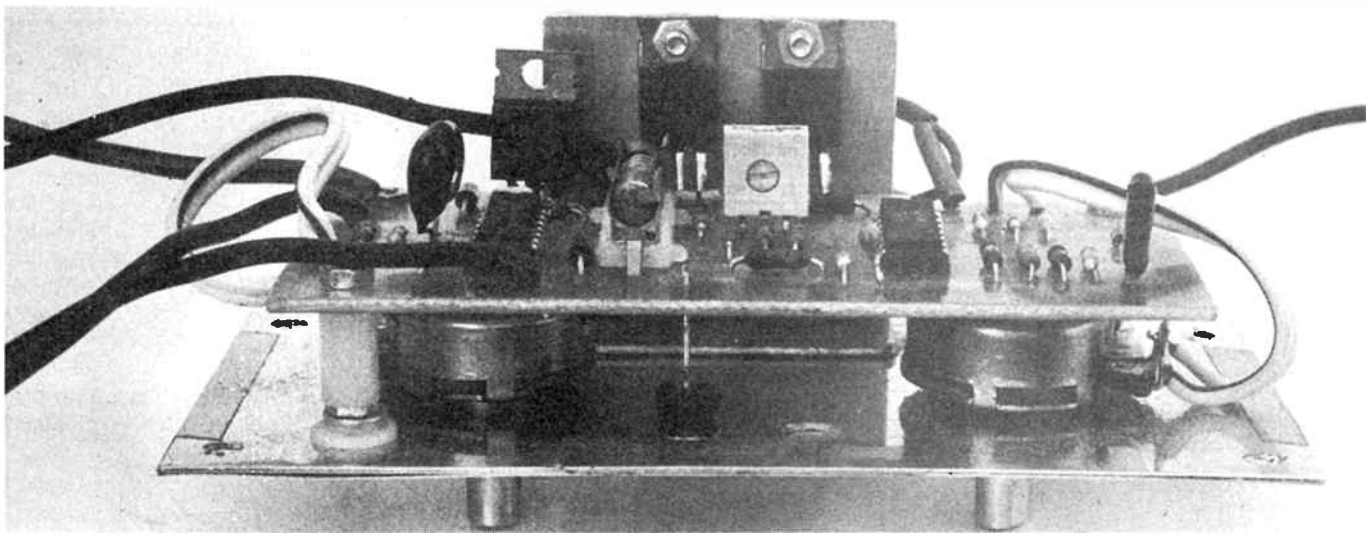
C1..... 33n greencap
C2 . 120n (0.12µ) greencap
C3, C4..... 100n (0.1 µ) ceramic or greencap

Miscellaneous

RT1 ..... Philips thermistor, disc type 2322 642 62474, or other type (see text).

AEM9506 pc board; Scotchcal front panel (if required); pc-mount fuse holder and 5 A fuse; jiffy box 40 x 68 x 130 mm; two pointer knobs; small piece of 18 gauge aluminium; one LED bezel; three 20 mm M3 bolts with six nuts; three 12 mm nylon spacers; Two 6 mm M3 bolts and nuts with washers; lengths of figure-8 hookup cable (one wire marked) – see text - and short length of light hookup wire.

Estimated cost: $40-$45



Side-on view of the board mounted to the front panel, showing how the LED is mounted, together with a different view of the heatsinking arrangement for the FEts. The charge current trimpot, RV3, is accessible from this side of the assembly.

File small notches in the top sides of the plastic case of the jiffy box in appropriate places to provide for the battery and thermistor leads. I attached a large pair of car-type alligator clips to the 12 V input leads, and a special battery connector to the NiCad leads. A connector of this type is usually supplied with your NiCad battery. Bolt the front panel to the box and screw the potentiometer knobs in place. The unit is now ready for testing and adjusting.

Power-up and adjustment

Connect a low value 10 watt resistor, say 8.2 Ohms (8R2), in series with a 0-2 Adc ammeter in place of the battery to be charged. Turn the CHARGE TIME potentiometer to half travel and the MAX BATT TEMP potentiometer fully anti-clockwise. Connect the unit to a 12 volt battery or power supply. The ammeter should show the current to be zero. Using your multimeter, check the output from the regulator IC3; it should be approximately 8-8.5 V. Turn the TEMP potentiometer until the ammeter just starts reading, and hold the thermistor between your fingers. The current should cease.

OK so far? Then turn the TEMP potentiometer further round, and turn the CHARGE TIME potentiometer fully clockwise. Within a couple of minutes the ammeter current should cease. Did you notice anything else going on while you were busy adjusting the controls? Yes, the LED came ON when the ammeter was reading.

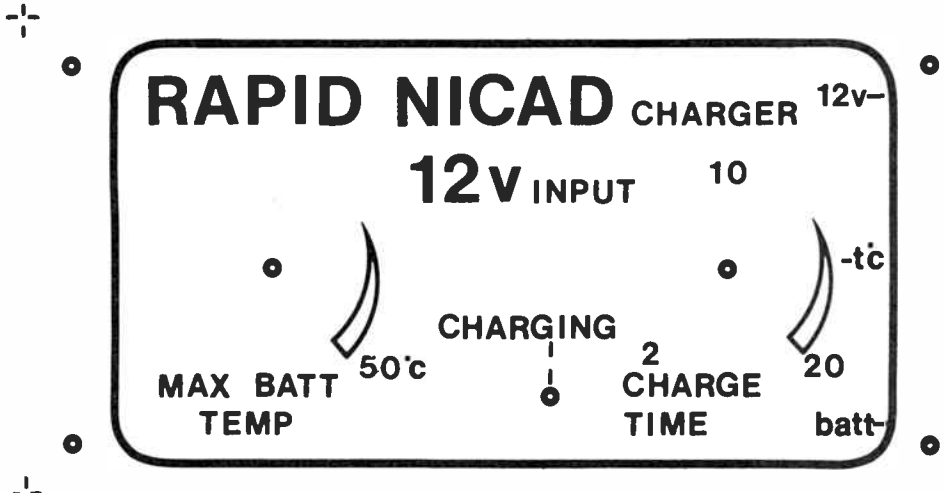
Once the timer has tripped the ramp oscillator off, it is necessary to switch off or disconnect the 12 V input source, then reapply it. C2 and R1 provide a power-up reset to IC1. With the project reset, try adjusting RV3. The output current should vary, giving a maximum reading when the control is fully anti-clockwise. Turn CHARGE TIME control to the fully clockwise position.

Assuming that all is well at this stage, you can now connect a known flat battery in place of the 8.2 Ohm resistor and turn RV3 fully clockwise. Disconnect the 12 V input momentarily to reset the project's timer. With the supply back on, adjust RV3 to obtain the correct current for your battery according to the manufacturer's recommendation. Insert the thermistor temperature probe into the battery hole or tape it to the side of the battery, and keep turning up the TEMP control until the battery reaches the maximum design temperature (usually 50 °C). Use a thermometer or some other type of temperature sensor/indicator to check the temperature.

Remember, the charger will turn off when the battery reaches its maximum temperature or the timer reaches its maximum time. The latter could occur first if the battery does not reach the trip temperature. This safeguard is included to protect your expensive battery.

If you don't get any sensible results, switch off and check your wiring and board assembly.

In use, you'll find the charger simple to operate and a very convenient means of rapidly charging flattened batteries so you can keep your models juiced-up and rarin' to go!



Full-size artworks for the front panel.

A low-cost amateur colour TV transmitter

Part 3

Bob Reid VK3AWL
Howard Rider VK3ZJY

In this final article, we describe how to put the whole thing together and adjust it for the best performance.

WELL, HAVING BUILT and aligned the exciter, and assembled the video and sound modules, you may decide to operate at this level, with just 100 mW output, or just to test the assembly "so far". Either way, the next two sections describe the steps.

Setting the video module

Testing and setting the video modulator is best done with only the exciter and video modulator connected together. Before doing a trial hookup or installing the video module in the chassis, it should be doubly checked to see that there are no shorts between the 12 V line and earth.

The 47 ohm resistor which was soldered across the exciter output while it was being tuned should still be left in place.

Temporarily wire-up the front panel video gain control, VR1 (don't forget to wire R16 across it), and all the power and video connections should be wired to the camera socket at this stage. A 12 volt power supply should now be applied to the video module and the current consumption checked — see that it is approximately 70 mA. Do not plug the camera in yet.

Set VR2 (the CLAMP trimpot) fully anticlockwise, and set VR2a (the SYNC. trimpot) to about half travel and turn the video gain (VR1) to minimum.

Apply power to the modulator and exciter and tune a television set to the exciter's output frequency. Most modern electronically tuneable TV receivers or VCR tuners can be tuned down to the 70 cm band. The position on the TV or VCR tuning dial that the exciter will be found will depend upon whether transmission is taking place at 426.25 MHz or 444.25 MHz. 426.25 MHz may be found at the very low end of the UHF band. You may encounter some tuners that will not tune this low and a converter will need to be used. If the exciter is of the 444.25 MHz variety, it should appear around channel 26 on the UHF band. Don't make the mistake of looking for it on Ch.35 (579.25 MHz).

When you "acquire" your exciter's signal, the screen will go black. Confirm that it is the exciter that is being received by switching the power supply on and off. The TV screen should go dark and light (snowy) in sympathy.

The camera can now be plugged in and pointed at an "average" scene. Wind up the video gain control until a picture is seen. At this stage, it is not worth trying to achieve a final setting, that will be reached with the RF power module in place. The optimum setting will require slight changes to the trimpots and is best done later.

LEVEL: We rate this construction project as suitable for constructors of:

INTERMEDIATE

experience, between beginners and experienced constructors, with experience in building a number of projects of differing complexity.

Setting the sound module

Prior to installing the sound module in your chassis, it should be tested for shorts between the supply line and earth. With a 12 volt supply connected, the unit should draw approximately 30 ma.

Install the sound module, not forgetting to wire-up the front panel audio gain control (VR4) and check the following:

1. The exciter is installed and wired.
2. The exciter still has the 47 Ω dummy load resistor in place.
3. The video modulator is installed and wired.
4. The camera (with its microphone) is plugged in.

Preset the two trimpots as follows: VR3 (the LINEARITY control) to about ¾ travel clockwise, and VR5 (the SOUND LEVEL control) fully clockwise, and wind the audio gain control on the front panel to minimum (fully anti-clockwise).

Apply power to the transmitter and tune in the picture on a television receiver. When the audio of the TV receiver is increased, random noise will be heard (unless by a fluke, the sound just happens to be on the correct frequency).

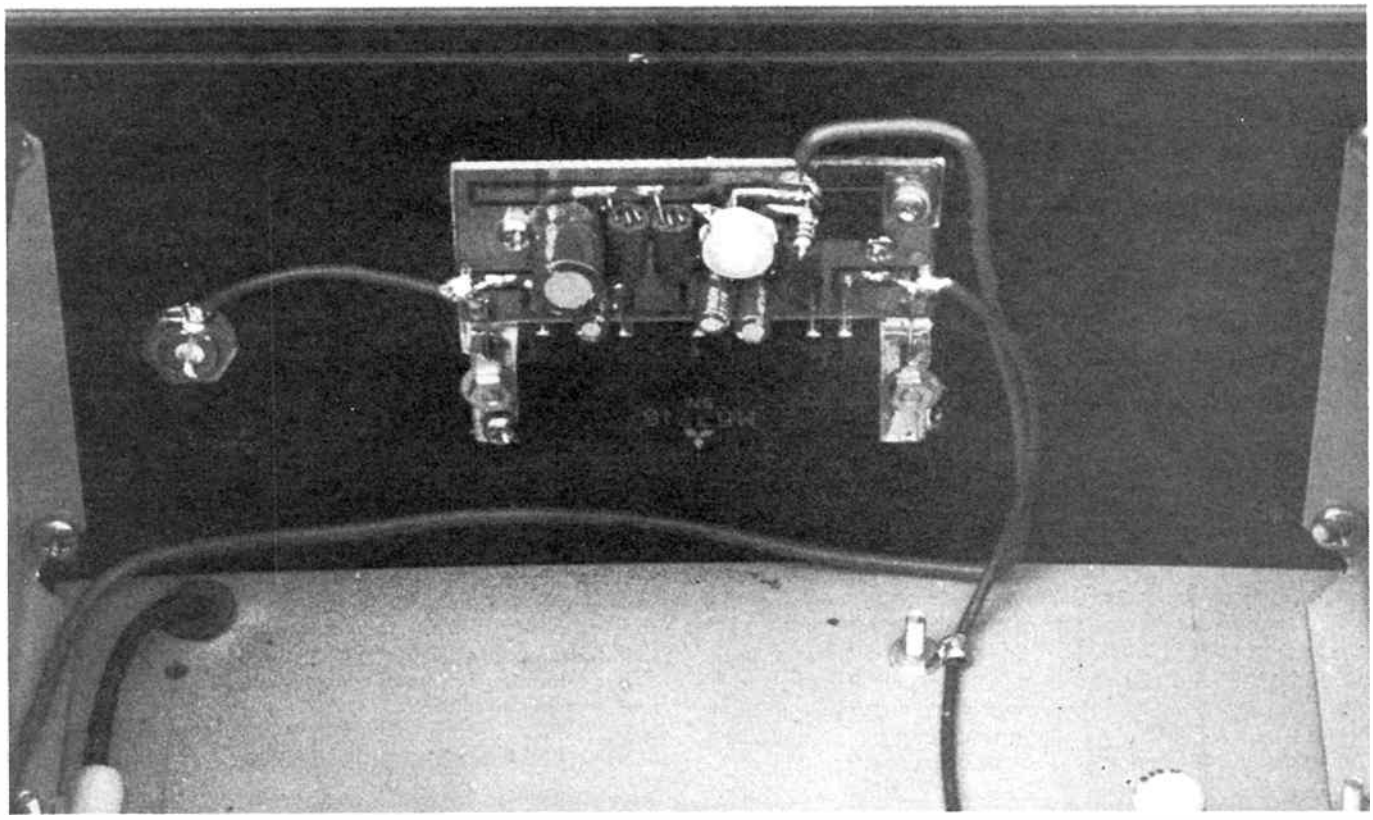
Tune the slug in L8 until the random noise goes quiet. If the audio gain control on the ATV transmitter is now increased, transmitted sound should be heard on the TV receiver. The slug in L8 should now be tuned for the cleanest sound.

Looking at the picture, a pattern from the sound on areas of bright colour will possibly be noticed. This effect can be minimised by adjustment of the SOUND LEVEL trimpot, VR5, which will reduce the sound carrier level.

However, the adjustment can only be continued until the sound starts to become noisy. It will probably need to be set again when the RF module is in place and contact is made with another amateur.

If the 47 Ω resistor is now removed from the exciter coax and this cable is attached to the RF output socket, the unit is ready to transmit a complete signal — although at low power. Connected to a resonant antenna, it will give excellent pictures to nearby amateurs.

If you've decided this is as far as you want to go, then turn to the final on-air tuning instructions. If you're "going all the way", then build the M57716 RF power module and install everything in the chassis, as described following. ▷



AEM3515

RF POWER MODULE

Semiconductors

IC1 ..... M57716
IC2 ..... 7805 or LM340T/5

Resistors

R1 ..... 150R, ¼ W, 5%
RV1 ..... 1k horizontal, trimpot

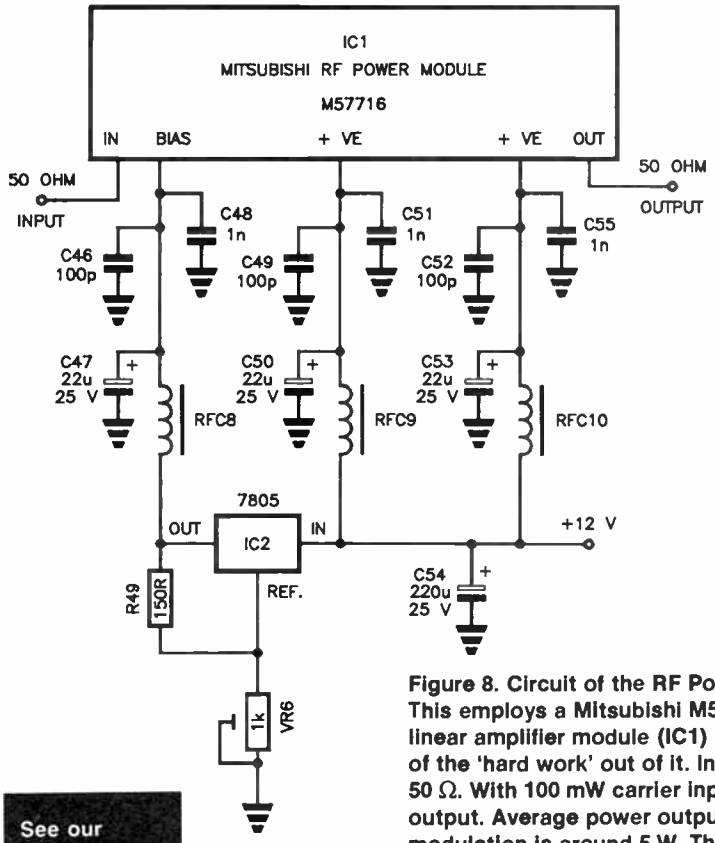
Capacitors

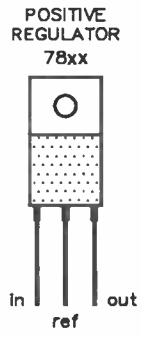
C46, 49, 52 ..... 100p chip caps
C48, 51, 55 .. 1n chip caps
C47, 50, 53 ... 22µ/25 V RB electros
C54 ..... 220µ/25 V electro.

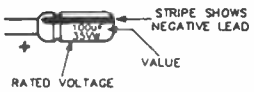
Miscellaneous

RFC8, 9, 10 ..... 6-hole ferrite RF chokes

DR-75 pc board; mounting kit for three-terminal regulator; small sheet of "two-thou" brass shim; two 5/32" solder lugs; three No.4 x 9 mm self tappers; two 4BA 12 mm bolts and nuts; short length of RG178 Teflon coax.



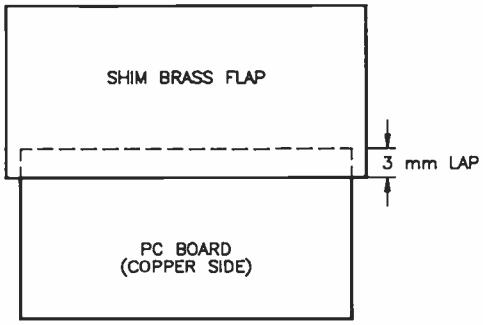




See our 'PROJECT BUYERS GUIDE' this issue for a guide to component sources and kit suppliers.

Figure 8. Circuit of the RF Power Module linear amplifier. This employs a Mitsubishi M57716 430-450 MHz "block" linear amplifier module (IC1) – which certainly takes a lot of the 'hard work' out of it. Input and output impedance 50 Ω. With 100 mW carrier input, it typically delivers 19 W output. Average power output with typical video modulation is around 5 W. The three-terminal regulator, IC2, is used to apply 9 V of bias to IC1's bias terminal. Note the heavy decoupling of the bias and supply leads. Capacitors C46, 48, 49, 51, 52 and 55 are all ceramic chip capacitors which have very low inductance and thus provide the best bypassing. The three electrolytics provide supply rail "smoothing" and low frequency bypassing.

Figure 9. Sweating the brass flap to the pc board all-copper side.



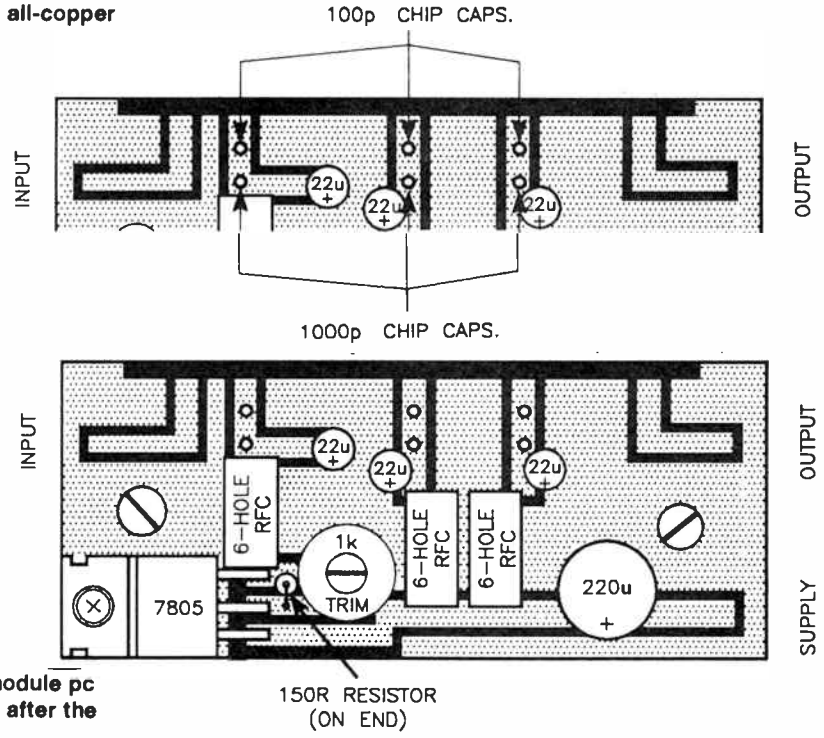


Figure 10. Assembly diagram for the RF power module pc board. The chip capacitors are soldered in place after the brass flap has been sweated to the board.

Building the RF power module

At 100 mW, the output of the exciter alone is quite low, so to raise it to that level popularly used by ATVers, we have employed a linear RF power amplifier "block" from Mitsubishi, the M57716. A data sheet for this is reproduced elsewhere in this issue. It is a broadband power amplifier, covering 430-450 MHz. The circuit is shown in Figure 8.

Typically, with 100 mW carrier input, the M57716 will produce 19 W output. Internally, it is a multi-stage amplifier, mounted on an integral metallic block which serves to conduct heat to a heatsink. A rectangular plastic encapsulation provides protection. All the external connections are made via pins along one side.

The Mitsubishi module requires reasonable heatsinking, which is provided if the complete kit is purchased. The overall efficiency of the M57716 is around 35%, and in this application with typical modulated TV signals it will be dissipating around 20 watts. The heatsink used with this kitset will fit exactly on the rear of the designated Horwood case and measures 105 mm by 200 mm. It is supplied by Rod Irving Electronics of Melbourne as part number H-10543.

The module is constructed on a piece of double-sided pc board, with large tracks etched on the top (component) side. A shim brass flap is soldered to the all-copper side, and this flap goes between the M57716 and the heatsink. It serves to align the M57716's pins with the pc board and conduct heat from the M57716 to the heatsink.

The objective throughout the following instructions is to use a minimum of solder and avoid solder lumps — particularly on the underside of the pc board.

The shim brass flap should be handled carefully. Try not to crease it or allow burrs to remain as the thermal path between the module flange and the heatsink is via this flange.

Now we get down to the assembly of this module. When reading the component layout diagram, refer to the circuit diagram in Figure 8. Follow these instructions as set down and you should experience no difficulties.

First give the board a visual check to see that all the holes are drilled and clear. Note the five tracks along one long side on the top of the pc board. These line up with the pins of the M57716. The three tracks in the "middle" each have a pair of holes drilled through to take the ceramic chip bypass capacitors.

The first step is to turn the pc board over on a flat surface and lay the brass shim next to the board overlapping this long edge by 3 mm. Cut four pieces of 22g (0.071 mm) solder each 10 mm and long lay these adjacent to the overlap.

Pin the shim brass to the pc board with the edge of a steel rule or scrap of aluminium strip and run a soldering iron down the join to sweat the flap to the board. See Figure 9.

Into the three small holes through the board *nearest the flap* drop the 100 pF chip capacitors. Into the three small holes through the board *farthest* from the flap, drop the 1000 pF (1n) chip capacitors. Their locations are shown in Figure 10.

Solder the plated end of the chip capacitors to the underside of the pc board. A piece of solder about 5 mm long laid near the chip before applying a small-tipped, clean, hot iron is the best approach. Turn the pc board over and solder the other end of the chips to the pc board tracks in the same manner. A magnifying glass will come in handy to verify the soldering.

Check with an ohmmeter that there are no shorts across the chip capacitors. (NOTE: At this stage, there is no dc connection between top and bottom faces of the pc board, the above checks are made between appropriate tracks and the underside of the board.)

Form the leads of the 7805 to line up with its matching tracks. Surplus lead length should be cut off so that as much of the tracks as possible are left clear for further components. Mount the 7805 with an insulating washer under its flange, solder its leads in place and a use a bolt and nut to temporarily secure it.

Using Figure 10 as a guide, now you can assemble the rest of the components to the board, before mounting the M57716 module. Solder the 1k trimpot (VR6) and 150 Ω resistor in place; the latter goes on its end. Follow with the three 22 µF electrolytics. Wind the three 6-hole RF chokes (RFC8-9-10), putting 2½ turns of 22g tinned copper wire through *four* holes, so that the leads come out at each end of the choke. Lastly, mount the 220 µF electrolytic, C54.

Now the board and module are assembled to the heatsink. But first, the heatsink must be prepared for mounting to the Horwood case as it replaces the rear panel. The details are given in the accompanying box.

Remove the temporary bolt holding the 7805 and place the pc ▷

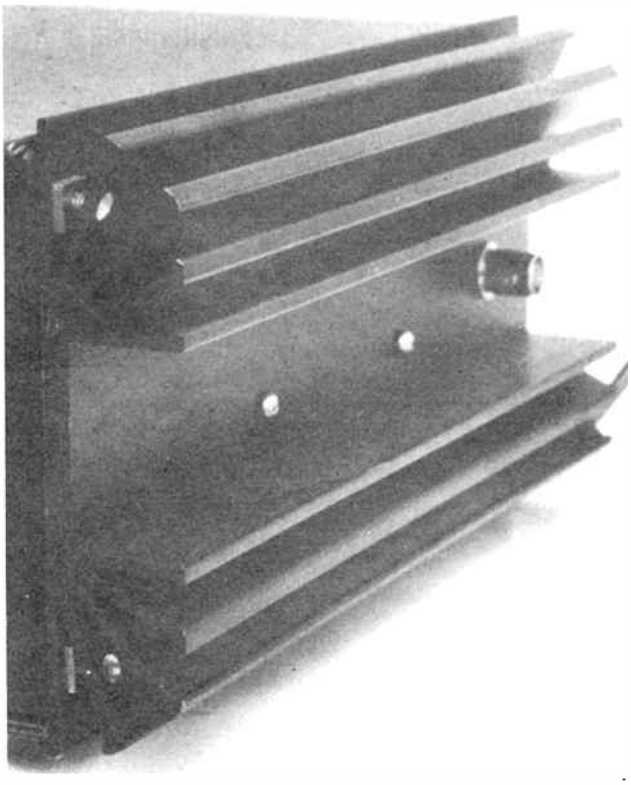
FITTING THE HEATSINK TO THE CASE

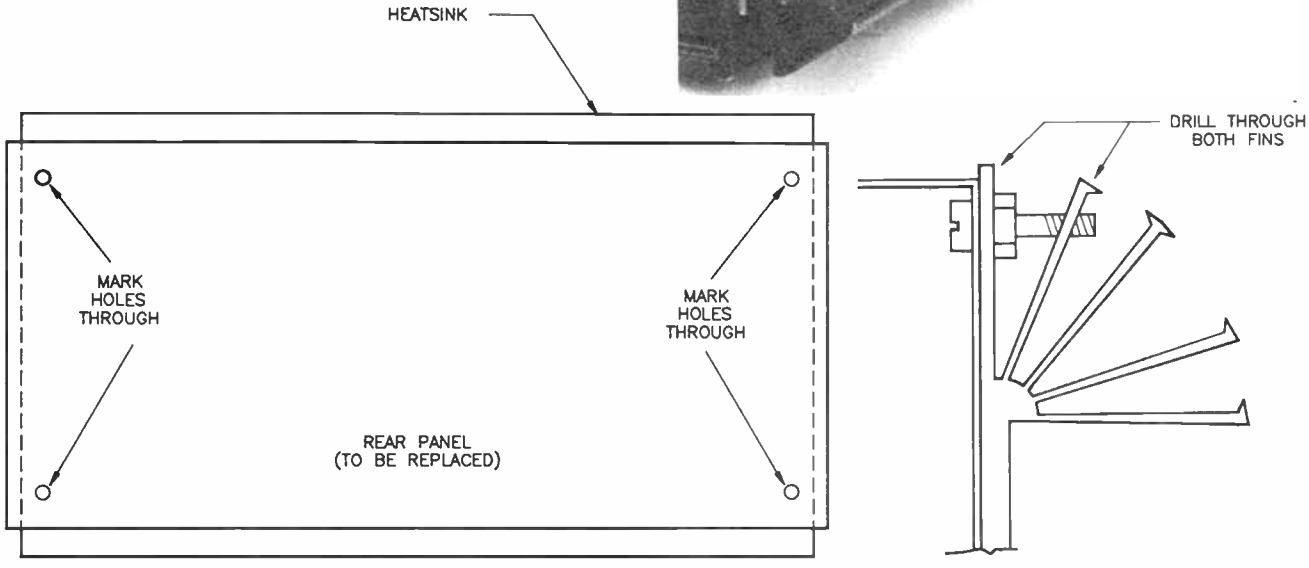
The Horwood 84-series case suggested measures 203 mm wide by 203 mm deep by 102 mm high. It is listed as model no. 84/8/V. With this unit, all panels can be separately removed and replaced if necessary. This, in fact, is exactly what is to happen — the rear panel will be removed and replaced with the large heatsink.

Begin by removing the rear panel, saving the holding nuts and bolts — these will be used again in re-assembling the modified case. Place the rear panel on the heatsink, carefully centering it. See the accompanying diagram. Note that the heatsink is a fraction wider and a little narrower than the rear panel.

Mark the mounting holes on the heatsink, through the rear panel, and drill these with a 4 mm drill, after first centre-punching them. Drill not only through the flat section of the heatsink, but also through the first fin, as illustrated here.

Now mount the heatsink to the side panels of the box by reversing the previous position of the bolts — by placing the head of the bolt on the inside of the box. The nut can be held in place with a pair of long-nose pliers to allow a few threads to be started.





board and flap on the flat side of the pre-prepared heatsink in the position shown in Figure 11. Cut back the M57716 leads to 7 mm long. Lay the module in place on the flap with its leads lined up with the pc board tracks and its edge hard against the board.

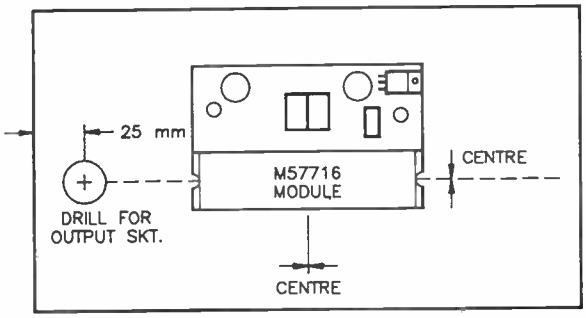
Mark the location of the two mounting holes for the pc board and the hole for the 7805 bolt. Also mark the location for the mounting holes for the M57716 module, which should be in the centre of the cutouts in the module's flange. Remove the pc board and module from the heatsink.

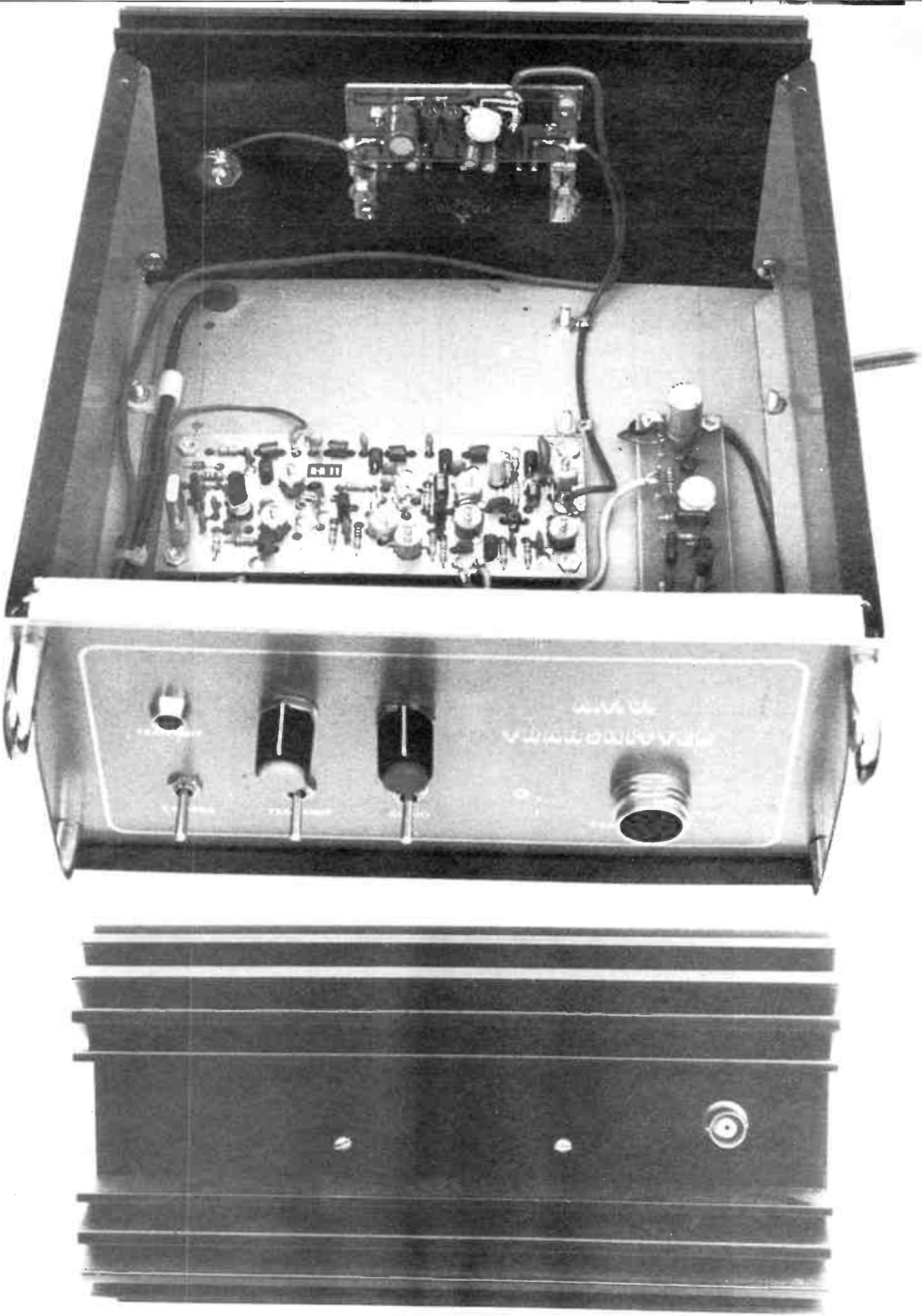
Drill suitable holes in the heatsink at these five points. It's a good idea to centre-punch the hole centres first, to prevent the drill wandering. Also, with a good pair of scissors, cut slots in the flap a little larger than those in the M57716 flange, so as to clear the module's mounting bolts.

Lightly smear the heatsink with silicone thermal compound (that white, "icky" stuff) where it will contact the flap, then bolt the pc board and 7805 to the heatsink. NOTE: these are both best secured by self-tappers as it would be impractical to utilize a nut and bolt in the position these are mounted.

Lightly smear the module flange with silicone thermal compound and place it in position, carefully positioning its leads with the pc board tracks. Bolt the module to the heatsink with 4BA nuts and bolts, placing solder lugs under the bolt heads on top of the flange so that they lay over the top side of the pc board. Now solder the lugs to the top of the board. Carefully bend the M57716 module leads to lay on the tracks and solder them quickly to avoid disturbing the chip capacitors. ▷

Figure 11. Marking out the heatsink.





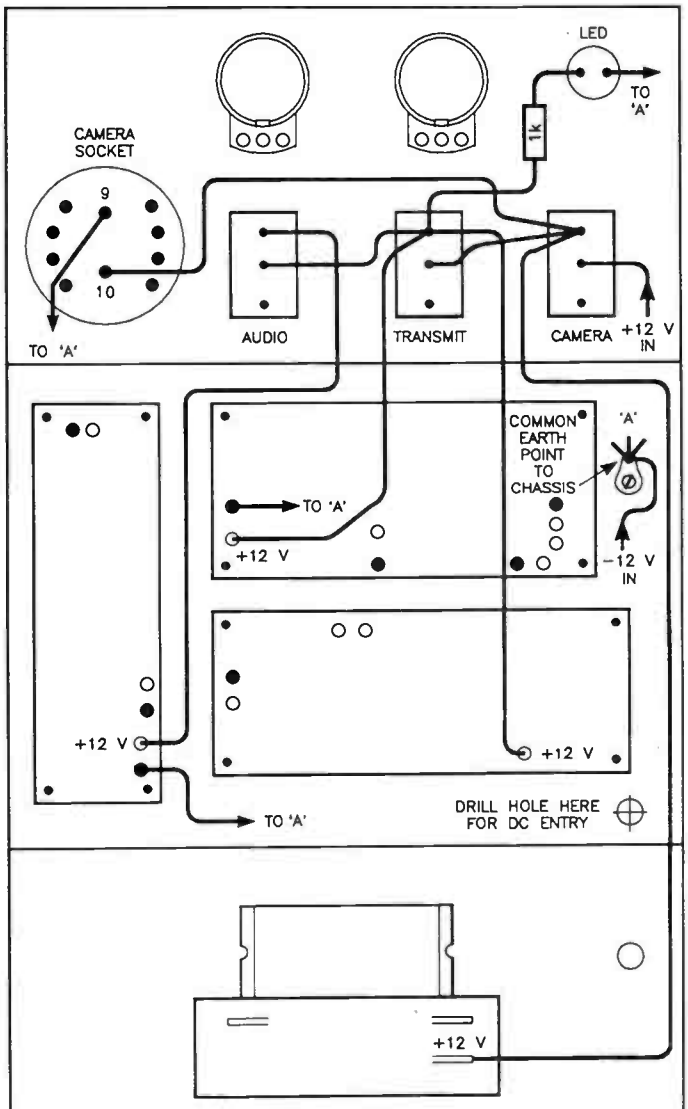


Figure 15. The dc connections.

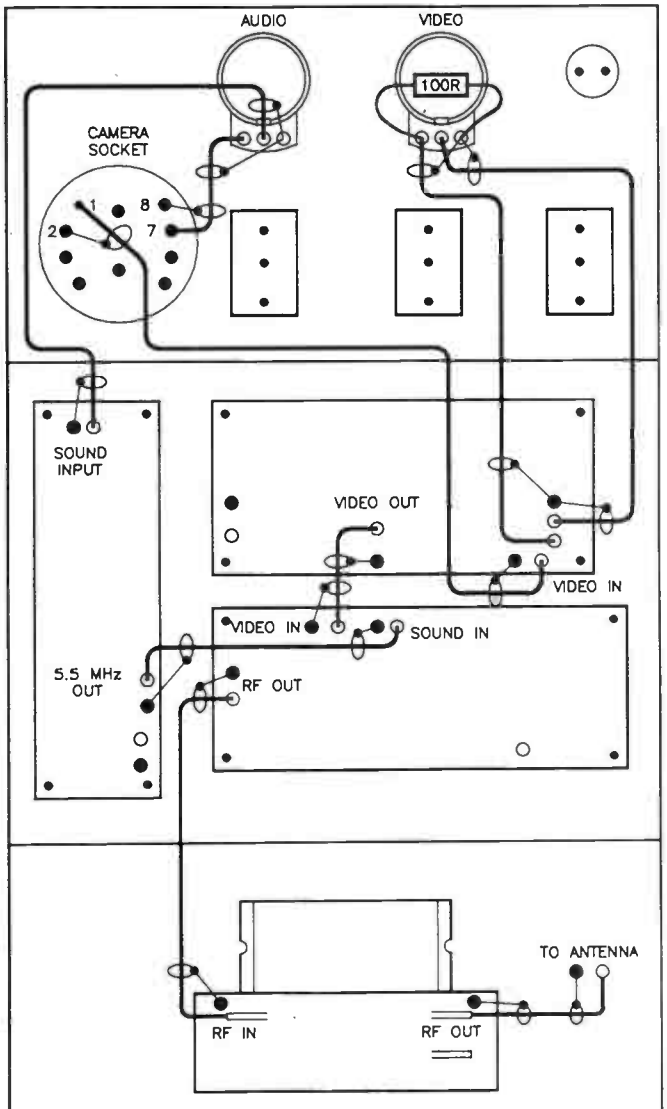
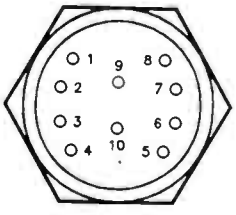
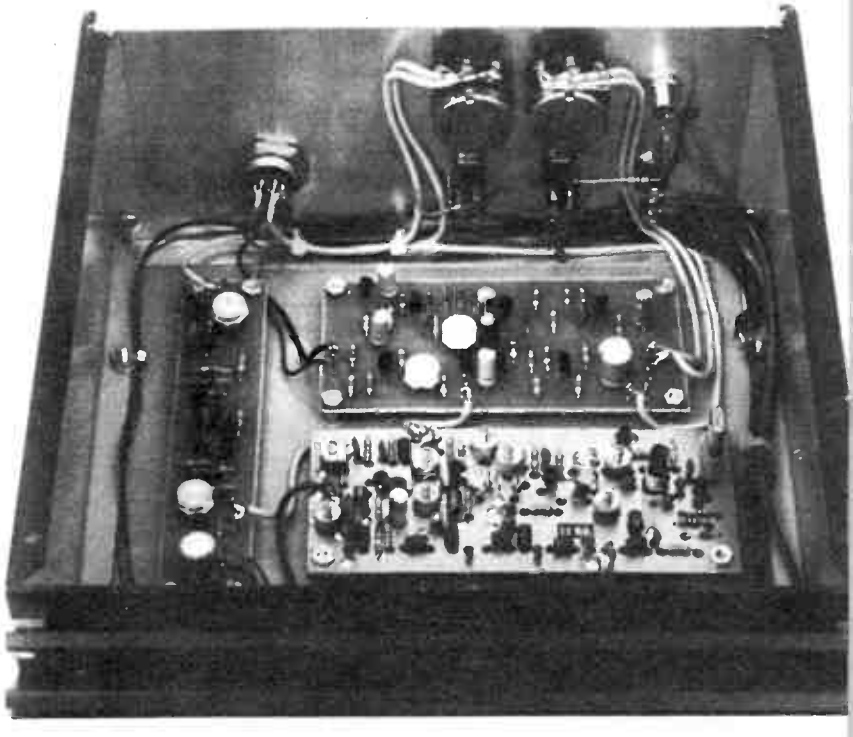


Figure 16. The audio, video and RF connections.



VIDEO CAMERA INPUT SOCKET CONNECTIONS (REAR VIEW)

1 – VIDEO OUTPUT
2 – VIDEO EARTH
7 – AUDIO OUTPUT
8 – AUDIO EARTH
9 – 12 V NEGATIVE (EARTH)
10 – 12 V POSITIVE



AEM3515 CASE AND OTHER HARDWARE

1 x Horwood case type 84/8/V.
1 x Radial fin heatsink, 105 mm x 200 mm.
1 x Scotchcal front panel.
2 x SPDT toggle switches.
1 x RED chrome LED unit.
1 x 10-pin video panel socket.
1 x BNC panel socket.
3 x cable ties.
2 x knobs.
12 x 6 mm spacers.
13 x ⅛" x 12 mm bolts.
13 x ⅛" nuts.
1 x ⅛" solder lug.
300 mm RG178 Teflon coax.
1.5 m single audio cable.
1 m red hookup wire.
1 m black hookup wire.
500 mm heavy duty red hookup wire.
500 mm heavy duty black hookup wire.

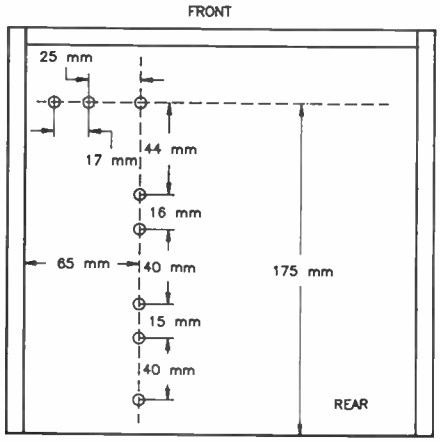


Figure 12.

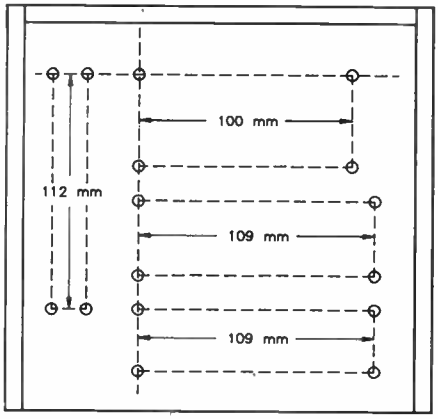


Figure 13.

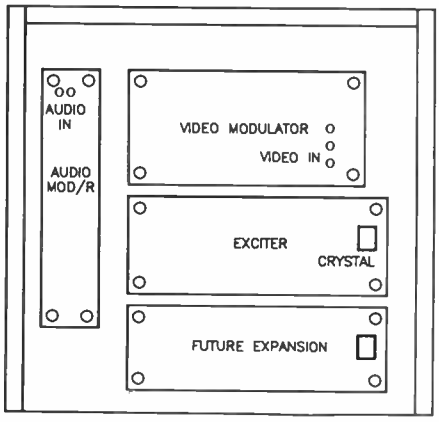


Figure 14.

Visually check your work for shorts. Fix any problems. Once you're satisfied, you can apply power to the assembly — no more than 15 volts, preferably only 12.5-13.5 volts (little current is drawn) — negative to the groundplane, positive to the SUPPLY track, as indicated in Figure 10. Measure the voltage between the 7805's output pin and groundplane, and adjust the trimpot VR6 to obtain 9 volts. This is the required bias for the M57716.

If your module draws *lots* of current, there's something wrong — most likely a short circuit somewhere. Switch off and look for it.

If, or when, all's well, disconnect the temporary supply hookup, set the heatsink assembly aside and proceed to the next stage - the case.

The case — drilling the base plate

Remove the base plate from the case and place it so that the fully-crimped overlaps are on the right and left-hand side, and the partially-crimped overlap is furthest away. Marking-out for the modules is carried out in two steps.

Firstly, mark the baselines as shown on the drawing in Figure 12, and where circles are drawn, mark the centres with a punch. Extend the lines as shown in Figure 13, and mark these circles' centres also with a punch. Drill all 16 holes with a 3.2 mm (⅛") drill.

Mount the modules where shown in Figure 14, using 9 mm or 12 mm spacers. Note that provision has been made for an additional exciter in the future — making the unit a dual-frequency transmitter.

Once the modules are mounted, the base plate can be assembled back on the case and the modules are ready to be interconnected.

The dc circuits

Before proceeding, assemble the front panel. Remove it from the case first. This is quite straightforward. Apply the Scotchcal escutcheon. Soak it in water first and sponge the panel with water just before applying it. This allows you to "slip" the Scotchcal into position, otherwise, you only get *one* chance to get it right. Carefully cut away the Scotchcal over the various mounting holes using a sharp hobby knife. Now assemble the pots, switches, LED and bezel, and the camera socket to the panel. Take care not to damage the Scotchcal when tightening securing nuts.

All the power supply interconnections and earthing details are given in Figure 15. Note the earthing lug near the side of the video module — this provides a single point dc earth to the case. Return all dc negative lines to this lug, as shown.

The dc supply wiring from the audio, video and exciter modules is made with "medium duty" hookup wire (10 × 0.2 mm). Use "heavy duty" (32 × 0.2 mm) red and black hookup wires for the dc input cables, plus the feeds for the camera and RF power module.

The dc input cable is passed through a hole in the rear of the bottom plate (see Figure 15) and a cable clamp held by one of the bottom plate securing bolts keeps it in place.

Route all the cables around the edges of the case, as seen in the internal photographs, tying them together at various points with nylon zip-up cable ties.

The audio, video and RF circuits

All the audio and video interconnections are made with shielded cable, as shown in Figure 16. Use a short length of the thin RG178 teflon coaxial cable for connection between the antenna socket and the output of the RF power amp module. The free end of the RG178 from the exciter is soldered to the input.

When doing these connections, carefully expose a short length of dielectric and inner conductor, but don't fan out the shield braid. This is just tinned and soldered directly to the groundplane adjacent to the input and output tracks. A little of the inner conductor, about 3-4 mm is exposed and tinned, then soldered to the tracks.

Route the coax between the exciter and RF amp module down the middle of the bottom plate, holding it down with solder lugs secured under nuts and bolts put in the holes you drilled for the future expansion module. This can be seen from the internal photographs.

Final tuning

In keeping with the philosophy stated in the first article, the final tuning of the project requires a minimum of test equipment — a multimeter and a TV receiver! The ideal situation would be to have a demodulator feeding into a video monitor or a cathode ray oscilloscope — however, it is assumed that such is not available.

Do not be dismayed by the lack of such equipment however, because excellent pictures are quite easily obtainable with just the multimeter and TV set. The only major problem that may occur is one of overload of the TV receiver. This could happen because of the close proximity of the transmitter and the TV receiver and the way to overcome it is obvious — move the units as far apart as possible.

Overload should be suspected if a good picture cannot be obtained on a local receiver or reports are received from a distant station which vary widely from what is seen on a local TV monitor.

Connect an antenna and camera to the completed transmitter and turn the unit on. Note that the CAMERA switch must be on

— to page 83 ▷

This proximity/motion detector has heaps of applications

Paul Destafano

This project can be used to detect people or animals moving within a given area, or to detect the proximity of a hand or body, or some object, that comes close. It has numerous applications; as apart of a burglar alarm system, or to detect whether the family fido or moggie has come home, to give but two examples.

THIS DEVICE "floods" a room or area with a low-level RF signal from a UHF oscillator. Anybody approaching or moving within the area changes the RF field set up and this affects the oscillator. This affect on the oscillator is detected and used to operate a relay. The concept is very simple and remarkably easy to implement.

So, let us first have a look at the principle in a little more detail and then see how the project works.

Disturbing a field

Figure 1 shows an idealised sequence of events when somebody walks through an RF field. An oscillator sets up a "static" or undisturbed field, represented by the concentric circles in (A) here. You might liken these to the ripples you see on the surface of a pond when a stone is dropped into the middle. Now see what happens when somebody walks into the field (B); the field lines become distorted because the body is basically conductive (being mostly water!), and absorbs some power from the field. Because the field lines find it easier to flow through a conductor, they become concentrated in its vicinity, in this case the person walking into the field. Note that the distortion in the field lines affects them *all*, although near the oscillator antenna they are only slightly distorted.

As the person walks further into the field (C), the distortion of the field lines becomes greater because the body absorbs more power, and the effect on the field lines closest to the oscillator antenna is now greater. As the person continues, the effect reduces.

So how does all this affect the oscillator and how do we go about detecting it?

In this device we have an oscillator with an antenna directly connected to the tuned circuit. Power from the oscillator, radiated by the antenna, is absorbed by the "space" and objects around it. Even if there were a vacuum, power would be absorbed by the "free space"; such is the nature of electromagnetic radiation. By the way, did you know that "free space" has an impedance of 377 Ohms? An antenna simply serves to couple RF power from a generating source (an oscillator or a transmitter) to the impedance of free space — or the impedance of the space surrounding it, and beyond.

Now, when somebody walks into the field of the antenna connected to the oscillator, some extra power is absorbed -

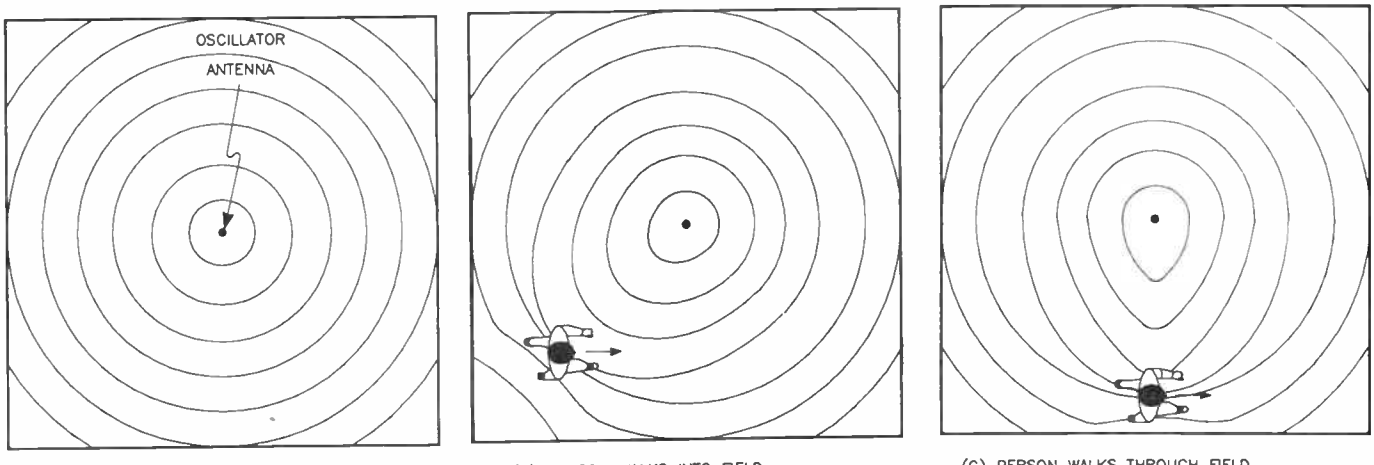
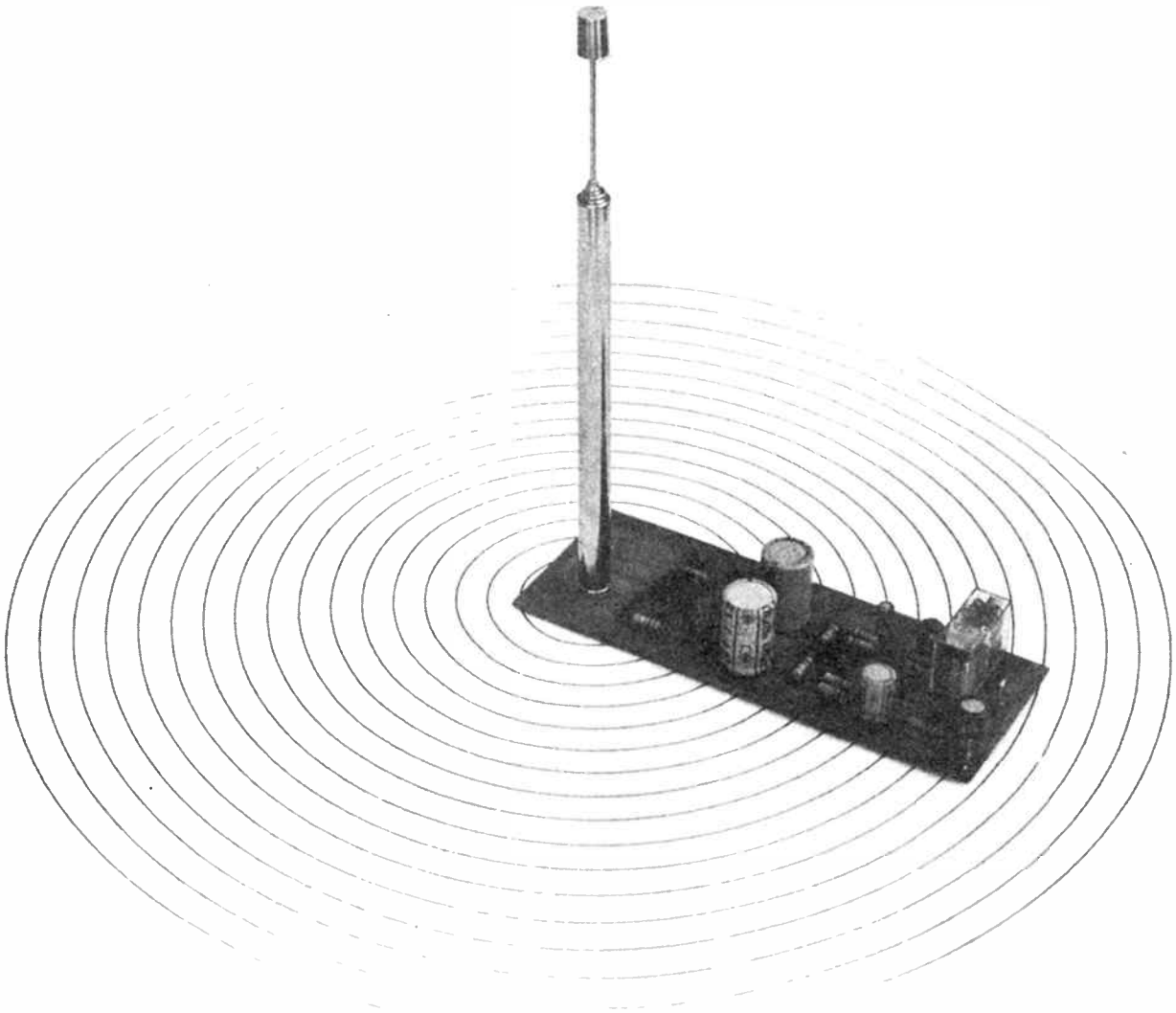


Figure 1. This shows an "idealised" sequence of events of how the motion detector works. The oscillator sets up a field in the area around the antenna. When a person walks into that field, they "disturb" the field pattern. The disturbance to the field pattern affects the performance characteristics of the oscillator. This is detected and used to operate a relay.



more than that absorbed by the "undisturbed" field. Because the antenna is connected directly to the oscillator, this will cause a change in the oscillator's operating conditions, *changing* the current it draws from its power supply. It is this change which is detected and used to operate a relay.

In reality, the field set up by the oscillator antenna will be quite complex, nothing so simple as depicted in Figure 1, particularly when set up indoors, as reflection and refraction from nearby objects creates a very complex field pattern, with "peaks" and "dips" in the field strength. When a person moves through this field, the *amount* of absorption will increase and decrease as they move through a quarter wavelength at the oscillator's frequency. Hence, the oscillator's supply current will vary at a low frequency as the person walks through the field. Figure 2 shows the general idea.

By operating the oscillator on an extremely high frequency, the person, or whatever, doesn't have to move very far to create a significant disturbance! If the frequency were 500 MHz, for example, a quarter wavelength is only 15 cm.

Circuit details

Figure 3 shows the block diagram of the system used in this project. The change in the oscillator's operating characteristics is first filtered by an active low frequency filter circuit that has no gain at dc, plenty of gain up to a few Hertz and then rolls off. This is followed by a passive low pass filter that improves the rejection of 50 Hz mains hum and noise. A comparator then senses when the oscillator change goes through a certain level, this level being set by the sensitivity control which varies the characteristics of the comparator.

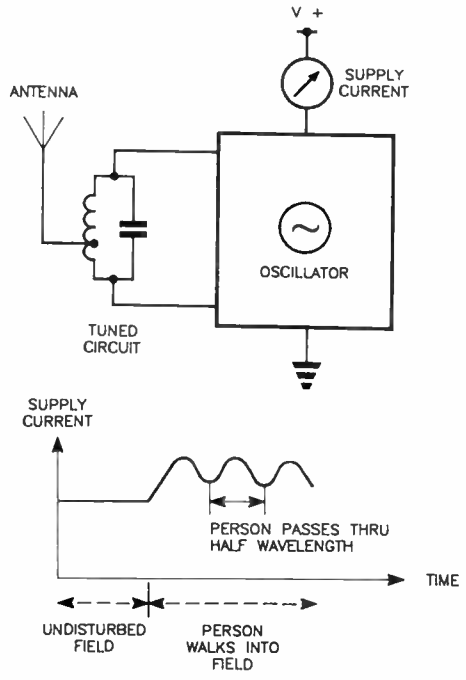
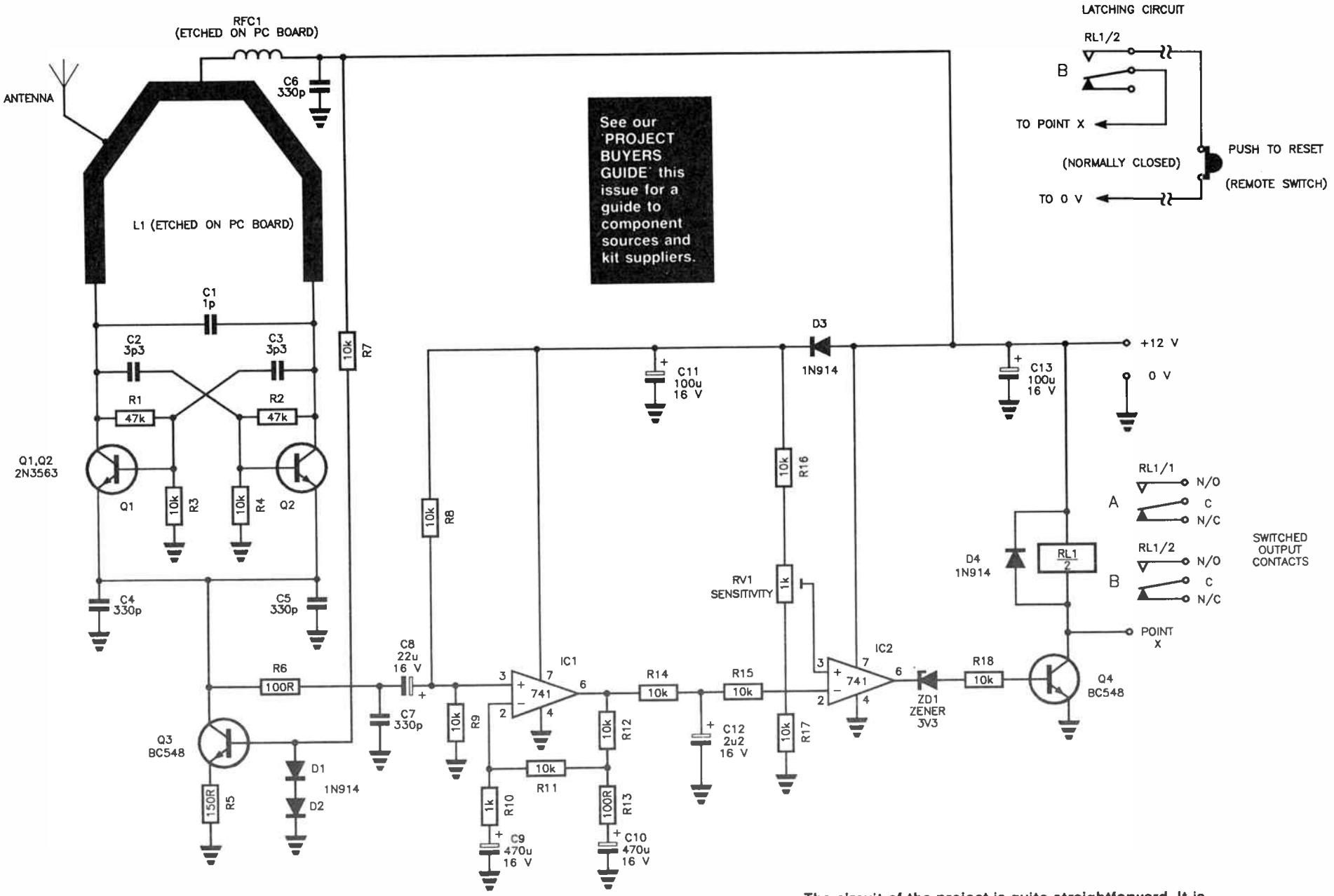


Figure 2. The antenna is connected directly to the oscillator tuned circuit. When the field is disturbed, the oscillator attempts to compensate for the change in the "load", and its supply current will vary as the person moves through the field.



See our 'PROJECT BUYERS GUIDE' this issue for a guide to component sources and kit suppliers.

The circuit of the project is quite straightforward. It is quite easy to distinguish the different stages as shown in the block diagram and thus understand how it works.

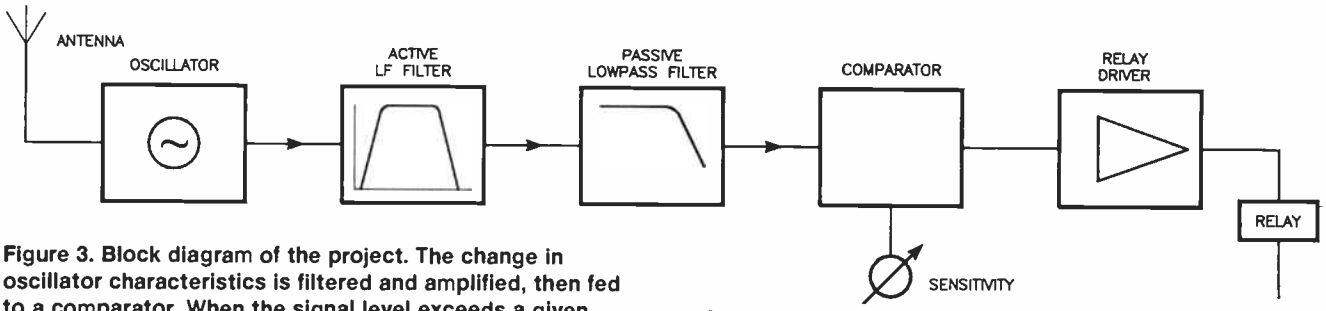


Figure 3. Block diagram of the project. The change in oscillator characteristics is filtered and amplified, then fed to a comparator. When the signal level exceeds a given threshold set by the comparator, the relay is operated.

When the change exceeds the set threshold, the comparator will operate the relay driver and the relay will close.

The threshold may be set to enable movement to be detected at quite a distance, or set to a low sensitivity so that only movement in close proximity may be detected.

The circuit is relatively simple, using components which are readily obtainable off-the-shelf from virtually any electronics retailer — no special parts here. You don't even have to wind any coils — they're "printed" on the pc board! The board measures just 155 mm long by 57 mm wide, with the oscillator at one end and the relay at the other.

Transistors Q1 and Q2 form a push-pull oscillator running at about 470 MHz. A resonant circuit comprising L1-C1 (plus 'stray' capacitances) is connected between the two collectors. This is a "transmission line" tuned circuit, as explained shortly. Total input power is around 40-50 milliwatts, output power probably being less than half that. So, it's a very low level signal. Nevertheless, motion detection indoors up to some 10 metres radius is possible.

The oscillator's tuned circuit is not a coil and capacitor as such. Operating at such a high frequency, even a piece of wire 10 mm long has considerable inductance and coils become impractical and very difficult for constructors to repeat with the required accuracy — this oscillator has no tuning adjustments. However, a length of transmission line, like the 300 Ohm 'ribbon' between your TV antenna and TV receiver, can be used as

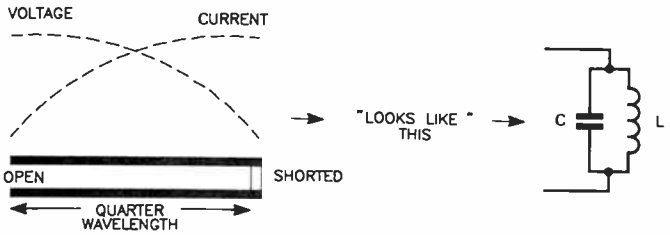


Figure 4. A quarterwave length of two-wire transmission line, open at one end and shorted at the other, behaves like a coil and capacitor tuned circuit. A transmission line tuned circuit is used in the project's oscillator, rather than a coil and capacitor as coils at these frequencies become impractical.

a "tuned circuit" if short-circuited at one end and left open at the other. Figure 4 shows the arrangement.

When this arrangement has a signal applied at the frequency for which it is a quarter wavelength, the voltage at its open end will be at a maximum and the current at a minimum; and vice versa at the shorted end. It will have the same characteristics as a coil-&-capacitor tuned circuit.

A quarter wavelength at 470 Mhz is about 16 cm long — that'd take up quite a lot of pc board "real estate"! Now, any added capacitance effectively connected across the open end of the transmission line, or even anywhere along its length, will have the same effect as adding capacitance to any tuned circuit - the resonant frequency will be lowered. You can look at this another way; a shorter length of transmission line with some capacitance connected across it will resonate to the same frequency as a longer length without any added capacitance.

Now, *any* high frequency circuit will have "stray" capacitances, even though they may be quite small — even less than a picofarad. At these frequencies, such capacitances can be quite significant. Our oscillator here uses two transistors in a "push-pull" circuit, because we're using a two-wire transmission line which is an inherently "balanced" circuit. The junction capacitances of the oscillator transistors and the capacitance contributed by the pc board substrate and nearby copper "groundplane" all contribute to the stray capacitance which influences the length of the transmission line tuned circuit. In addition, capacitor C1 contributes around half the total effective tuned circuit capacitance. Hence, the length of transmission line required is quite short.

For those more familiar with digital electronics, the oscillator circuit is rather reminiscent of a multivibrator! It works like this: Initially, when power is first applied, C2 and C3 will appear as short circuits and each will attempt to charge via the base-emitter circuits of the transistors to which they are connected. Now, because individual transistors have slightly differing characteristics, one of the transistors, say Q1, will turn on first, from the short pulse of current provided by C3 charging.

Q1's collector current will rise sharply and its collector voltage will drop. This will cause C2 to discharge. When the collector voltage falls sufficiently, Q1's base current will not be sustained and it will turn off.

Now that first pulse of collector current through Q1 will cause the resonant circuit to "ring" and, once Q1 turns off, the tuned circuit will "swing" the collector voltage back up again, charging C2. This will turn Q2 on and its collector current will rise and collector voltage fall, governed by the tuned circuit. Q2 will then go through the process that Q1 just experienced.

So, each transistor will turn on then off, in turn; their respective collector voltages "see-sawing" at the resonant frequency of the tuned circuit. Q1 will supply power for one half cycle, Q2 the next half cycle, etc.

The emitters of Q1 and Q2 are tied together and fed from a constant current source comprising Q3, D1, D2, R5 and R7. Diodes D1 and D2 provide a fixed bias voltage of about 1.4 V at the base of Q3. They are biased on with current supplied from the +12 V supply rail via R7. Allowing for the base-emitter voltage of Q3 of about 0.65 V, something close to 0.75 V appears across R5 which establishes a collector current of approximately 5 mA.

So, this establishes the average collector current for Q1 and Q2 at 5 mA, which is in the region of peak small signal current gain for the 2N3563. In addition, at that collector current the 2N3563s have a very high gain-bandwidth product of at least 900 MHz, about twice the oscillator frequency.

The positive supply rail voltage is provided to the oscillator circuit via RFC1, a small inductor etched on the pc board. C6 provides RF bypassing. Capacitors C4 and C5 provide RF bypassing for the emitters of Q1 and Q2. An antenna may be connected to the tuned circuit, "tapped along" one "arm" of L1. This may be required where the project is used as a motion detector, in order to provide the required detection range.

When a person walks within the oscillator's field, changing the field pattern and the "load" on the oscillator, as explained in ▷

the main text, the oscillator reacts to the changing load by trying to alter the collector-emitter current. But this is fixed by the constant current source, so it is the voltage on the collector of Q3 which varies, and thus the collector-emitter voltage of Q1 and Q2. This voltage will increase and decrease as the person moves through a quarter wavelength, that is, about 16 cm.

If the person is relatively far away, the effect is only quite small; closer in, the effect will be substantially greater. If the project is used as a proximity detector, where a hand or object moves within perhaps a few centimetres of the oscillator, the effect may be quite large indeed — the load on the oscillator being such that it may be in danger of dropping out of oscillation. However, the selection of the operating point as detailed above ensures that the circuit remains oscillating.

The varying voltage at the collector of Q3 is capacitively coupled to the non-inverting input of the op-amp IC1 via C8; R6-C7 provide RF filtering. This stage is the active filter. To avoid the requirement of having positive and negative supply rails, resistors R8 and R9 provide a bias to the non-inverting input of IC1 of half the supply rail. This also biases the output at half the supply rail. Feedback is applied around IC1 by the network involving R10-11-12 and C9-C10. IC1 has unity gain at dc, a very high gain at low frequencies, and then the response rolls off again. The output from this stage passes to the comparator via the passive low pass filter, R14-C12, which helps filter out unwanted mains interference and any higher frequency noise.

IC2 is the comparator stage. A pre-set dc level in the range 5.7 to 6.3 volts is established on the non-inverting input by the sensitivity control, RV1. Now, the signal from IC1 is fed to the inverting input of IC2. When the signal here causes the inverting input to fall below the preset level on the non-inverting input, IC2's output goes high; that is, from near zero to a value near the supply rail.

The sensitivity control is adjusted so that the relay is not operated. When there's movement in the oscillator's field, the voltage on IC2's inverting input rises and falls. When it falls below the voltage set on the non-inverting input, IC2's output suddenly goes high. This biases on Q4 and its collector current operates the relay.

The zener diode between the output of IC2 and the base of Q4 is necessary because, under "quiet" conditions, the output of IC2 does not go to zero volts and would otherwise permanently bias Q4 on, holding the relay on.

Diode D3 decouples the supply rail between the output and active filter-comparator input sections of the circuit. When the relay turns on, the supply rail will momentarily drop slightly in voltage. This negative-going pulse can be coupled via the supply rail to the active filter stage and comparator, causing false re-triggering under some circumstances.

The relay specified has two pairs of changeover contacts; one pair may be used to trigger a subsequent circuit, such as a trigger input to a burglar alarm, the other pair may be spare or connected so as to "latch" the relay on as shown in the auxilliary circuit adjacent to the main circuit diagram.

The project may be powered from a small 12 Vdc plugpack or a transformer and capacitor-input rectifier. The former is recommended for safety and convenience. It may also be powered from a 12 V sealed, rechargeable battery kept charged by a "trickle" charger powered from the mains. This arrangement is ideal for application in a burglar alarm system.

Constructing it

While the project is simple to construct, there are a number of important points to note. Firstly, all the components around the oscillator must be seated right down on the printed circuit board so that they have absolute minimum lead length. Remember, a few millimetres of wire at these frequencies has considerable inductance and is likely to affect performance. Note that the 330 pF ceramic bypass capacitors should be low voltage, small (4 mm dia.) disc or plate types.

Before assembling any components to the printed circuit board, first give it a thorough visual check. See that all the holes are drilled and the correct diameter for the components to fit them. See there aren't any tiny copper "fingers" between closely-spaced pads, especially around the ICs. At this point, you might consider how you're going to mount the completed unit so that you can drill holes in appropriate positions for mounting bolts if needed. Details on housing the project are given later.

You'll find it easiest if you commence assembly by soldering all the resistors in place, leaving RV1 for the moment. Follow with the transistors, ICs and diodes, taking care to get their orientation correct. Check the pinouts of the transistors before inserting them, particularly if you are using alternative types to those specified on the circuit diagram. Make sure Q1 and Q2 are pushed well down on the board.

Now insert the link, which is adjacent to where C12 goes. Then solder RV1 in place. Complete the board assembly by soldering all the capacitors in position, taking care to get the electrolytics the right way round, followed by the relay. For terminating the off-board wiring, use "pc pins". If you're going to use an antenna like the telescopic type shown in our photographs, don't assemble it to the board at this stage.

Once the board assembly is completed, give your work a thorough visual check, looking for "dodgy" soldered joints, solder "bridges" between closely-spaced pads and any misoriented components.

Setting it up

It's best to make some initial checks and adjustments before mounting the unit in its final resting place. You will need a 12 Vdc power supply. The unit doesn't draw much current, so a supply capable of delivering a hundred milliamps or more is all that's required.

The board should be supported with the copper side 10-15 mm off the bench or table surface. Set RV1 to mid-travel. Connect your power supply (watch the polarity!); the relay may click on and off once or twice. Once the circuit has stabilised (keep still for a minute!), try moving your hand toward or in the vicinity of the oscillator and at some point, the relay will operate.

If the project does not behave as expected, first check the supply rail, then at the supply pins (7 and 4) of the two ICs. Check that there's somewhere between 0.65 and 0.75 volts across R5. If there are any problems revealed by these checks, switch off, disconnect the supply and look for faults. If the supply appears on IC2, but not IC1, check the polarity and continuity of D3.

When you have confirmed the project is operating properly, you can then look to housing and mounting it.

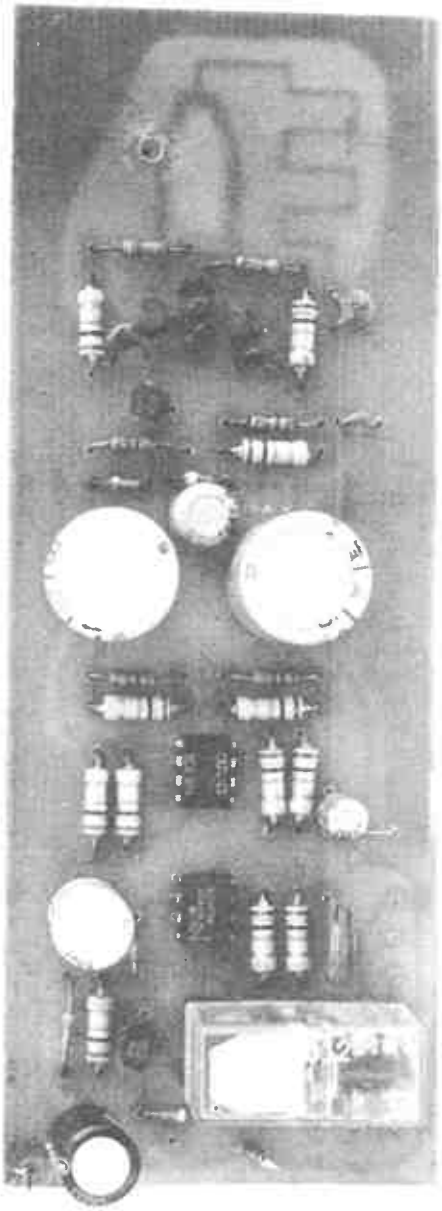
Mounting and final setting

As the project may be used in a wide variety of situations, the exact details of housing and mounting the it will have to be up to you. However, here are a few pointers to assist.

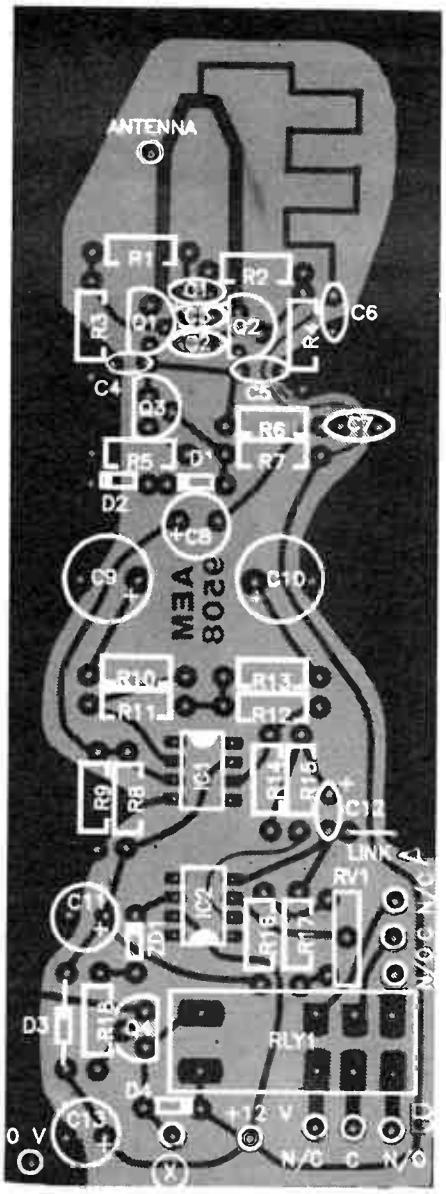
The board may be mounted in a box for protection, but it should be a plastic box; a common, low-cost all-plastic "jiffy" box is ideal. You might also be able to mount a power supply in with it. If the project is to act as a proximity detector (without the antenna), mount it to the lid of the box using 10 mm long spacers and mount the box such that the lid faces toward the "detection area". This may be a doorway, or benchtop, for example.

Drill a hole in the side of the box adjacent to, and in line with, the sensitivity trimpot to permit adjustment once the project's mounted in position. The relay may be connected to any external circuit by means of a two-pin connector or screw terminal block mounted to that end of the case adjacent to the relay.

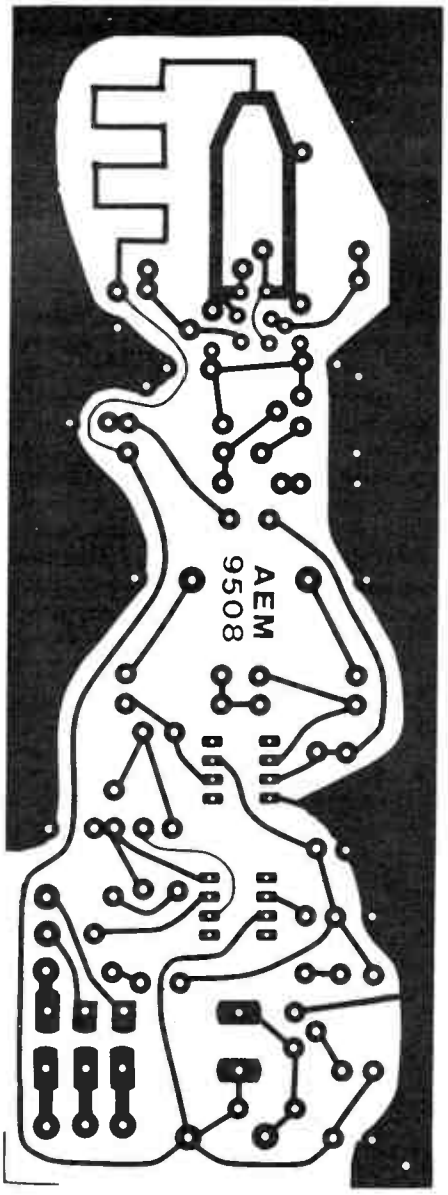
If you're using it as a motion detector, you'll need to mount the antenna to the board. In this case, mount the board in the



View of the completed printed circuit board.



Board overlay, showing placement of all the components.



Full-size reproduction of the printed circuit board.

AEM9508 PARTS LIST

Semiconductors

Q1, Q2... 2N3563, PN3563, 2N3564, PN3564, 2N918, 2N5770, 2N4292, 2N4293 etc
Q3, Q4..... BC548, BC108 etc.
D1-4..... 1N914, 1N4148
ZD1 .. 3V3, 400 mW or 1 W zener diode
IC1, IC2..... LM741, uA741

Resistors all ¼ W, 5%

R1, R2 ..... 47k
R3, R4 ..... 10k
R5..... 150R
R6..... 100R
R7, 8, 9..... 10k
R10 ..... 1k
R11, R12 ..... 10k
R13..... 100R
R14-R18 ..... 10k
RV1..... 1k vertical mounting trimpot

Capacitors

C1 ..... 1p NPO ceramic
C2, C3 .. 3p3 NPO ceramic
C4-C7 ..... 330p ceramic
C8.... 22u/16 V RB electro.
C9, C10..... 470u/16 V RB electro.
C11.. 2u2/16 V RB electro.
C12, C13..... 100u/16 V RB electro.

Miscellaneous

RL1..... 12 V "standard" relay with DPDT contacts

AEM9508 pc board; length of 22g tinned copper wire for antenna, or telescopic antenna to suit (see text); power supply – 12 Vdc plugpack and dc connector (optional); jiffy box or housing to suit (optional).

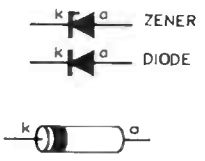
Estimated cost: $25-$30

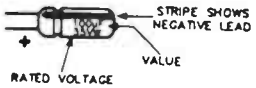
LEVEL: We rate this construction project as suitable for constructors of:

INTERMEDIATE

experience, between beginners and experienced constructors, with experience in building a number of projects of differing complexity.

COMPONENT PINOUTS





2N3563 BC548

Understanding the op-amp and its applications

Part 2

Brian Hammill

This month we look at the concept of negative feedback and how it's used to modify the behaviour of the op-amp to produce amplifiers with "predictable" gain and filters.

IN PART 1, I showed you how to use an op-amp to make a comparator with hysteresis. This involved an important technique, which we're going to explore more. What I did was to take a

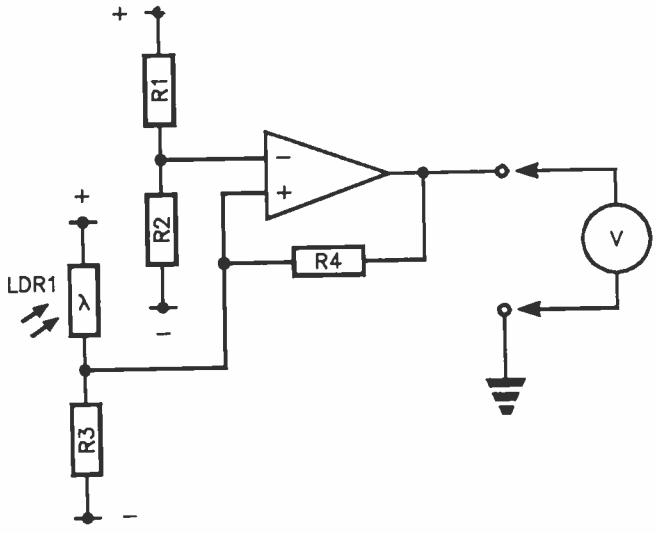


Figure 8. This is what I covered in Part 1. To simplify the "look" of the circuit, it's been drawn without the power supply "rails", without the power supply connections to the op-amp and without the 741 pin numbers. The following circuits are also drawn the same way. As you will encounter many circuit diagrams drawn like this, this has been done so that you can become familiar with the method. Relate this circuit to Figure 6 in Part 1; and the 741 pinouts in Figure 2.

portion of the op-amp's output and feed it back into the non-inverting input, as shown in Figure 8.

This trick of feeding some of the output back to the input is called *feedback*. When it's between the output and the non-inverting input it's called *positive feedback*. So when I say "adding positive feedback to an operational amplifier makes it exhibit hysteresis", you know what I mean!

Those of you with suspicious or investigative minds will be asking what happens when we take some of the output and feed it into the inverting (–) input. Well, this is called *negative feedback* (no prizes for guessing that), and it's what we are going to cover now.

Negative feedback

First, we'll take the positive feedback out of Figure 8, and add a negative feedback resistor instead, which is shown in Figure 9 here. Let's make a few assumptions about this circuit: We'll say that R1 and R2 are 20k, and that R4 is 10k.

Looking at the circuit, what happens when the non-inverting

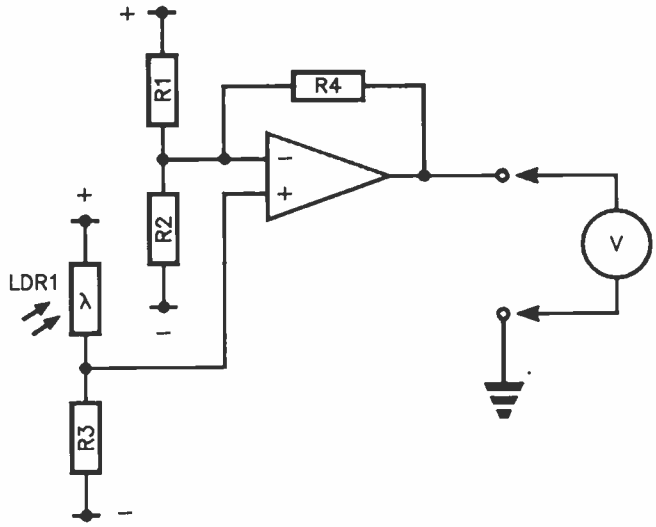


Figure 9. Here's the Figure 8 circuit re-drawn with *negative* feedback this time.

input is positive?; let us say it's at +0.1 V. Well, we know that without the negative feedback, the output of the op-amp will be at about +8 V.

Now what happens to the inverting input? The fact that one end of R4 is at +8 V will pull the inverting input higher. In fact it will go to about +4 V. Now the non-inverting input (which, remember, is only at +0.1 V) is less positive than the inverting input, and so the output of the op-amp will start to fall.

When the output reaches, say, +4 V (which it will do in considerably less than one millionth of a second), the inverting input will only be at +2 V, as the right-hand end of R4 is now not as positive as it was before. So the fall of the op-amp's output will slow down.

When the output gets to +2 V, the inverting input will only be at +1 V. When the output gets to +0.2 V, the it will be at +0.1 V. Now, this is the same voltage as the input, and so the output will stabilise here.

Negative feedback is something you have to picture in your mind to understand. Look at the graph in Figure 10. The horizontal axis is the output of the op-amp. The further to the right, the more positive the output. The vertical axis shows the *differ-*

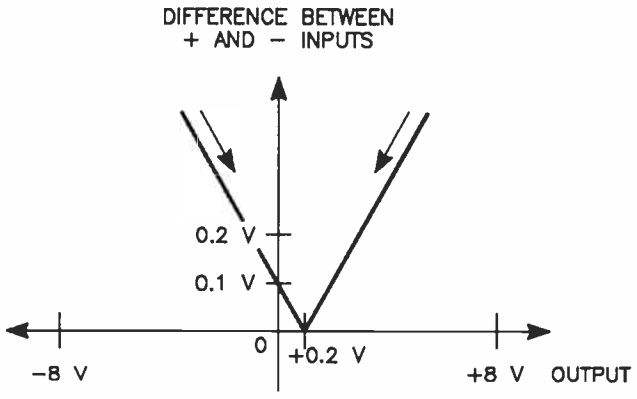


Figure 10. You can picture negative feedback like this.

ence between the non-inverting and inverting inputs. The arrows on the two sloping legs of the graph show which way the difference in inputs is going to force the output.

When the output is, say, +2 V, then there is a fairly large difference in the inputs, and that difference will tend to force the output of the 741 more negative (as indicated by the arrow pointing down to the left). When the output of the 741 is -2 V, the effect of the difference in input voltages will tend to force the output more positive.

So you can imagine the actual value of the output voltage as a ball starting at the top of either leg of the graph, rolling down to the bottom and settling there.

Now, when you look at the circuit diagram, the effect is this: the output of the 741 will always be equal to *twice* the voltage on the non-inverting input.

As the light falling on the LDR increases, the voltage on the non-inverting input of the 741 will *increase*, and the voltage at the output will *increase* correspondingly. This means that the 741 is operating as an amplifier — that the output is the same as the input, only larger. In fact, Figure 11 is a graph of output

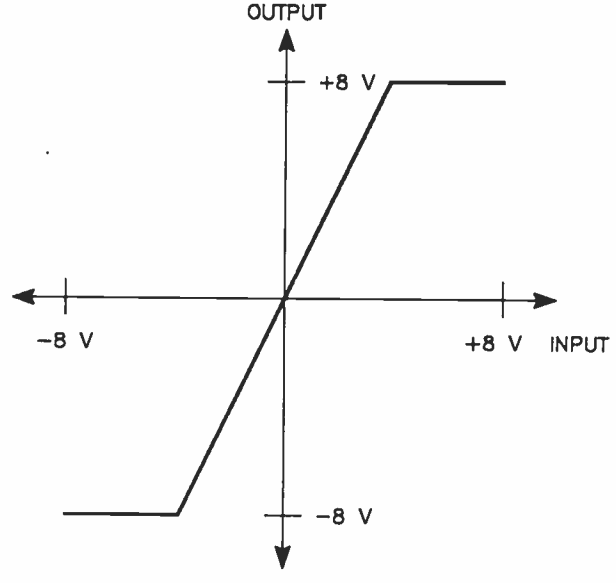


Figure 11. A graph of the output versus the input for the circuit in Figure 9

against input for the 741 in this circuit. Compare it with Figure 7a in Part 1.

So you can think of an op-amp with negative feedback in Figure 9 like this: It's forever trying to make the voltage on its inverting input the same as the voltage on its non-inverting input. It will always change its output until the inverting input is at the same voltage as the non-inverting input.

This brings us to the next type of circuit. An inverting amplifier.

The inverting amplifier

Remember, and pardon me for repeating this for the third time, ***an operational amplifier with negative feedback is forever trying to make the voltage on its inverting input match the voltage on its non-inverting input".***

Take a look at Figure 12. Remember that the symbol that's connected to the non-inverting input in this circuit is an "earth": that is, it's the O V point of your balanced supply (i.e: the point where your two batteries are joined together, the common of the split supply). So the non-inverting input is at O V. The op-amp will be trying to change its output so that the inverting input is also at O V.

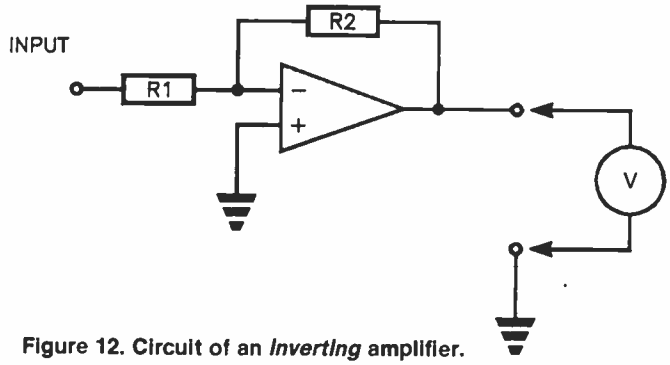


Figure 12. Circuit of an *Inverting* amplifier.

Now, what say we make the two resistors R1 and R2 10k each, and set the input to the circuit at +1 V. The only way that the op-amp can make the inverting input the same as the non-inverting input is if the output is -1 V. Perhaps it might help you to see this if we draw just R1 and R2 and ignoring the op-amp, as in Figure 13.

Similarly, whatever the input to the circuit of Figure 12, the output will simply be the negative of it. This sort of circuit is

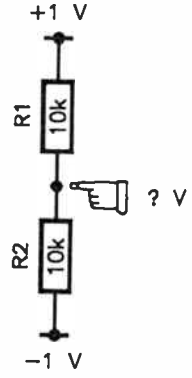


Figure 13. Re-appraising the circuit of Figure 12, ignoring the op-amp.

called an *inverting amplifier*, because it inverts whatever the input is. The circuit in Figure 9, by the way, is called a *non-inverting amplifier*.

Fine. Now we've got a circuit which changes the sign of the input — but what use is it? Well, apart from the fact that it can be used (and often is) as a 'buffer' circuit (the input impedance is 10k, and the output impedance is a few hundred Ohms), it can be used where there is a need to change the sign of a signal; in other words, switch the phase by 180°.

For example, say you want to drive two amplifiers in a 'bridge' configuration — with the output of each amplifier connected to opposite terminals of the same speaker. This increases the power that you produce. In order to do this, you have to drive the amplifiers with signals that are the same, but opposite ▷

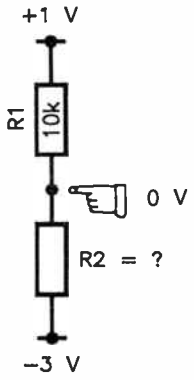


Figure 14. Finding the value of R2, the feedback resistor, for a gain of -3.

in sign. (Notice, by the way, that not all amplifiers are capable of being used in this configuration — so don't try it until you are sure that yours can!)

Now the gain of the amplifier in Figure 12 is -1. As an aside, the 'gain' of an amplifier is defined as being the number that you have to multiply the input voltage by to get the output voltage. The gain of the amplifier in Figure 9 is two (2).

Can we make an amplifier with a gain of, say, -3? How would we arrange the values of Figure 12 to obtain a gain of -3? Take a look at Figure 13 again. Say we wanted to keep R1 (which determines the input impedance of the circuit) the same. Now for an input of +1 V, and a gain of -3, we want an output of -3 V. Look at Figure 14, which is a re-arrangement of Figure 13 which defines what we want to do. It's pretty obvious that R2 will have to be 30k.

In fact, the gain of the circuit in Figure 12 is:

$$-R2/R1.$$

Notice that changing the value of R2 does not alter the input impedance of the circuit. This is because the inverting input of the op-amp is always at O V, regardless of anything else. So in Figure 14, the fact that R2 is changed will not make the slightest difference to something that is connected to the top of R1: it will always see a 10k resistor connected to O V.

This fact has caused the amplifier in Figure 12 to be known a *virtual earth* amplifier: because the inverting input of the amplifier, while not actually an earth (i.e: not actually connected to the O V point of the supply), "looks like" an earth to the rest of the circuit. So it's called a "virtual" earth.

This brings us to the next application of the op-amp — the *virtual earth mixer.*

The virtual earth mixer

The most common use for the virtual earth mixer is in audio - where you have the signals from say, a number of microphones, and you want to add these signals together before feeding the result into a public address amplifier. Figure 15 shows such a these mixers. As you can see, it's very similar to Figure 12, except that R3 and R4 have been added.

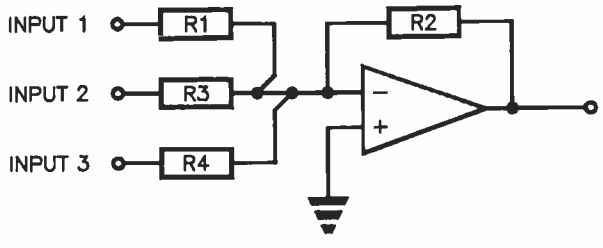


Figure 15. Circuit of a *virtual earth mixer.*

Now, you can ignore the effects of R3 and R4 for the moment, because if there's nothing connected to their inputs, they will have no effect on the circuit.

So to start with, you have the same circuit as before: any signal at INPUT 1 will appear at the output with a gain of -R2/R1.

Let's take the case where R1, R2, R3 and R4 are all 10k and INPUT 1 is at +1 V. The output of the op-amp will be - 1 V, as before. Leaving it like that for a moment, let's add a second input at INPUT 2, of +0.1 V.

This will tend to drive the op-amp's inverting input more positive, and the op-amp will react by making the output 0.1 V more negative. This will *exactly counteract* the effect of INPUT 2, and keep the inverting input at 0 V.

Notice, however, that as far as INPUT 1 is concerned, nothing has changed: the inverting input of the op-amp is still at 0 V.

So the output of the op-amp will be:

$$[\ -1(\ \text{INPUT 1}\ \text{INPUT 2}\ \text{INPUT 3})\ ]$$

So what the circuit is doing is *adding* the three inputs together and then *multiplying* the result by -1 (the gain).

What if we make R1 5k instead of 10k? The op-amp will then have to respond to changes in INPUT 1 by moving the output twice as far. In fact, the gain of INPUT 1 will be -2. The gains of INPUTS 2 and 3 will still be -1, however!

And notice that no matter what happens, the inverting input of the amplifier will always stay at 0 V: none of the signals coming in through the inputs will ever go out through other inputs and affect the microphones.

As I said, this sort of circuit is used very often in audio mixing applications. In fact, if you choose the right values for the resistors, and make portion of the input resistors variable, you can build a simple microphone mixer using this circuit. The output may go into either the mic or the line input of an amplifier, depending on what gain you choose for the circuit.

Filters

One way to look at a capacitor's role in a circuit is to think of how the circuit is going to respond to a single frequency, find the reactance (resistance) of the capacitor at that frequency, and then treat it like a fixed resistor. This sort of approach is useful in looking at op-amp circuits of the type we're going to cover now.

The impedance of a capacitor can be found from the following equation:

$$Rc = 1/2.\pi.f.C$$

where Rc is the reactance, or "equivalent resistance" of the capacitor,

π is pi, a constant whose value is about 3.14,

f is the frequency you're looking at, and

C is the capacitance.

Now in the above equation, C is in Farads, Rc is in Ohms, and f is in Hertz. The Farad is a very large unit — most capacitors are measured in millionths of a Farad (microfarads — uF), or thousand-millionths of a Farad (nanofarads — nF). Most resistors that you would use in this sort of work would be measured in kilohms — so why don't we make the equation a bit easier to live with by altering it like this:

$$Rc = 159/(f.C)$$

where

Rc is in kilohms,
f is in Hertz, and
C is in microfarads (μF).

Or, 159 000/(f.C),
where C is in nanofarads (nF).

So if we want to find out what the equivalent resistance of a 1 μF capacitor is at 100 Hz, then it's:

$$Rc = 159/(100.1)$$
$$= 1.59$$

(that's 1.59 kilohms, remember). You may like to try the same sum with the earlier form of the equation, just for fun.

So, how do we put this to use in op-amp circuits? Figure 16

shows a simple "high cut" filter, such as might be found on a hi-fi amplifier for removing "scratch" noise from old records.

It's called a high cut filter because it "cuts out" all signals with frequencies *above* a certain frequency, called the *cutoff frequency*. It's also known as a *low pass* filter, for reasons which should be immediately obvious. It works like this: First, imagine that the frequency of the signal passing through the filter is so

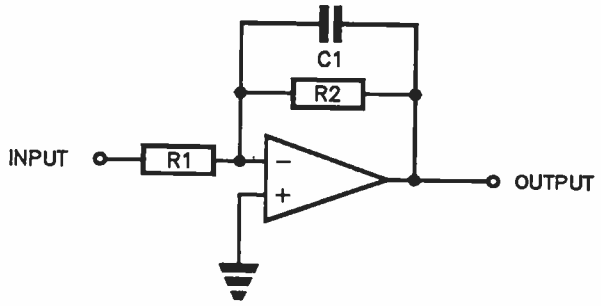


Figure 16. Circuit of a *high cut filter* (also known as a low pass filter).

low that C1 doesn't matter — in other words, the frequency is so low that the 'resistance' of C1 is very high, which means it can be ignored. The filter would then act just like a normal inverting amplifier, with a gain of - R2/R1.

Now look at the case where the frequency is so high that the resistance of C1 is very low — so low, in fact, that it's very much lower than the resistance of R2. The gain of the circuit is now -Rc/R1. Remember that we said that the resistance of C1 was lower at this frequency than that of R1? Well, if you compare the two gain equations, you'll see that the gain of the whole circuit is lower at this frequency because of that fact.

So, the gain of the circuit is altered, becoming lower at higher frequencies. You can see that those higher frequency signals would be "cut out" — they would pass through the filter so attenuated that for all practical purposes, they'd "disappear" at the output.

So, if we graph the circuit's gain versus frequency, we get something looking like that in Figure 17 — the *frequency response*. Note that the gain of the circuit never actually drops completely to zero, because the resistance of C1 never actually gets to zero.

The cutoff frequency of the circuit is generally taken to be that frequency where the gain is *half* what it is at lower frequencies.

Now, just take a look at Figure 16 again. You can see that the cutoff frequency is where the resistance of C1 is the *same (not*

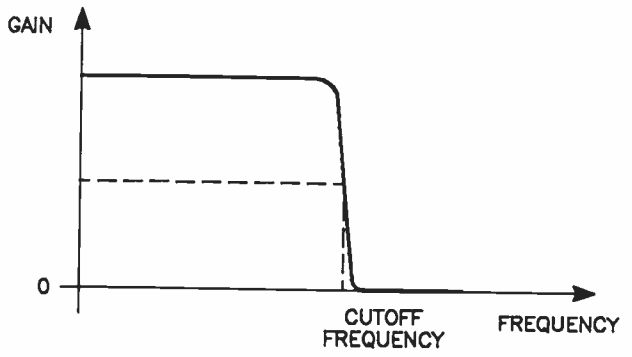


Figure 17. Frequency response of the Figure 16 circuit. The cutoff frequency is that frequency where the circuit's gain falls to half that at low frequencies.

half!) the value of R2. At such a frequency, the combined resistance of R2 and C1 in parallel is half that of R2 alone.

Here's an example, to illustrate. Say we want a filter that has an input impedance of 10k, a cutoff frequency of 10 kHz, and a low frequency gain of -1. Well, the input impedance is set by R1, so we make R1 equal to 10k. That takes care of the circuit's input impedance. Now, R2 sets the low frequency gain, and since this is to be -1, we have to make R2 10k also.

What about the value of C1? Well, we want the resistance of C1 to equal that of R2 at the cutoff frequency. So the resistance of C1 at 10 kHz must be 10k. Using our new, improved equation:

$10 = 159\,000/(10\,000.C)$

re-arranging that, we get

$C = 159\,000/(10\,000.10)$

$= 1.59$ nF

A 1.5 nF capacitor would be close enough with 10% tolerance capacitors.

Thus endeth the second lesson. In Part 3, I'll conclude by discussing some more complicated things, after I've told you about *low cut* filters. In the meantime, try and work out how you'd make a low cut filter.

▶ **from page 73.**

picture should already be viewed on a local monitor or by another amateur.

Place Probe 3 in a fixed position near the output of the M57716 module so as to obtain a readable output on the multimeter connected to the probe.

The next steps will try an achieve the highest power output without sacrificing quality. The operative word here is *quality* and not power. It takes a large change in power output before any change in strength is noticed by a receiving station, so make picture quality and stability your number one priority.

The technique is to arrive at the best combination of clamp setting (VR2) and video gain (VR1). Try varying settings of each and check for good quality and stability and then look at the multimeter (acting as a power meter). A feeling for these adjustments will quickly be obtained and minor changes will make little difference. The final settings will be those which give the highest reading of power without any sacrifice in quality.

An indication of the correct amount of power output is obtained by placing a hand on the heatsink (as supplied with the kit) after the transmitter has been in operation for at least 30 minutes. It should be quite warm to the touch and a little unpleasant to grip tightly.

If a power meter is available (that can be trusted at 450 MHz!) and is connected to the output, it should read around five watts with a normal picture. With the video gain turned down and the clamp and sync pulse potentiometers (VR2 and VR2a) set for maximum power, the meter should read between 15 and 20 watts. Don't forget to return the pot. settings to their original positions if you make this latter power reading.

Recheck that the sound is on frequency as discussed in the sound module tuning earlier. Place a lens cap over the camera lens so there is no video signal present. Set the sound level by reducing it with the level potentiometer until a point is reached where a remote station just starts to hear background noise. Raise the level until this noise disappears. NOTE: A very slight adjustment of C5 on the exciter module can peak the sound carrier level without any noticeable effect on the transmitter output power — the major point here is that the adjustment is "very slight".

When the lens cap is removed there may be some background noise appear when there are very bright areas in the picture. This indicates that the video gain is set a little too high, so reduce it until this noise disappears.

This completes the assembly of your colour ATV transmitter and you will have an excellent unit in operation.

The Goldstar DM-6335 handheld digital multimeter

Ben Furby

A new name on the instrument market, Goldstar seems set to make quite an impact, if this instrument from their range is any gauge.

"HOW," asked Roger, "Would you like to test drive a digital multimeter?" Well, you know me by now; I'm the guy Pope was thinking of when he wrote "For fools rush in where angels fear to tread". Only he wrote it about two centuries before I was born. Perspicacious fellow.

That's how I came to be unpacking a Goldstar DM-6335 near the home workbench. It's well packed, too. Inside the attractive carton, the instrument was shrouded in foam plastic. I admired Goldstar's forethought. That's the sort of stuff to protect delicate meter movements, I told the bench vice.

As the DM-6335 burst into sight, I was bedazzled by the industrial orange décor. Just the thing to wave at searching aircraft when you are adrift clutching a plank after being shipwrecked off Broome. Jokes aside, point 1 to Goldstar.

However, knowing that I come from a pre-DMM era, Roger had thoughtfully lent me another DMM for comparison, and this also came in industrial orange.

Honours even, so far.

Well, I climbed over and under the thing looking for the good old D'Arsonval meter movement, but nary a sight of a moving coil could I get! Until it dawned that what I thought was a LCD for a clock (handy to know the time) or calculator (great for on-the-spot Ohm's Law or power calculations — very thoughtful of Goldstar, I opined), turned out to be the readout for the thing.

Why not suggest to the manufacturers that they include a calculation function in their DMMs, I thought, for dashing off the odd Ohm's Law and power calculation? Already been done, says Roger, ten years ago. Ah well, I suppose the wheel was reinvented a few times, too.

Fingers, fun and findings

You probably though I should have headed this section "Hands on". But you'd need incredibly small hands to get more than one on the DM-6335! First thing to do — press the on/off switch; it was like ringing *full ahead* on a ship's engine room telegraph. From now on it was all flashing symbols and figures. The message I got was that it was trying to tell me something, and it was saying it in figures large enough for even me to read without trouble.

Well, the test leads were good. Good positive seating in their sockets, not always springing out like the negative lead plug in my analogue benchtop instrument. Notice how they always do that when you're concentrating on getting the right spot to take your reading and how you curse when you can't get one, until you look up and spot the sprung connection? I can't see the Goldstar pulling that one on me.

Solid, properly flexible test leads. Yes, nothing cheesepared there. Nifty probes, too. Complete with non-slip finger guards, very handy for restoration work on vintage valve radios with 300 V high tension.

Screw-on alligator clips are also supplied, properly insulated, too. Saves the assembly of the clip leads I have to clip on the old bench job's probes when I need such a facility. Now to get to grips with the thing.

You have to swap the positive probe's plug to a different socket for volt/ohms, and mA and A. I think it's a thing you'd get used to pretty quickly.

So I trundled it out on to the street and began by running it round the block: metaphorically speaking. Out came a few resistors, of those minuscule sizes usually too hard for my dimmed eyes to spot the colours.

Shift up the selector to Ohms range, let out the clutch and try a few measurements. This is living! That tan-red-black one was really a 12.2 Ω disguised as a 12 Ω resistor. But, in fairness, it was a 10 per cent type so we can't blame the resistor maker too much. It was the same with other resistors. In circuits that call for accurate values or matched value resistors, a DMM is the "tool" for the job.

None of your logarithmic analogue resistance scales on the old moving coil job, all crowded at one end; you know where you are with this thing.

So, now it was time to move into the voltage and current "fast lanes."

I got out an ancient, 20-year old Sanyo receiver, the same model as my long lost first transistor radio, which I bought secondhand in fond memory of that first one. Only this replacement set has always sounded distorted, and I haven't quite been able to put my finger on it. Not that it mattered much, as I have other transistor portables I use.

There was all the fun and games of setting up a power supply for the thing. Merrily I took it all in my stride: the supply was delivering 6.2 V, the Goldstar told me.

"Can't have that," I told the drill press. "If I'm looking for distortion I can't blame the set if I'm delivering too many jolts to it, when it was designed for 4.5 V."

Current mode: by jove, that works like a charm. A quick bit of that R = E/I stuff, choose a resistor, back to Ohms range and confirm that I'm still not colour blind. Whang it in, check voltage, 5.2: yeah, that'll do. Like I said it before, this is really living!

Now the hard bit begins, like measuring the volts around the push-pull output stage. They don't make transformers like they used to, you know! You should have seen the output transformers on valve sets, they were real tributes to Faraday and all those conductors cutting magnetic lines of force stuff.

Well, to cut a long story short, the Goldstar courteously told me the voltages wherever I put the probe. Not just rounded off to the nearest volt, you got "3.84" and this sort of "keep decimals off the dole" stuff.

No parallax error with meter needles, either, you know. With this sense of the middle road the thing would go far in politics, and I think I ought to nominate it

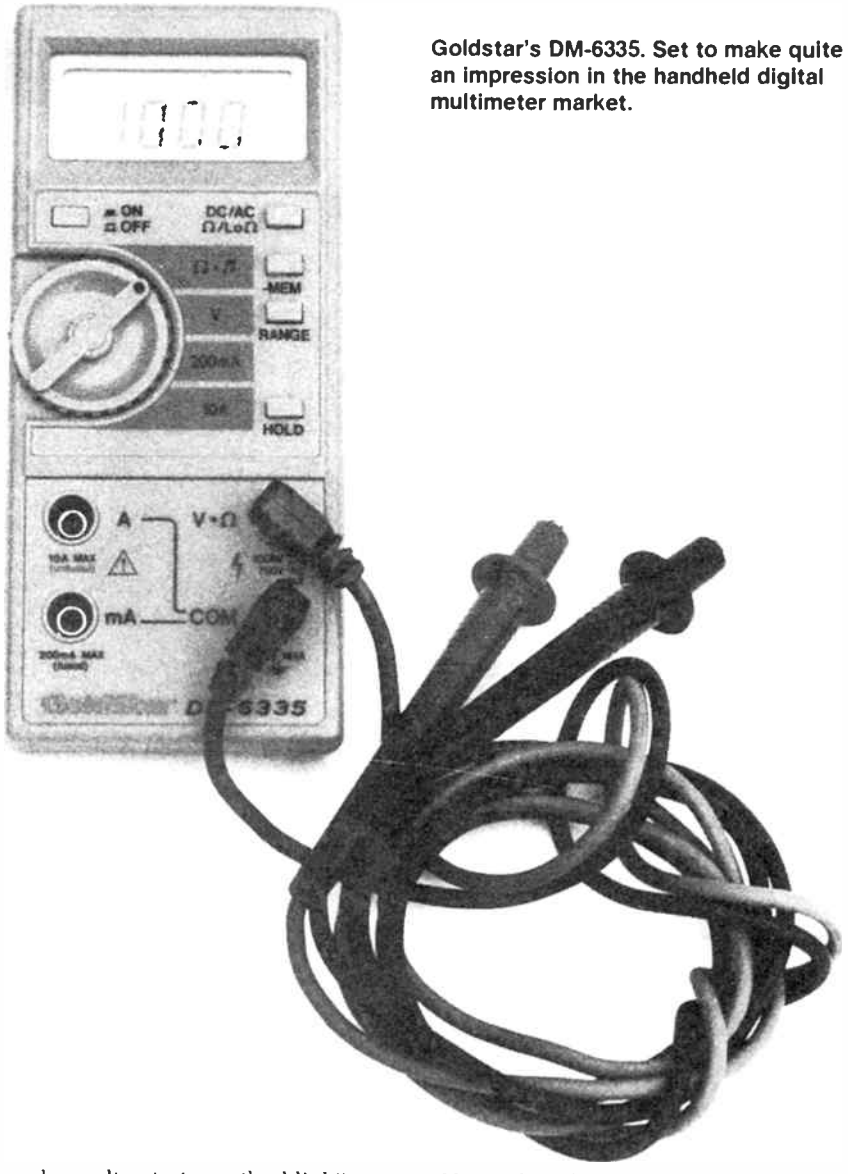
to stand for Federal Parliament. Except for Barry Jones and Senator Button, it would be far more intelligent than the rest of them in Canberra, I'll warrant.

But I've left the best till last. The Goldstar DM-6335 paragon of virtues has a "Hold" button on it. So, you peer and poke and get a reading, and with your spare hand touch "hold". And before you can say "the finest journal out", you find that reading stays while you take the probes away and wonder what you can do next.

In practice, it means you can write it down at leisure without forgetting it when you drop the pen in your haste to get that analogue measurement down before you forget it.

So this is the DM-6335, which is priced at $99 pre-tax, and $118.80 after Canberra. If you don't feel you are equal to living in a workshop with a DMM that has a "hold" facility, you can settle for the DM-6235 without hold. That will set your bank account back by $99.60, but substantially improve your workbench performance.

If after all that you can't think you are intellectually capable of competing with a DMM on your workbench that has a memory function and range hold, you are still allowed to buy the basic model, the DM-6135, which will be sold to you for $88.80.



Goldstar's DM-6335. Set to make quite an impression in the handheld digital multimeter market.

Facts and figures

Let's get physical about the Goldstar DM-6335. It's a 3½-digit multimeter that measures dc and ac volts and current, resistance, memory mode for relative measurement and hold.

On overrange, "1" blinks. Sampling is twice a second, and I found that when you put the probes on a voltage or resistance source it hunted for a couple of seconds, flashing several values (improbable ones) before stabilising. This is not connected with the 30 second warmup time the handbook advises.

Measuring transistor voltages in what was probably a class B audio stage was difficult: the constantly varying voltage made for constantly changing readings. But probably more experience would get you used to a suitable technique.

One of the reasons I had not tackled this particular receiver earlier was that my valve voltmeter doesn't seem to have been working well in past years. I know the feeling only too well, this creakiness as old age ravages one.

(A valve voltmeter used valves to provide you with the means of measuring voltages with a far higher impedance than even a 20 000 Ω per volt multimeter could provide. Well, that was the excuse I kept telling myself. Nothing to do with unfamiliarity with solid state, oh dear no.)

However, at an input impedance of 10M Ω for the Goldstar I couldn't use the "The valve voltmeter's on the blink" excuse any more, could I?

In dc volts, you are offered these ranges (resolution accuracy bracketed): 200 mV (100 μV); 2 V (1 mV); 20 V (10 mV); 200 V (100 mV); and 1000 V (1 V).

My workshop doesn't have any voltage, current or resistance standards so I couldn't test accuracies. Sorry about that, so we just pass on the claimed accuracy for dc volts is ±0.5% + 1 digit.

I should say that I once ventured to suggest to Roger that AEM ought to buy me a set of standards for my workshop but he said that if he did it would have to come out of my beer allowance, along with the FBT. Naturally, to such a suggestion there can be only one reply.

On the AC volts range, the DM-6335 will give you full-scale readings of: 2 V (1 mV resolution); 20 V (10 mV); 200 V (100 mV); and 750 V (1 V). Accuracy is quoted as ±0.75% + 5 digits.

The highest inputs allowable before the protection circuitry comes into play are quoted as 1100 Vdc, or 750 Vac (1100 Vac peak) for 60 seconds.

Now, for dc current, you get two ranges: 200 mA (100 μA resolution) and 10 A (10 mA). Accuracy on the first range is given as ±0.75% + 1 digit, and on the second, ±1.5% + 5 digits.

The two ac current ranges are identical to the dc current ranges, except that accuracies are ±1% + 5 digits and ±2% + 7 digits. Overload protection on the 200 mA range is 400 mA (60 sec.) with automatic current limiting against component damage. The overload protection on the 10 A range is 13 A for 40 seconds before the fuse blows.

Resistance is interesting. There are five ranges: 200 Ω (0.1 Ω resolution); 2 kΩ (1.0 Ω); 20 kΩ (10 Ω); 200 kΩ (100 Ω); and 2000 kΩ (1 kΩ). I have retained "kΩ" on the last range because that's the way the Goldstar says it, instead of "MΩ", and of course it saves too many symbols for the LCD to turn on for you. Resistance accuracy claimed is ±0.75% + 1 digit.

The Ohms and volts selections are auto-ranging.

The liquid crystal display shows 0 to 1999 with decimal point for readings, and ▷

these "annunciators" or indicators: AUTO, – : AC, mV, V; mA; A; Ω; kΩ, LOΩ, BAT (shows when the battery is exhausted or dropping below operating voltage); MEM; and HOLD.

Unlike every self-respecting multimeter I've ever owned, this one beeps at you when it gets angry over an overload or something. Sorry I don't speak digital multimeterese, so I had to consult the little handbook that came with it to get the interpretation.

When the input is overranged, piezo buzzer (sic) *is activated by a non-continuous 4 KHz* (sic) *beep tone in both auto and manual range*, the handbook said.

At this time, MSD of LCD display (sic) *also flashes and the three least significant digits are set to zero.* Seems like great fun for Guy Fawkes' Night, doesn't it?

The handbook advises you on safety precautions, and that only qualified technicians should try and recalibrate it. At least it carries on to tell the qualified technicians how to do it.

By the way, it's compact enough, and presumably robust enough, to slip into your pocket; measuring just 148 mm long by 65 mm wide by 25 mm deep overall. If you do slip it into your pocket, after banking or exchanging all those silly $2 coins rattling around in the bottom, it is not so fragile or thin it would snap in half if you bent over. The handbook is not A4, nor even A5, but smaller than the meter, so it slips into the pocket also without folding and creasing.

Now, a great advantage in making your pocket multimeter a digital type is that a little pocket analogue multimeter has a small scale, making measurements hard to read with any accuracy. But using the Goldstar as a pocket job means you get superior accuracy, better than a bench D'Arsonval multimeter. Think about it, when the family asks you what you want for your next birthday present.

Finish

Well, that's about all I can say about the Goldstar DM-6335. Certainly, I am impressed. All I want now is the cash to buy one of my own. What offers do I get from members of the Vintage Electronics Preservation and Benevolent Society for Aged and Infirm Radio Technicians for an aberrant valve voltmeter? Will swap for a brand new Goldstar DM-6335.

Review unit kindly supplied by Elmeasco, 18 Hilly St, Mortlake NSW 2137 ☎ 736 2888.

PRACTICAL PA, from page 59.

from all the individual channel auxiliaries. Very often, PFL is found here for individual auxiliaries. Next in importance comes the *headphone level* control. Insert points are often provided as well.

Some desks have a *talk back* facility. This enables the engineer to plug a microphone into the desk and talk to the people on stage through, say, the auxiliary send (this saves a lot of shouting around the room in sound checks).

Another feature is a 1 kHz oscillator. This is useful for setting up levels (more so in recording than in live work.) On some desks the oscillator "on" button is close to the headphone circuitry and in the heat of a performance it can be turned on by mistake. This has two effects: it scares the hell out of the engineer and sends the foldback operator crazy trying to find what appears to be a burst of 1 kHz feedback which is not his fault!

Effects send master controls are essentially the same as auxiliary masters, except they are normally used to incorporate signal processors. Finally, *meter assign* buttons are often used to share meters among several sources (e.g: auxiliaries, subgroups and masters).

Ideally, to maximise "headroom" (safety margin before signal distortion occurs), a steady increase in gain should be used, with each stage adding progressively more gain. There is no point having your channel faders up all the way and your left and right masters up a fraction of a millimetre. A logical gain structure allows more flexibility in setting levels.

This article is by no means exhaustive. The best way is actually to get out and have a "play" – if you can get the manual for the particular desk, even better.

Two gigs on a disk

Elmeasco has signed up to distribute Optimem optical disks in Australia. The Optimem 1000 and 2400 were the first in a family of optical drives using WORM (write-once, read many times) technology.

The model 100 stores 2 Gbytes and the model 2400 2.4 Gbytes on a 304 mm (12 inch) removable disk, so they are ideal for low cost storage in advanced image-oriented office systems, transaction processing, data archiving and other high capacity data storage applications such as financial auditing.

System is simplified by using the industry standard SCSI which will accommodate up to eight drives per controller. A driver/controller for the IBM XT/AT is available and soon to be released for the Microchannel models.

The driver allows the optical drive to look like an extra external device operating under MDOS. A driver is also available for the Novell-Lan environment.

Elmeasco is at **18 Hilly St, Mortlake, NSW 2137 ☎ (02)736 2888.**

Intelligent Backup gets better

Many enhancements and a simpler user interface are claimed for a more powerful and flexible version of a hard disk management system for pc users, Intelligent Backup.

Among the enhancements are automatic diskette formatting, a back-up history file, and a choice of data compression methods that incorporate a compression method claimed to save back-up diskette space by 50 per cent.

A verify feature allows users to confirm that back-up files are restorable, which allows users to track and restore files that had been deleted since the last back-up.

The system has provided a hard disc management system which while said to be simple to use, provides sophisticated functions in managing files without DOS commands. Advanced users will find new commands with more power and flexibility in Version 3.1.

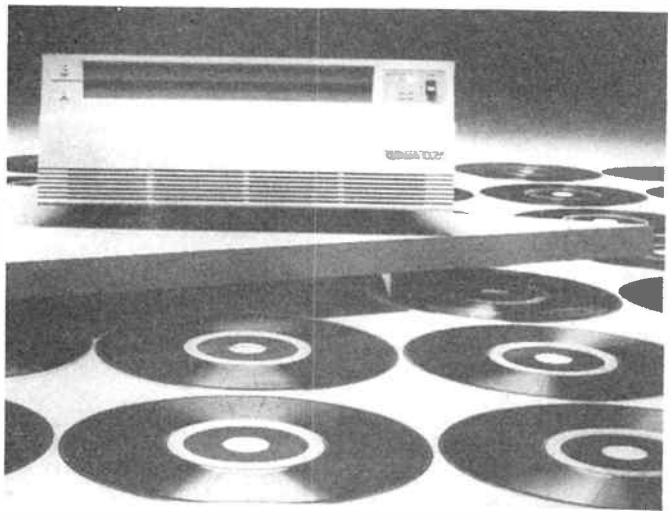
Support for handling multiple hard disks and multiple sets of back-up diskettes has been expanded, and an updated and improved User's Guide is included.

A daily prompt informs the user that back-up is needed and says how many days have gone by since the last back-up was completed.

An installation option can even force the user to perform a back-up before proceeding, if wanted. This feature ensures corporate users enforce back-up disciplines set by a company.

The system claims to use back-up diskettes more effectively, and recommends a consolidate level back-up to release diskettes not needed, when the disk pool is exhausted.

Interface with **Optimum Software, 71-73 Thistlethwaite St, South Melbourne, Vic 3205 ☎ (03)690 4133.**



The Optimem optical disk drive and disks; to be distributed by Elmeasco.

A-D I/O board

Applications in instrumentation, general purpose data and process control equipment along with energy management, product test and laboratory R&D are suggested uses for a A-D I/O board and modular panels.

These are said to bring the industry's highest signal conditioning performance to IBM PC/XT/AT and compatible systems.

Designated RTI-820, it plugs directly into one PC slot. Four external panels provide multiplexing and isolated and non-isolated signal conditioning for up to 64 analogue inputs, 16 analogue outputs, and 24 channels of digital I/O with data acquisition rates up to 19 kHz.

Software support has MS-DOS drivers for high level language support, and various menu-driven application software packages.

The 5BO2 signal conditioning panel accommodates up to 16 5B modules for isolated signal conditioning.

The 5B modules offer high accuracy and isolation capabilities: '0.05 per cent span and ±1500 V rms typical, respectively. These modules also feature 160 dB common mode rejection and '240 V rms protection.

For non-isolated I/O applications, the STM-HL panel provides 16 high level (0-10 V) single-ended analogue inputs and four analogue outputs.

Designed for applications that do not require signal conditioning, the STB-HL and RTI-820 offer a low-cost solution per input-channel.

For digital I/O the AD1585-1 and DB24 offer connections for non-isolated and isolated digital inputs. The first handles TTL-I/O, and the other accommodates high-level digital sensing and switching with (+-)4000 V isolation.

Functionally, the RTI-820 board consists of digital and analogue I/O sections. The digital portion has three 8-bit digital I/O ports.

All digital I/O channels are inverse TTL level signals and are compatible with standard solid-state relay subsystems and Analog Devices' digital panels.

For analogue I/O the RTI-820 contains a 12-bit A-D converter and a 12-bit D-A converter which provide one channel of analogue input and one channel of analogue output, respectively.

Multiple channels are accommodated with the interface panels by multiplexing several input and output channels on to a single I/O line.

For more data, input to **Parameters, PO Box 261, North Ryde, NSW 2113 ☎ (02)888 8777.**

Two million mouses

To mark having produced 2 M mouses (mice, meece?), Logitech has a "Clear Case" mouse available as a limited edition in Australia from November through January.

A transparent case replaces the usual cream plastic, showing the opto-mechanical design, said to be unique. This claims several advantages: it needs no special pad, the large rubber coated ball tracks smoothly over most surfaces, it is inherently reliable as the encoder assembly offers virtually no friction and does not contact electrically.

The rrp of the Clear Case Mouse is $260 (including sales tax). With the mouse are Logitech's Paintshow Plus program and Plus Package software. Contact **B.J.E. Enterprises, 124 Rowe St, Eastwood, NSW 2122 ☎ (02)858 5611.**

Data comms group expands

Remaining as separately owned entities, Datacraft and Computer Protocol have merged their Australian sales and service operations and together with Summit Communications, now claim to be the country's largest data communications group.

The combined R&D expenditure of the group will be $4.5M. Computer Protocol will build up ▷

its R&D group in Perth and concentrate on the export market through its international operations.

The Australian operation will be named Datacraft Computer Control (DCP) and operate as a fully owned subsidiary of Datacraft. The managing director of Datacraft (Aust.), Mr Peter Pryor, becomes managing director of DCP.

The company will combine a wider range of products and give enhanced service. Datacraft has also committed to a phased investment in Computer Protocol. $2M at first, to support the company's expected growth.

The US office of Computer Protocol recently won a contract to supply sophisticated networking products to the US Army. The first contract worth US$3M is expected to be expanded as other related defence projects begin.

Computer Protocol has other overseas operations in Malaysia, the UK and New Zealand supporting projects in banking and government communications networks.

The agreement also provides for marketing Computer Protocol products by Datacraft's Hong Kong and NZ subsidiaries. Datacraft won a contract early last year to supply a digital data network to the HK Telco.

Video card features back compatibility

A fully VGA register-compatible 16-bit video card features full backwards compatibility to all the key established graphics standards, according to the maker.

These standards are the MDA (monochrome display adapter), HGC (Hercules graphics controller), CGA (colour graphics adapter) and EGA (enhanced graphics adapter).

The card is the Zenith Z-549, rrp $899, with full compatibility with the maker's Z-150, Z-200 and Z-300 series computers as well as the IBM PC, XT and AT computers and compatibles. It has 256 kb of video memory with D-A converter to support colour depth up to 256 colours out of a palette of 256 000 colours.

It includes 16-bit compatible DB-15 pin connector, and uses a 16-bit bus interface when plugged into an AT-compatible 16-bit bus and also works on an 8-bit PC compatible bus.

Zenith Data Systems, based is Sydney, claims a strong foothold in the Australian pc market and forecasts a $9 M turnover for the 1988 calendar year.

The US company, which designs and builds desktop and laptop computers and monitors established a branch in Sydney a year ago.

The managing director, Mr Stephen Hague, said he planned to open an office in Melbourne in January and another in Canberra in March.

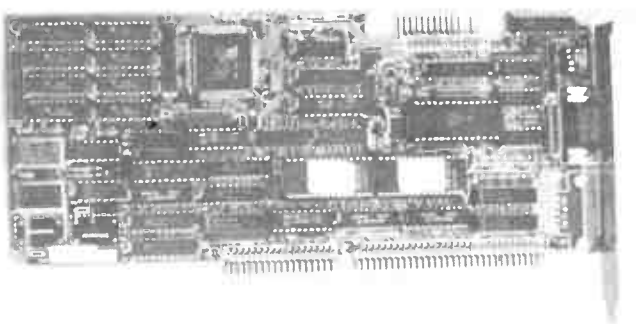
He was confident that the Australian market would respond to Zenith's vision of multiprocessing technology, with extra power added, rather than moves to create more powerful processors. Each year, Mr Hague said, Zenith came up with practical innovations such as zero wait states, intelligent power management and page white screens that had set the industry pace, particularly in the laptop market.

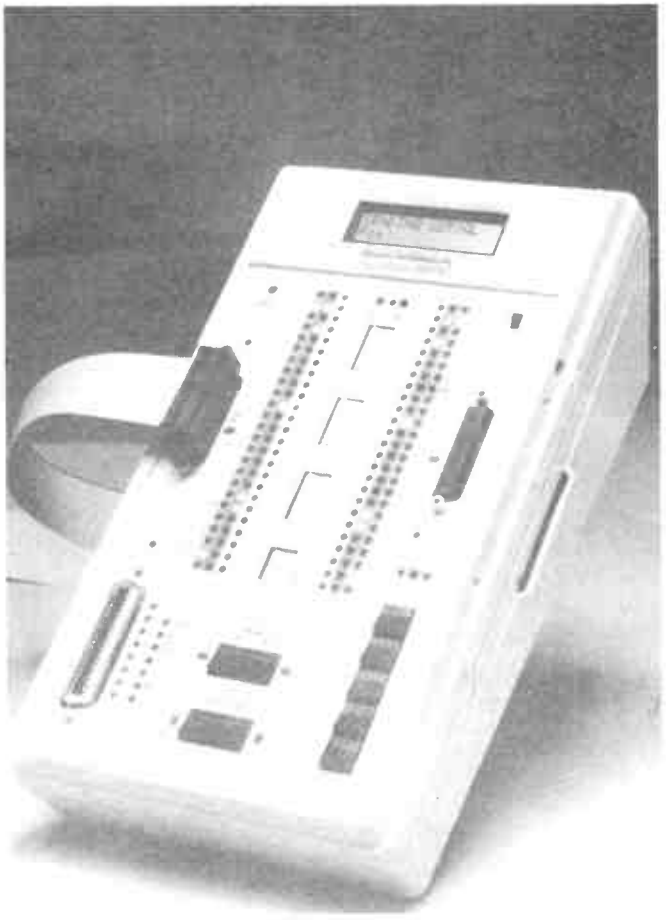
At present a major effort was being directed at developing more power while eliminating the threat of obsolescence: the multiprocessor approach.

This was built around cost-effective, industry-standard pc components and was at the heart of working Zenith prototypes code named Z1000 that used up to six Intel 386 microprocessors operating simultaneously.

The open architecture of the technology would accommodate multiple users, of both a series of terminals and a network of pcs, running virtually any existing applications software based on the UNIX and MS-DOS operating systems.

Zenith's Z-549 VGA video card for PCs features back compatibility with earlier video standards.





Break it out Arfa! Datatool's multifunction communications tester.

Multifunction tester

Designed specifically for computer and data installations, the DataTool 5000 Multifunction communications tester is said to be compact, rugged and lightweight.

Battery powered, the unit captures, displays and creates data via the RS232C serial or parallel interface ports.

It is easily set up through the internal menu to talk to devices such as computers, terminals, printers, plotters, modems, line drivers, multiplexers and data communication links. It can determine how interconnecting cables are configured. Functions the unit provides are: pin analysis, device analysis, bit stream analysis, transmit data, data monitor/trapping, testing flow control, bit and block error rate testing, data printout, event timing, data pulse signal levels, bias distortion, polling, pulse detection and cable testing. Available as an option is a soft padded contura carrying case. It is compartmented for the tester, external power pack, cables, manual and test accessories. Contact Elmeasco, PO Box 30, Concord, NSW 2137 ☎ (02)736 2888.

Versatile solutions

More flexibility of choice is offered users of the IBM AT-style model 30-286, which has 512K of memory as standard.

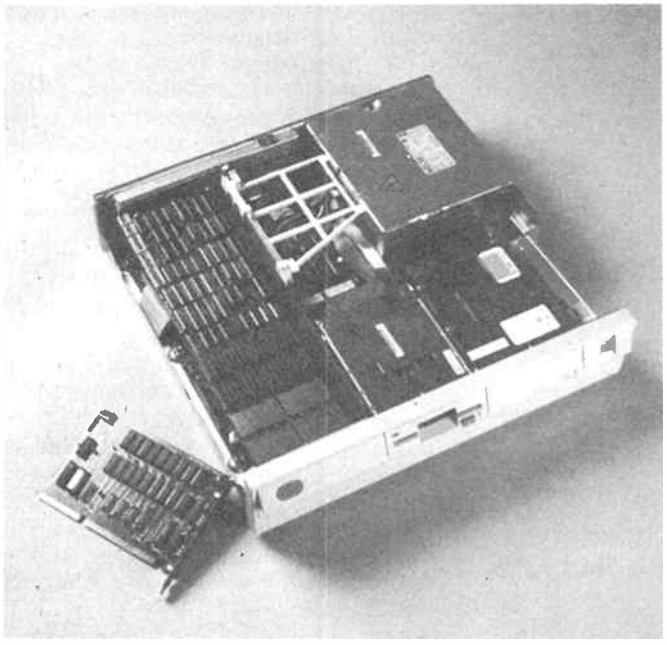
IBM offers two upgrade options, to 1M using a further 512K, or to 4M by replacing the original 512K with four 1M modules.

The Hypertec RAM alternatives

For the user who wants the DOS limit of 640K of RAM, Hypertec offers its Hyper 128-16, at rrp $295 (tax excluded).

For those who want expanded or extended memory, there is the Hyperam XT/AT, a memory board supplying between 2 and 8 Mb of memory.

This board supplements the standard 512K on the 30-286 motherboard, where the IBM upgrade requires the motherboard to be further populated by removing the standard 512K and replacing it with 1M modules. The motherboard can take four modules at the most, hence the 4M restriction. The Hyperam XT/AT is said to be compatible



The Hyper 128-16 memory board beside an IBM PS/2 Model 30-186 (which has a Hyperam XT/AT memory board installed!)

with other PC/XT and AT machines. See **Hypertec, 408 Victoria Rd, Gladesville, NSW 2111 ☎ (02)816 1211.**

Big memory board

A 2M to 8M 16-bit, slimline board is designed to meet memory needs for OS/2, DOS 4 and new LIM 4 applications and to run in a wide range of AT-style machines as well as IBM's AT including Compaq, Epson, Olivetti, Wyse, NEC and IBM's PS/2 model 30-286.

The Hyperam 286 provides full 16-bit memory and its slimline form means the board will also run in 8-bit PCs, XTs and compatibles.

It comes standard with 2M of memory and can be populated to 4M or 8M using 1M ZIPs. No piggybacks are necessary. The board can be used to supply expanded, extended or system memory, or any combination of three.

It supports the LIM 4 expanded memory specification and is also shipped with RAM disk and print spooling software. For more, go to **Hypertec, 408 Victoria Rd, Gladesville, NSW 2111 ☎ (02)816 1211.**

Image graph plotter

A new low cost, intelligent (programmable using HP-GL) six-pen plotter is compact, lightweight and quiet, the makers say.

Its size — 420 x 260 x 95 mm, and weight of 4.5 kg — is achieved by a grid roller mechanism, which will take up half the footprint of an A3 flatbed type, we're told.

The Fujitsu FPG-316 Imagegraph has a plot speed of 250 mm/sec with a pen up-down cycle time of 10 cps and a plotting area of 276 x 399 mm (A3). Six colour pens with water based ballpoint and ink fibre tips and oil based plastic tip pens are available with auto capping to protect them from drying.

A high quality drawing resolution of 0.025 mm with repeatability of 0.100 mm (same pen) with normal, coated and tracing paper and overhead transparent film allows many applications for business graphics and personal CAD application.

The plotters are said to have the flexibility to interface to most pc systems. The FPG-316-101 has centronics and RS232 interface, and the FPG316-201 has HP-GL interface for instruments and scientific computers.

Contact **Bell Test & Measurement, PO Box 14, 32 Parramatta Rd, Lidcombe, NSW 2141 ☎ (02)648 5455.**

Megacraft network

Electrical supplier, Prospect Electricity, has installed a 2 M/s voice and data network based on Datacraft Australia's MegaCraft 3600 system. The second largest electricity distributor in NSW, Prospect services 1.2 M people spread over 16 115 km². With Parramatta the near-to-Sydney boundary, the authority distributes power to Lithgow, the Blue Mountains, Mudgee, Wisemans Ferry and St Albans, making distance between branches one of its main problems.

Prospect's resources have been stretched to the limit meeting the needs of nearly 427 000 customers using more than $535M-worth of electricity a year.

The authority decided it needed a 2 Mb data network to handle customer accounts and database, and chose the MegaCraft 3600. Main nodes have been put in the authority's head office at Parramatta and four other offices. Out of these nodes data would be supplied from Parramatta to 20 other depots.

Prospect bought six of the data systems and 50 modems.

The computer connection

Ready to tailor connectors, cables and fibre optics for just about any computer installation in Australia, a division of the Metal Manufacturers' group, named Datacon, has been formed.

The company carries more than 800 individual parts ranging from the smallest RS232 connector to a 32 port, fibre optic, multiplex.

The range includes: connectors; IBM cabling components; Ethernet local area network components; wiring management systems, including Nevada Weston, Modular and Thomas & Betts; block wiring accessories; fibre optic cables; personal computers; access control systems; security systems such as video cameras and tag recognition or multi-product production line switching.

Wire into **Datacon, 5/552-560 Church St, North Parramatta, NSW 2151 ☎ (02)683 1399.**

You too, can be boss of the DOS

Jim Tucker

This month we introduce DOSTalk, a column for DOS Users. Jim Tucker has taken on the unenviable job of presenting this column each month. He is a programmer from way back, and has had many useful programs on the market as well as many years exposure to a variety of computers and operating systems. Aged readers may remember a review of his FlashPrint program (AEM, Oct '85). We envisage DOSTalk will be a source of useful information and tips for users of MS-DOS based computers, popular with the 'electronics fraternity'. Perhaps you would like to contribute something?

LET'S BEGIN WITH BUGS. Both in programs and printers. Bugs infest every computer program, from humble word processors to the US space program. The first space shuttle stayed firmly on the launch pad because of an itsy-bitsy program error. It must have cost millions.

Personally, I never written a program with a bug. Everything works first time. I tell lies, too.

But my $500 printer has a bug which has cost me a couple of sleepless nights. And I still get letters concerning a Microsoft BASIC program I wrote a few years ago. Let's begin with the program.

It's simple. It lets you fill a grid on the screen to design a printer character. And at the press of a button out pops the bit image code required to print the character. For instance, you can draw a car on the screen using cursor keys and the program produces the following bit image code:

```
27 42 4 38 0 248 252 126 62 30 22 30
22 30 22 30 22 30 22 30 22 30 22 30
23 31 23 31 22 30 22 30 22 30 30 30
30 30 30 22 22 12 4
```

These are magic numbers. They mean nothing to mere humans. But in this case they mean something to your average Epson printer. Print them in ASCII using any program and you will get a character that looks like a car.

It isn't much of a program. The sort of thing that any BASIC programmer with a six-pack of beer and a plate of sandwiches could write on a wet Saturday afternoon. But it cost me time, and time is money when you write code for a living.

The problem was that every now and again, when designing a character, the printer would produce garbage.

I first blamed my program, then I blamed the printer. But it turned out the bug was a *"feature"* of Microsoft BASIC Now BASIC assumes that if you LPRINT CHR$(7) you want to tab. (ASCII 7 is the value for horizontal tab). Instead of sending the tab character, Microsoft BASIC sends spaces to move the print head to the appropriate column.

This non-intelligent interpretation of your intentions bombs the bit image, wherever and whenever it contains a bit pattern with a value of 7. The problem does not exist in later versions of BASIC , such as Quick BASIC or Turbo BASIC or the Microsoft BASIC compiler.

When you are writing programs for printers you can blame yourself, the printer or the language. Generally in that order. In this case the villain was the language. The lesson here is do not use Microsoft BASIC to test printers.

⊙ ⊙

Another problem! My label printing program, which has two special features and is appropriately named the *Parton Label Program*, works a treat on my old and faithful Panasonic printer. But not on my super-duper Epson LQ-500.

Parton does a few clever things, like printing in different fonts, large characters and so on. She is not trivial. About 10 000 lines of code. Dolly (oops, Parton) is used by several manufacturers to make sticky labels for their big boxes. It can print several labels across the sheet by setting the printer's left margin.

You set a left margin on an Epson with the ESC "l" n sequence where l is the lower case letter and n is the position of the margin. Try this:

```
FOR J=1 TO 70

  LPRINT
  CHR$(27)+"l"+CHR$(J);
  LPRINT "HELLO"
NEXT
```

The word "HELLO" should print on each line indented J characters from the left. But not on my Epson LQ-500.

Grrrrr! When the J count reaches 45 (the value of the left margin) the LQ-500 gives up. Epson has agreed that this code works on other Epson printers and you can set a left margin anywhere on the page. It is just that there is a problem in the LQ-500 ROM.

I am still waiting for a reply to my phone calls and letters, Mr Epson. The Parton Label Program will not run on an LQ-500 so I'm supplying it with a Panasonic printer.

Wordstar — ♥ ♥ ♥

I am a Wordstar fan from way back. My love-hate relationship with Wordstar began with version 2.26 running under CP/M. Later, I bought Version 3.3 for DOS. Then a $230 "upgrade" to Version 4.

When I first ran Wordstar Version 4 about a year ago, I discovered it can draw rules and boxes (using function keys) and it lets you do three lines of headers and footers. Great, I said. I'll use a graphic character to draw a rule across the bottom of the page as the first line of a footer and print some text under the rule.

Arrrgh! This doesn't work. Graphics are stored as four bytes per character. The limit in a header or footer is about 200 bytes so a header or footer can only contain about 50 characters if they are rule or box characters.

Wordstar Version 5 allows you to allocate a header or footer buffer and seems to overcome the problem. But I am not sure Version 5 is secure. Backwards scrolling has produced some strange effects. I am still using the one I love to hate (or hate to love) — Wordstar 3.3.

Incidentally, Wordstar can now be upgraded from any version (even 2.26!) to Version 5. The cost is $250 plus $10 handling. This is good news for those who run ancient versions. But it is expensive for

those who just spent $220 to upgrade from Version 3.3 to Version 4.0 and now want to go to Version 5. The two-jump upgrade will have cost $470.

News Flash!

Stand by for Wordstar 6.0. Gnomes in San Rafael are working through the night.

License or License?

A friend selling a program thought he might protect himself just in case the program contained a bug. So to find the rules he looked up his IBM DOS manual. It said:

> "The program is provided as is without warranty of any kind, either expressed or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. The entire risk as to the quality and performance of the program is with you. Should the program prove defective you (and not IBM or an authorized personal computer dealer) assume the entire cost of all necessary servicing, repair or correction..."

And so on. He assumes that it means if DOS doesn't work then it's your problem; it gets worse.

The IBM DOS manual, purchased with his genuine IBM PC in Australia, says the "agreement" (presumably between you and IBM) is subject to the laws of the State of Florida. Wherever that is. I know for a fact that it's north of Queensland.

An imported version? Not true. This DOS manual was supplied by IBM and printed in Australia. Is IBM software (or anything else) sold in Australia really subject to the laws of a foreign country?

ECHO OFF

Magazines used to be full of tricks to display a blank line from DOS batch files. Peter Norton even explained how to do it by changing a batch file using debug. You cannot echo a space on a line by itself in a batch file. Most people who write batch files simply echo a full point when they want a blank line. The line looks like a blank line but begins with a dot.

But here is a curiosity. Note that in the second line, the full point is hard up against the word echo. This works with DOS 3.1 but I do not think it works like this with all versions of DOS.

```
echo THIS IS A LINE
echo.
echo WAS THE PREVIOUS LINE BLANK?
```

One more batch file trick some of you may not know. To include a comment in a batch file, simply put a colon at the start of line. It will be treated as a label.

CTRL-ALT-DEL

One of the most simple programs I have ever seen was one which made the user cold boot the computer. It did this:

```
echo PLEASE PRESS CTRL-ALT-DELETE
:loop
goto loop
```

The echo command displays the message and then the batch file loops forever until you reboot. But why would you ask a user to reboot his machine?

Well, I have a few games which manipulate the keyboard in memory. They were supplied by IBM and they were (still are) good games. But they turn on the caps lock and cursor pad in memory. They use RAM locations to manipulate the interpretation of the keyboard characters, and within the program every keystroke is assumed to be in caps. The problem begins when you exit the program. Everything is still in caps.

Not a problem you might assume. Just hit the caps lock key. However, my keyboard has a little light (LED) telling me when the caps lock is on or off. When I exit the light gets it wrong. It says caps is on when caps is off and vice versa. The keyboard can talk to DOS but DOS cannot talk to the keyboard and so the LED doesn't know what DOS knows and which way is up.

_, ■ or |?

And while I'm in bitching mode... Have you noticed that Borland (and other) programs mess around with the cursor? DOS will not let you alter the blink rate of the cursor but it will let you change the size. I use a nice fat cursor and set the size with a short assembler program called from my AUTOEXEC.BAT file.

Turbo Pascal programs (and likely lots of others) create their own cursor. When they exit back to DOS or the calling program they do not bother looking at the size of the original cursor. They set it back to the DOS default, a difficult-to-see underscore character.

Wordstar 5 installation is clever. It allows you to set the size of the cursor you would like to use with Wordstar and the size of the cursor you want when you exit Wordstar. A simple cosmetic consideration you might say, but still a matter of preference and comfort!

Eureka!

Enough about problems. Here is a solution.

Setting up your printer can be simple if you understand the buttons on the front panel and the DIP switches down in the deep. But there are many things that can only be controlled by software. For example, setting a left margin, setting tab positions, changing colours or selecting the IBM print mode.

This month's AEM DOSTalk program, FLASHSET.COM, allows you to send any escape sequence to your printer from the DOS command line or a batch file.

Here's how it works: Suppose you want to set your printer into bold, with a left margin of 10, page length 70, and you want it to put slashes through numeral zero.

On my Star NX-1000 the code required is this; (your printer may be different so you can put any code supported by your printer here.)

```
27 71          ; double strike
27 "l" 10      ; 10 left margin
27 "C" 70      ; set page to 70 lines
27 126 49      ; slash zero
```

FLASHSET lets you send this code (or any other code) from the DOS command line or a batch file to the printer. The rules are simple. Enter the program name FLASHSET then a space followed by the code.

All characters are sent to the printer so do not include superfluous spaces. Here's how it looks if you run FLASHSET from drive A:

```
A:>FLASHSET
[27][71][27]l[10][27]C[70][27][126][49]
```

Golly. This looks complicated. But if you look carefully you'll see that every number is within square brackets. And remember, you only have to work it out once and put it in a batch file. In fact, using batch files will let you set up your printer for just about anything you like.

FLASHSET checks to set if the printer is ready. You can use the following command:

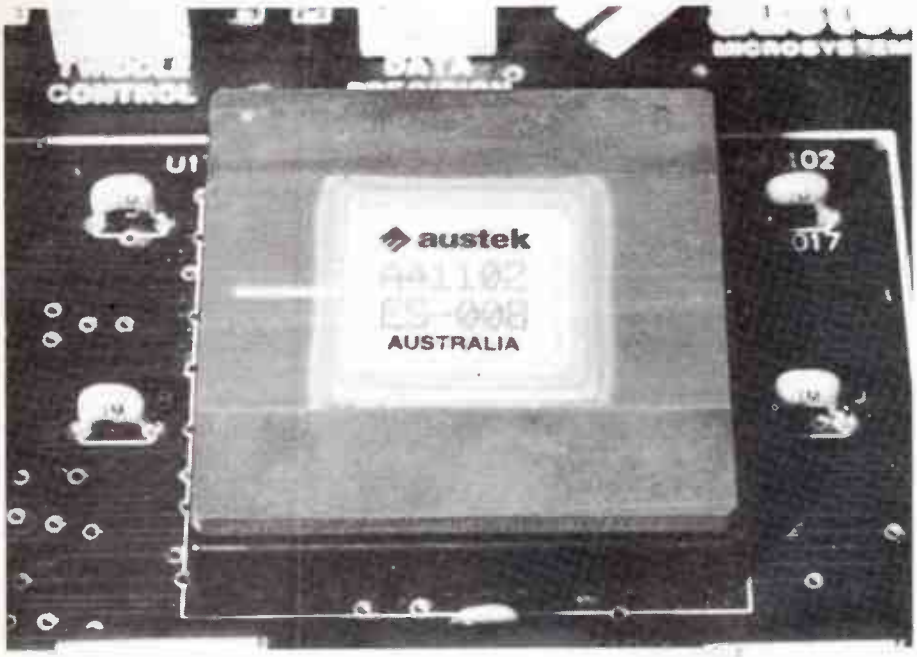
```
A:>FLASHSET [7]
```

If the printer is ready it will beep. If it is not ready FLASHSET will display a message on the screen.

FLASHSET is available free to AEM readers. Simply send a DOS 5.25-inch 360K formatted disk to:

Jim Tucker,
PO Box 582,
Blackwood SA 5051

in a suitable mailer (available from Australia Post) with return postage.



Aussie DSP chip to win wide overseas market

A signal processing chip, because of its speed and completeness, could revolutionise the way computer and electronics companies approach computer-based picture processing, satellite communication, radar and analysing sound waves.

The A41102 frequency domain processor chip represents the Adelaide-based Austek company's entry into the growing digital signal processing (DSP) market. Austek already sells most of its chips to US computer makers.

The A41102 does more than 100 million operations per second. This means that accurate seismic pictures of the earth can be produced more economically, TV pictures can be carried on phone lines, and body scans can be done in a medical practitioner's surgery instead of a hospital, so reducing costs.

The chip was conceived by scientists in CSIRO's Division of radiophysics, and then brought together with Austek's design, manufacturing and marketing facilities in Adelaide and California. It is one of the first commercial spin-offs from the Australia Telescope project

DSP has become the most efficient technique for analysing and transforming information in waveforms, medical imaging, hi-fi sound systems, seismic exploration and radar. By representing a waveform in its frequency components, more cost-effective processing can be carried out. However, until now this technique was not satisfactory for problems of high complexity, which require high speed and economical processing, a solution now provided by Austek's chip.

Australia has much to offer the world market because of its expertise in medical electronics, radiotelescopes, defence, and other forms of signal processing.

Austek and CSIRO engineers and scientists drew upon this expertise to refine the original concept to the point that the chip launched today meets a broad range of high complexity signal processing tasks. Engineering samples of the A41102 in a 132-pin, ceramic package are available immediately in quantities of 1000 for $150 per device, with volume shipments to begin in the first quarter of next year.

Austek Microsystems designs, develops and markets proprietary system level, VLSI components. The company was founded in 1984 by a team of computer designers, IC technologists and CAD specialists, and is privately held. The A41102 is made under licence from the Australian Commonwealth Scientific and Industrial Research Organisation's Division of Radiophysics. Chip away at Austek for more information, **Technology Park, SA 5095 ☎ (08)260 0155.**

Samples of the Austek Microsystems' A41102 Frequency Domain Processor chip, which offers significant advantages in system size and completeness, performance, accuracy and price over competitive solutions, will help Australia exploit the worldwide market for DSP components, Austek says.

CGA chip cuts DRAM requirement

A version of the NCR single chip colour graphics monochrome adaptor (CGMA) cuts the DRAM count to two devices. Named the 72C81, it is said to reduce costs, retain pin configuration compatibility with the earlier 4-DRAM 72C80, and maintain all key integration and performance features including CGA, MDA and HGA display standard support plus a high definition CGA mode.

The device supports CGA (colour graphics adapter), MDA (monochrome display adapter) and HGA (Hercules graphics adapter) display standards at the hardware compatible level.

Its high definition mode allows CGA displays to be presented in a 640 x 400 format using high quality text and scan doubled graphics. In this high definition CGA mode, special mapper circuitry translates timing parameters written to an on-chip 6845 CRT controller, providing a transparent translation to high definition display while retaining CGA software compatibility.

The high definition mode uses test quality similar to that of the EGA (extended graphics adapter) format, plus an additional two lines on inter-row spacing in text mode to provide high quality text. In graphics mode, lines are scan doubled to produce a crisp, fuller image than the standard CGA mode.

Interleaved memory allows the host processor to write the display buffer at any time without producing distortions or snow on the screen.

The 72C81 integrates all peripheral logic including character ROMs, the 6845 CRTC, pc bus interface, frame buffer interface and direct monitor drive circuitry.

Parallel port (monochrome and LPTI) address decoders provide chip selections for external printer port circuitry. This simplifies logic requirements for adding a printer port to the card, and does away with the need for more decoder chips.

The chip's high level of integration allows a CGA-compatible display adapter to be constructed with only three devices: the 72C81 and two DRAMs. While other adapters are said to need an additional clock source, the clock for standard CGA mode (14.318 MHz) using the 72C81 is

available from the pc expansion bus. Ask for more from **Energy Control, 26 Boron St, Sumner Park, Qld 4074 ☎ (07)376 2955.**

FRAM takes significant step

Technology R&D company Ramtron Australia has taken a further step in licensing its ferroelectronic RAM (FRAM) now it has signed an agreement between its majority-owned US subsidiary and a US aerospace and defence contractor.

The signatories are Ramtron Corporation of Colorado Springs and the Microelectronics Centre of TRW at Redondo Beach, California. TRW gets a licence for Ramtron's advanced FRAM technology to develop a range of non-volatile FRAMs specifically for aerospace and defence.

The agreement is Ramtron's fourth this year, consistent with its strategy of combining forces with established makers of various applications to introduce the new FRAM technology into electronic mass markets as quickly as possible.

In October Ramtron signed a co-development and licensing agreement with NMB Semiconductor Co., a subsidiary of Japan's Minebea group, to develop 4 Mbit dynamic random access memory chips to be produced in 1990. Ramtron expects to earn more than $100 M in royalties from that agreement.

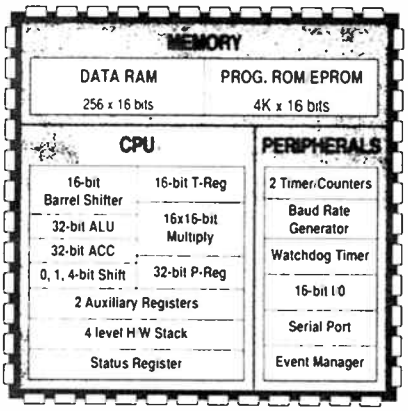
In June, Ramtron finalised an agreement with ITT Semiconductors worth more than $13M to Ramtron. Both groups will jointly develop advanced manufacturing processes for VLSI applications. There is also an agreement made in February worth $1M with Single Chip Systems of California for using Ramtron technology in the specialised area of RF accessed devices such as non-contact smart cards and smart tagging systems.

Ramtron's involvement is its ferroelectronic memory technology which produces non-volatile semiconductor memories: they retain data even when a computer system loses power. See *Ferram - promising new memory technology*, page 40, July 1988 AEM.

Fastest microcontroller

Said to be the first device to combine the high performance of a digital signal processing (DSP) microcontroller with the on-chip peripherals of a microcontroller, the Texas Instruments TM320C14 is a 16-bit DSP microcontroller. Operating at 25.6 MHz, the new device is the world's fastest microcontroller. It is said to offer five to 10 times the speed of traditional 16-bit microcontrollers although comparably priced.

It is object-code compatible with the industry standard TMS320C10 DSP and offers 256 words of on-chip RAM and 4 K words of on-chip ROM or EPROM. The



device can also address 4 K words of off-chip memory.

The chip's peripheral functions include: four timers, bit-selectable I/O, an event manager, a serial port with three modes of operation, and 15 external/internal interrupts including one non-maskable interrupt.

The processing power of a DSP engine allows the TMS320C14 to compute advanced control algorithms such as Kalman filters and state controllers for analogue type performance. The device, however, is not affected by inaccuracies caused by environmental conditions such as temperature drift and aging.

The TMS320E14 is an EPROM version of the TMS320C14, providing code development and prototyping ease. The maker says extensive development support for the TMS320C14 is available. Software support includes an assembler/linker and CPU simulator. Hardware support will include a full in-circuit emulator.

Texas Instruments can be contacted through **PO Box 106, North Ryde, NSW 2113 ☎887 1122.**

Into electronic imaging

With the market for imaging-related products expected to grow dramatically in the next five years, Brooktree Corporation of the USA has entered this market with two products, the Bt208 video A-D converter and the Bt70101 decompression processor.

The Bt208 integrates some specialised features reducing the amount of external components and pc board needed. It uses flash converter topology to achieve 20 M sample per second (MSPS) speeds. This high sampling rate allows up to four times oversampling of NTSC, PAL and SECAM video signals, giving the engineer flexibility and a margin for worst case situations.

Designed specifically to fit the specifications of image capture applications, the Bt208 does not need an additional video amplifier to meet input level needs. It features an analog input range of 0.714 to 1.2 V, which covers the NTSC, PAL, SECAM and RS-343A video standards. This is where some other A-D converters need 2 V input signals, making it necessary to use another high speed amplifier.

The Bt208 has features that simplify the design of imaging products. External zero and clamp control allows ac coupled video signals to be dc restored during each horizontal blanking interval. This does away with extra circuitry for dc restoration.

The Bt70101 is an add-in card for the IBM PC/AT and compatible computers. It gives high speed decompression of CCITT groups 3 and 4 encoded images for applications such as document filing systems, pc workstations, and high speed FAX servers for local area networks.

Its decompression rate is 20 Mbits per second and its line register configuration allows decompressing images as large as 1524 mm at 100 dps, and 2:1 image scaling, Brooktree claim. Inquiries to **Energy Control, 26 Boron St, Sumner Park, Qld 4074 ☎ (07)376 2955.**

Analogue I/O port

An analogue I/O port, the AD7669, combines an 8-bit A-D converter, two 8-bit D-A converters, a 200 kHz track and hold amplifier, two buffer amplifiers and a voltage reference on a single chip.

This level of integration allows designers to replace up to eight separate ICs with one. The on-chip A-D guarantees a 2 µs highest conversion time to ±½LSB and each D-A is buffered by an on-chip amplifier to deliver a greatest 2 µs voltage-settling time to ±½LSB.

Applications such as disk drives, where the drive monitor's head position with the A-D and controls' positioning with the D-As, can benefit. In microstepping drives, one D-A can supply sine phase information, while the other provides cosine phase signal. Designers can also use the I/O port in control applications that need multiple analogue outputs generated.

The AD7669 is tested and specified for both static and dynamic performance. It guarantees ±2LSB highest total unadjusted error, ±1LSB relative accuracy, and ±1LSB differential nonlinearity.

Highest full-scale error match of the two D-As is ±2.5LSB. Dynamic specifications include a 44 dB S/N ratio, -48 dB total harmonic distortion, and -55 dB intermodulation distortion. More information can be obtained from Parameters, PO Box 261, North Ryde, NSW 2113. 6(02)888 8777.

Simple interfacing of AT chips to 386SX

Technical information is available from VLSI for simple interfacing of the VL82CPCAT (12 MHz) and VL82CPCAT-16 (16 MHz) chip sets to the 386SX microprocessor.

VLSI said the 386 had had many programs written for its systems, which

needed a 32-bit system data bus to accommodate the 386 microprocessor's 32-bit data bus and run its software. The 386SX was designed to provide a microprocessor for system designers wanting to use 386-based software in systems with a 16-bit data bus.

The greatest performance of the 386SX in the originally 286-based VLSI PC/AT compatible chip set was achieved with some interfacing. While the 286 was reasonably compatible with the 386SX there are differences.

The 386SX could optionally operate in either a pipelined mode or a non-pipelined mode, but the non-pipelined mode caused performance deterioration. The VLSI PC/AT compatible 386SX interface, the 386SX adaptor, was designed to allow the most pipelined performance from the 386SX. The interface needed only three octal latches, one PAL, and a single logic inverter.

The processor clock of the 386SX is 180° out of phase with the clock supplied to the 286 by the PC/AT compatible system. A 74for4 inverter corrects this. The control lines needed in the PC/AT compatible system to control the status and I/O functions differ from those supplied by the 386SX and those required by the PC/AT compatible system. A PAL16R6-12 converts this.

Since the 386SX will work in its pipelined mode for best performance, the address lines generated will become valid sooner, and remain valid for a shorter period than the PC/AT compatible system specification needs. To guarantee worst-case timing specification performance of the PC/AT compatible system, three 74LS373 octal latches "hold" the valid address values long enough for the PC/AT compatible system to recognise them.

The 386SX interface operates with the currently available 12 MHz and 16 MHz VLSI PC/AT compatible chip sets, as well as the future 20 MHz PC/AT compatible chip set. A dedicated 386SX version of the 16 MHz/20 MHz PC/AT compatible chip set is planned that will include the external interface logic.

The VLSI PC/AT — 386SX interface application note, consisting of the interfacing schematic, PAL equation listing, and brief circuit explanation is available from **Energy Control, 26 Boron St, Sumner Park, Qld 4074 ☎ (07)376 2955.**

Transimpedance amplifier

A monolithic transimpedance amplifier is said to improve performance and to reduce the parts count and cost in fibre optic receivers. The Philips NE5212 amplifies current from the photosensitive diodes that convert optical signals into electrical signals.

This type of amplifier, accepting a current input and giving a voltage output was previously made with combinations of ICs, transistors, FETs, resistors and capacitors for greater expense and size.

The chip can be used in general purpose RF applications as a wideband amplifier with differential or single-ended outputs. In these applications are general purpose instrumentation and sensor pre-amplifiers.

The NE5212 meets performance specifications for high end applications while meeting price restrictions of low end applications, thus allowing manufacturers to consider fibre optic solutions with price penalties.

It reduces the parts count and space needs of multiple device solutions and is designed to work in linear or digital applications, from dc to 100 MHz, and support a wide variety of date rates. **Philips Components**, the supplier, terminates at **11 Waltham St, Artarmon, NSW 2064. 6(02) 439 3322.**

Compact VMEbus chip

Including all the protocol logic, open collector drivers and input buffers needed to handle all seven VMEbus interrupt request levels, the VME low power CMOS chip is in a 24-pin slimline (300 mil wide) DIP or 28-pin LCC package.

The maker said it was the most compact VMEbus interrupt handler device available.

It replaces up to 15 discrete logic devices, buffers and drivers on each board, thus reducing board space, the total number of ICs and the power needed to implement a VMEbus interrupt handler.

For more information contact **Energy Control, at 26 Boron St, Sumner Park, Qld 4074 ☎ (07)376 2955.**

8-bit flash ADC

An alternative source to the TDC-1048, the AD9048 8-bit monolithic flash A-D converter improves input bandwidth, input capacitance, and conversion rate. It is said to suit converting video signals in real time, and it combines a 10 MHz input bandwidth and at lowest 35 MSPS (million samples per second conversion rate without degrading the S/N ratio or dynamic performance.

Beneficial for applications where input phase shifts must be controlled, the lower 16 pF input capacitance reduces analogue phase shifts and drive needs of an input buffer amplifier.

It is said to be an attractive and cost effective pin-compatible second source available for military instrumentation, digital radio, electro-optic and medical equipment.

On-board strobed latching comparators, encoding logic, and output buffer registers operate at a guaranteed rate of 35 MSPS, virtually eliminating the need for costly sample-and-hold or track-and-hold circuits in most applications.

All digital control inputs and two's-complement outputs are TTL-compatible. Further details may be obtained from **Parameters, PO Box 261, North Ryde, NSW 2113. ☎(02)888 8777.**

Fastest single chip from the rest

Able to execute 30 million instructions per second (MIPS) and process an add-and-multiply instruction in 33 nanoseconds, the WER DSP16A microchip is said to process data faster than any other single chip on the market. It is in 0.75 micron, double level CMOS and also claims increased memory, enabling it to handle applications normally using two or three chips.

It suits telecommunications, and computer applications such as modems, PBXs, digital cellular phones, laser printers and optical character recognisers.

The 16-bit DSPs are also available in speeds of 55 and 75 ns. AT&T Microelectronics has more information. This company is in the **Westpac Plaza, 21st level, 60 Margaret St, Sydney, NSW 2000. ☎(02)221 3055.**

Programmable memory

Termed the REROM, a high performance, in-system reprogrammable memory offering EPROM or EEPROM performance needs only 5 V to operate and can be completely reprogrammed in four seconds.

The 256 k device,, the AT9C256, is in a 28-pin DIL package. The Mbit device, the AT9C010, will be in a 32-pin package and available in the first half of next year.

Both are the first of a planned full family designed to fill the price/performance gap between the cost effective but difficult to revise EPROM and the expensive but more flexible EEPROM.

They both offer speeds down to 100 ns, but because they are processed with CMOS technology need reduced levels of power. Both can be reprogrammed 100 or 1000 times. Made by ATMEL, they meet or exceed Military Standard 883. Read more with **Energy Control, 26 Boron St, Sumner Park, Qld 4074 ☎ (07)376 3286.**

Export contract success

A series of design and supply contracts with US-based Encore Computers for developing and making a floating point controller has gone to Austek Microsystems.

The Austek floating point controller, the A11002C, used in Encore's Multimax multiprocessing computer interfaces between National Semiconductor NS32332 microprocessors and Weitek 1164/1165 chips.

The Multimax computer can take up to twenty NS32332 microprocessors, operating simultaneously to achieve high computing speeds. An A11002C further im-

proves the computing performance of the Multimax.

The A11002C has 102 000 transistors on a 7.8 x 8.7 mm silicon chip, using line widths of 1.5 microns. It provides local memory, communication paths between the NS32332 and the W1164/W1165 and control for the mathematical functions of sine, cosine, arctangent, square root, logarithm, exponential, multiply/accumulate and polynomial evaluation.

More information can be requested from **Austek, Technology Park, Innovation House, The Levels, SA 5095. 6(08)260 0155.**

Special A-D converters

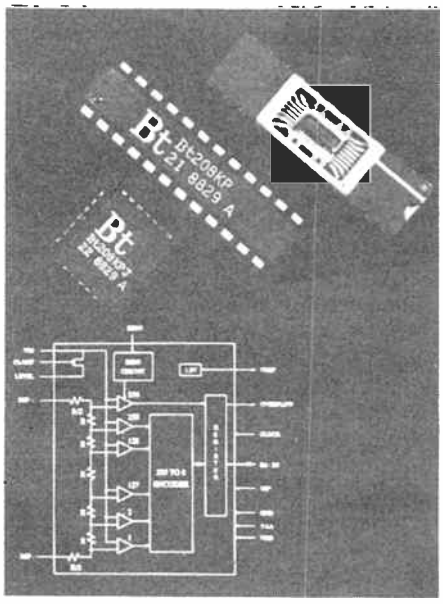
Designed for image capture equipment such as picture transmission systems, broadcast video, scanners, capture boards and medical imaging devices, the Brooktree Bt208 is an 8-bit flash, video A-D converter.

The device integrates special imaging features, said to reduce substantially the number of external components and pc board image digitisation circuit area needed.

The device uses flash converter topology to achieve 20 M sample per second (MSPS) speeds. This high sampling rate allows up to four times oversampling of PAL, SECAM or NTSC video so as to give the engineer flexibility and a margin for worst case situations.

Designed specifically to fit the specifications of image capture applications, the Bt208 does not need additional video amplification to meet input level requirements. It features an analogue input range of 0.714 to 1.2 V which covers PAL, SECAM, NTSC and RS-343A video standards. Other A-D converters that need 2 V input signals need an extra high speed amplifier.

The Bt208 has several special features which simplify designing imaging products. External zero and clamp control allows ac coupled video signals to be dc restored during each horizontal blanking interval. Therefore no extra circuitry is needed for restoring dc.



An output enable control allows the data outputs to be three-stated asynchronously to the clock, doing away with the need for a TTL three-stated buffer in most applications. The device's on-chip reference means an external voltage reference and op-amp are not needed.

It was designed so a single input controls the zeroing of the comparators. This gives designers complete control over system timing, and when to zero the comparators. Usually the zero would be asserted during each horizontal blanking interval, so the zeroing would automatically occur during each horizontal retrace interval.

The device is made in +5 V monolithic CMOS and needs a standard +5 V power supply. It features ±¼ LSB differential non-linearity, ±½ LSB integral non-linearity. There are two versions: a 24-pin 7.62 mm plastic DIP or a 28-pin PLCC package. For more information, contact **Energy Control, 26 Boron St, Sumner Park, Qld 4074 ☎ (07)376 2955.**

High speed and density products

What is called the "full 1-micron ASIC solution" encompasses VLSI Technology's application specific IC (ASIC) product line to include the VGT300 gate array family. This offers more than 243 000 available gates and the VSC300 cell-based family, achieving densities greater than 150 000 usable gates.

Performance characteristics for both include gate delays of less than 350 picoseconds. The "1-micron solution" includes software tools for designing ICs and foundry services for fabricating designs done with tools other than those from VLSI. Interface with **Energy Control** for more information, at **26 Boron St, Sumner Pk, Brisbane, Qld 4007. 6(07)376 2955.**

Analogue journal

A technical journal on circuits, systems and software for real-world signal processing, "Analog Dialogue", covers an analogue chip-set, the AD890, a precision wide-band channel processing element, for recovering digital data and the AD890 rigid disk drive amplifier. This is in volume 22, no. 1, with 36 pages.

Other products featured include a precision op amp setting a new standard with its low offset, drift and noise, with high gain and CMRR, the AD707; two 12-bit A-D converters for DSP providing complete interface, the AD1332 and AD1334; a monolithic log amp with 250 MHz bandwidth, the AD9521; and others.

This issue also covers a faster version of the ADSP-2100 DSP microprocessor, the ADSP-2100A, and two CMOS video D-A converters providing memory, interface and RGB outputs, the 8-bit ADV478 and the 6-bit ADV471, compatible with the IBM System/2.

Also listed are new data books, application notes, article reprints, a brief book review and more. Contact **Parameters PO Box 261, North Ryde, NSW 2113. 6(02)888 8777.**

High speed image decompression

The Brooktree Bt70101 image decompression processor is an add-in card for the IBM PC/AT and compatible computers. It gives high speed decompression of CCITT groups 3 and 4 digital facsimile encoded images.

Suggested applications are document filing systems, PC workstations which support image databases and high speed fax servers for local area networks.

The maker says it developed a unique decompression engine for the Bt70101 which provides 20 Mbit/s decompression rates for high speed image processing.

The board conforms to CCITT recommendations on groups 3 and 4 facsimile image decoding. It is said to be the only one of its kind to offer programmable line lengths to 64 kbits. The line length register, controlled by the PC host, specifies the image line length from 8 to 64 kbits. This allows the card decompression images as large as 1524 mm scanned at 1000 dpi.

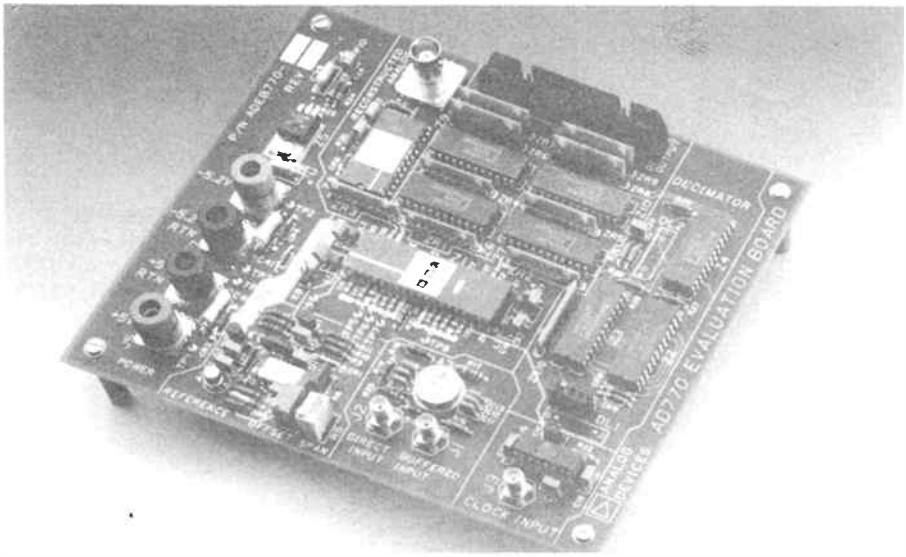
Additional features simplify system design and operation and include a command register which controls programmable inputs, byte swapping for compatibility with various processor byte order conventions, coded image type for groups 3 and 4 operation, and a half resolution option to simplify 300 to 150 dpi scaling.

A reset register allows the processor to be reset via software, and a status register contains status flags used by host software to determine interrupt sources and for host polling in non-interrupt environments.

The Bt70101 is available with a user's guide and a DOS-compatible floppy diskette that has diagnostics to verify the functionality of the board, demonstration software and compressed image files. For more details, contact **Energy Control, 26 Boron St, Sumner Park, Qld 4074 ☎ (07)376 3286.**

Evaluation board

Designed to ease observing and analysing significantly the performance of Analog Devices' AD770 flash A-D converter, the ADEB770 evaluation board provides the support circuitry needed for using this 8-bit, 200 megasample/s (MSPS) device. ▷



Special consideration in board layout, grounding and buffering assures best performance at these high data rates.

A high speed D-A converter allows sampled data to be reconstructed as an analogue waveform and compared with the original signal. Special decimation circuitry passes one-of-n digital results to slow down the effective digital output rate if necessary.

Analogue signal inputs are applied directly to the converter or via an AD9611 high-speed buffer amplifier. The on-board voltage reference has independent adjustments for the converter reference ladder top and bottom voltages. Full scale range and span can be anywhere within a ±2 V range to match the input signal.

A single user-supplied clock is buffered for the converter by the ADEB770. Digitised outputs are available through the high speed 100K ECL latches and drivers. Latch strobing sense is selectable to meet differing requirements. For more on the evaluation board, refer to **Parameters, PO Box 261, North Ryde, NSW 2113. 6(02)888 8777.**

ASIC verification products

ASIC verification products of Integrated Measurement Systems will be distributed in Australia exclusively by Parameters. The company said that as design and use of ASICs (application specific ICs) has grown rapidly, testing and verifying chips by traditional methods was expensive and inadequate.

Therefore IMS in the USA began in 1983 to develop verification solutions for ASIC designers, and through its successful products is said to have become the leading design in this market. Test **Parameters** for more at information **Centrecourt, 25 Paul St North, North Ryde, NSW 2113 ☎ (02)888 8777.**

Chip offers wider range

An improved dynamic range is offered in an 18-bit A-D converter chip set aimed at OEM companies seeking a wider dynamic range, that is, a lower noise level in the conversion process. The distributor for the dbx chip said the more bits in the conversion, the wider the dynamic range.

The 16-bit converters used at present theoretically produce a range of 96 dB, but in practice more like 90 to 92 dB. The 18-bit converter claims a dynamic range of 104.5 dB. **Amber Technology** distributes the dbx products and is found through **PO Box 942, Brookvale, NSW 2100 ☎ (02)975 1211.**

RISC user's manual update

Updating the user's manual for its reduced instruction set computer (RISC) family product line, VLSI Technology has put package and order information in the new manual.

There are specifications on the VL86C010 (32-bit RISC microprocessor), VL86C110 (Memory Controller, MEMC), VL86C310 (Video Controller, VIDC) and the VL86C410 (I/O Controller, IOC). Hardware and software examples are used extensively to help explain on the VL86C010's instruction set. Australian distributor is **Energy Control, 26 Boron St, Sumner Park, Qld 4074 ☎ (07)376 2955.**

12-bit, 800 nsec A-Ds

Two 12-bit, 800 nanosecond A-D converters from Analog Devices, each with internal buffer amplifier, are identical except for the analog input voltage range.

The ADC-520 and ADC-521 have a total of six pin-programmable analog input voltage ranges between them. The 520 has ranges of ±10 V, 0 to 10 V, 0 to 20 V and 0 to -20 V. The 521 includes ranges of ±2.5 V and 0 to 5 V.

Their performance is based on a digitally corrected subranging architecture enhanced by using a proprietary custom chip and unique laser trimming schemes.

Features include extremely low initial errors of ±3 LSB's maximum for offset and gain errors, CMOS/TTL compatibility, three state outputs, and greatest power dissipation of 1.9 W.

Output coding for both models can be in straight binary/offset binary, complementary binary/complementary offset binary, or two's complement, and complementary two's complement by using the COMP BIN and MSB pins. Both parts are tightly specified over the full operating ambient temperature range and power supply range.

This performance and these functions are packaged in a small 32-pin hybrid package.

Both models need ±15 and ±5 V dc. Models are available in the commercial 0° to 70° C and military -55° to 125° C operating temperature range.

Typical applications include spectrum, transient, vibration and waveform analysis. These devices are also ideally suited for radar, sonar, video digitisation, medical instrumentation and high speed data acquisition systems. Information is available on versions with high reliability screening. Buff the word to **Elmeasco, 18 Hilly St, Mortlake, NSW 2137 ☎ (02)736 2888.**

700 kHz sampling A-D converters

Performance of two 12-bit, 700 kHz sampling A-D converters is based on a digitally-corrected sub ranging architecture ehanced use of a proprietary custom chip, plus claimed unique laser trimming schemes.

The ADS-125 and 126 have a greastest conversion time of 800 nanoseconds and a highest acquision time of 395 nsec for sinusoidal inputs. Input impedance to the sample-and-hold is 15 MΩ. They offer pin programmable input voltage ranges of ±10 V and 0 to 10 V for the ADS-125 and ±2.5 V and 0 to 5 V for the 126.

Other features include TTL and CMOS compatible inputs and three-state outputs. Output coding can be in two's complement, complementary two's complement, straight binary/offset binary, or complementary binary/complementary offset binary.

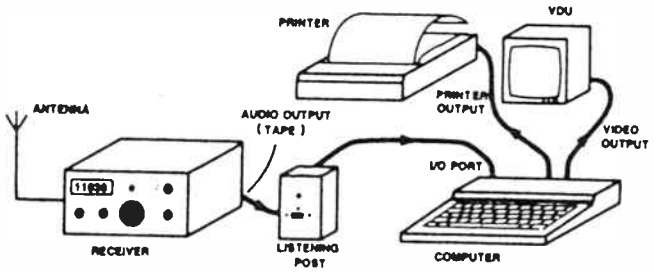
The chips are packaged in a small 32-pin DIP, needing ±15 and ±5 Vdc. Applications include spectrum, transient, vibration and waveform analysis.

This device is also ideally suited for radar, sonar, video digitising, medical instrumentation and high speed data acquisitrion systems. The converter is available in the commercial 0° to 70° C and military -55° to 125° C operating temperature ranges.

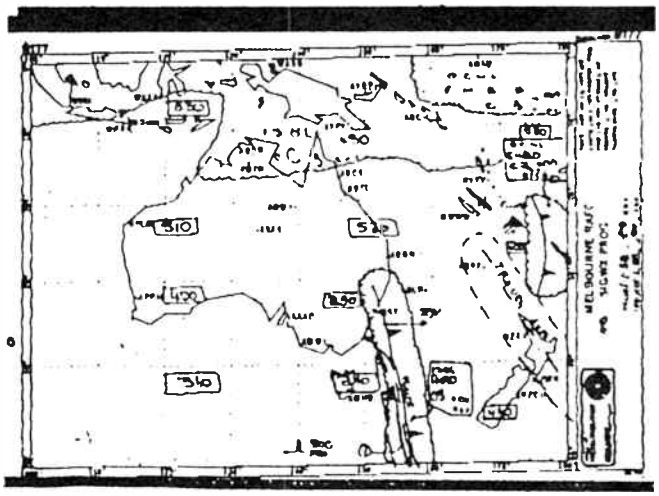
For information, sample **Elmeasco, PO Box 30, Concord, NSW 2137 ☎ (02)736 2888.**

RECEIVE FAX, RTTY & MORSE ON YOUR COMPUTER

Using the Australian Electronics Monthly "Listening Post" (AEM3500) project, you can tune-in to the myriad of non-voice transmissions on shortwave and decode them! All you need is a shortwave receiver with SSB reception, the AEM3500 Listening Post, computer and software. Be the first on your block to receive weather pictures and foreign news bulletins – USEFUL and FASCINATING.



Get the Most Out of Your Receiver!



MONSIEUR LE SECRETAIRE GENERAL, DES VOTRE NOMINATION A LA HAUTE FONCTION QUE VOUS OCCUPEZ VOUS AVEZ MARQUE AVEC FORCE L'IMPORTANCE QUE VOUS ATTACHIEZ A CE QUE L'ORGANISATION RETROUVE LES PRINCIPES QUI L'AVAIENT FONDEE : ''NOUS NOUS SOMMES, DISIEZ-VOUS, SANS CONTESTE, BEAUCOUP ECARTES DE LA CHARTE CES DERNIERES ANNEES. NOUS SOMMES PERILLEUSEMENT PROCHES D'UN NOUVEL ETAT D'ANARCHIE INTERNATIONALE''. ET UN PEU PLUS LOIN VO

Available in two packages:

- **SOFTWARE ONLY**
  Apple, Commodore 64, Microbee – **$25.00**

- **FULL PACKAGE – software & pc board.**
  Apple, Commodore 64, Microbee – **$35.00**

Both packages include full instructions for building the Listening Post project and application notes for your computer.

Send to: "AEM Listening Post Software", 1st Floor, 347 Darling St, BALMAIN 2041 NSW.

*You must include a blank C10 cassette or **formatted** disk.*
Please Tick.

☐ *Software Only*
☐ *Full Package*

☐ Microbee – Epson FX80/100 printer
☐ Microbee – C.Itoh 8510 printer
Microbee: ☐ 5¼" and ☐ 3½" disk or ☐ cassette

☐ Commodore C64/128 (most printers)
Commodore: ☐ 5¼" disk or ☐ cassette

☐ Apple (most printers)
☐ *5¼" disk ONLY*

☐ Cheque ☐ Money Order
☐ B/Card ☐ M/Card ☐ Visa
(make cheques or money orders payable to "Australian Electronics Monthly")

Card No ..... Expiry .....
Signed .....
Name .....
Address .....
.....
..... P/Code .....

WIA appoints general manager/secretary

After 36 years in banking, Bill Roper VK3ARZ has changed bands to become general manager/secretary of the Wireless Institute of Australia for a five year term.

Mr Roper, 52, can key into the WIA his specialised experience acquired in banking in administration, legal, accounting, staff training and retail banking. He has passed several training courses from staff and financial management to negotiation and marketing.

Recently he has been a district manager responsible for 36 branches, principal of a live-in staff training college, and a manager of a large retail banking branch office.

In amateur radio he has held his callsign since 1959. While his interest in designing receivers and transmitters had to take second place to family and work he has been finding ways and means of improving the performance of sophisticate commercial HF transceivers, and experimenting with antennas.

Bill's voice will be familiar to amateurs through his 12 years' involvement with the Federal Tapes, broadcast weekly via the states' Divisional broadcasts each Sunday.

He has served the WIA at divisional and Federal levels since 1960 and edited Amateur Radio for several years in the 70s.

Away from amateur radio, Mr Roper has interested himself in computers, especially as a management tool. Married, with four daughters and three grandchildren, Mr Roper had to leave his position with the bank to join the WIA, and after acting in the position since May, has been confirmed in the position by the WIA Federal Executive.

Watertight connectors

Making connections in harsh environments has led to a range of Buccaneer multipin and coaxial waterproof connectors for general electrical, electronic and communications service.

The basic connector and associated family of panel, flange, bulkhead mounting and in-line socket configurations are moulded in a glass-filed nylon material. Water and dust proofing is achieved with neoprene O-rings, compression sealing grommets and washers.

To suit varying needs the connector inserts have optional screw down or crimp pin terminals of high quality materials. Data sheets show the connectors have been made and tested for BS specifications IP66/67.

Coaxial variants use 50 Ω or 75 Ω BNC style inserts. Inserts are available for 2, 3, 4, 6, 7 and 9 poles. Connect up to **Rifa** for further details, at **202 Bell St, Preston, Vic 3072. ☎ (03)487 3333.**

Pressure on 2 m band edge

One of the comments of the outgoing president of the Townsville Amateur Radio Club was ". . .just a few worries."

Mrs Evelyn Bahr, VK4EQ, made the comment at the club's annual general meeting. She reported these as Telecom was writing to tell local amateurs of a paging system at Mt Inkerman, only 62 kHz from the club's 2 m repeater.

Next, the Department of Transport and Communications asked for the repeater to be turned off for a commercial service to carry out field tests. "So much for band sharing, but negotiations will continue on the issues," she said.

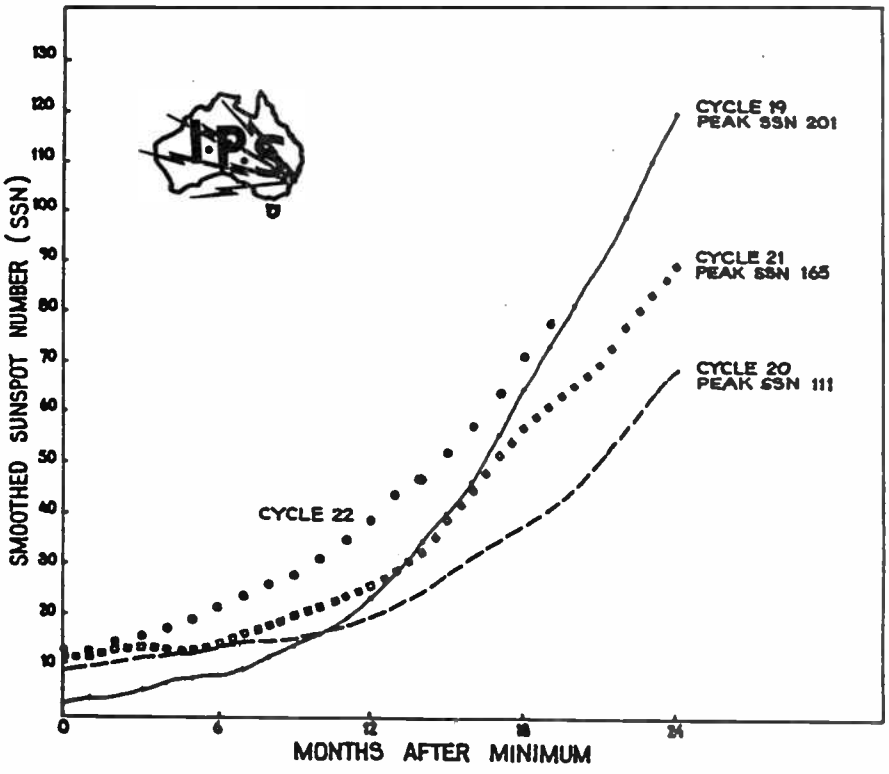
The club's portable repeater had been used successfully at exercises but it was immensely important during a search for a woman lost at Mt Spec.

Mrs Bahr said many club members spent many days in the area, while others lent handhelds and equipment. "It was a tragedy that the work was of no avail," she said.

The idea of a TAFE class on amateur radio was not widely accepted, so the club is conducting its own classes with a slow Morse co-ordinator and six operators helping.

There were 50 members at the

Buccaneer waterproof connnector.



The rise and rise of Solar Cycle 22! This comparison of the rise of the past three solar cycles and the progress of Cycle 22 shows an encouraging trend and explains all the frenzied activity recently on the higher HF bands, right through to the lower VHF bands (50 MHz +). We're in for a good peak 1989-90.

☎ ☎☎ ☎ ☎ ☎

AGM, and from them 31 positions were filled, to carry out club activities for the next year.

The club has held two displays during the year, the first at a Leisureama at Lavarack Barracks and four months later the Bicentennial Display at North Ward.

"Both were successful, but a great deal more effort went into the latter," Mrs Bahr said. "Many articles of historical interest as well as modern equipment was featured. Without a doubt it created much interest and over 500 contacts were made using the special callsign VI88QLD."

Microwave frequency counter

Makers of microwave and millimetre wave systems can take advantage of a frequency-extension option for the Hewlett Packard 5352B CW microwave frequency counter that extends the unit's range to 46 GHz without needing an external mixer.

The counter's sensitivity of -30 dBm at 26.5 GHz, linearly decreasing to -15 dBm at 46 GHz, lets EHF satellite communication system makers to measure weak signals accurately to 46 GHz without using external amplifiers and filters.

HP said that microwave and millimetre wave system maskers would find the counter's 120 measurements throughput contributing to improved measurement system efficiency to 46 GHz.

The microwave counter offers a 2.4 mm connector for users of coaxial measurement techniques at higher frequencies, and the option's connector offers mode-free operation to 50 GHz, a rugged interface, excellent return loss characteristics and repeatable performance.

The 2.4 mm connector also is available with other HP instrumentation, making it possible to configure a complete coaxial system based on a 2.4 mm connector.

The option augments the capability of HP's existing microwave frequency counters: HP 5350B (10 to 20 GHz), 5351B (10 to 26.5 GHz) and 5352B (now 10 to 46 GHz). Each model offers comparable performance, but differs in frequency range.

Features common to all members of the family are 60 ms acquisition time, 1 GHz/s tracking speed, and 120 measurements/s system throughput via HP-IB (IEEE-488). For more information, count on **Hewlett Packard, 31-41 Joseph St, Blackburn, Vic 3130. ☎(03)895 2895.**

Fun & frolics on VHF

Contests for VK2 amateurs that have caused a great deal of interest as well as promoting the use of various amateur bands in the past year are held between 9 and 11 p.m. on the last Friday of every month.

There is a different mode and band each time, and future contests are: Friday, December 30, 6 m all mode 52.000 to 54.000 MHz; and Friday January 27, 2 m, SSB, 144.100 to 144.500 MHz.

Economy CW synthesised generator

Because a cw signal alone suffices to carry out many microwave communications and automatic test measurements, the HP 8673G synthesised cw generator provides just such performance in the frequency range from 2 to 26.5 GHz, with a power range from +8 to -100 dBm.

Without any modulation features, the HP8673G's price is lower than full performance generators, HP claim, while it solves many microwave applications such as local oscillator substitution and up/down conversion.

Derived from the HP8673B/C/D family of synthesisers, all application software previously developed and proved will run on the new generator.

Its predecessors' field-proved reliability is greater than 12 000 hours of mean time before failures (MTBF) and the new product will have a stated MTBF of 15 000 hours. The unit has the circuitry to operate HP n-wave multiplier heads for generating signals to 60 GHz.

The generator has a SSB phase noise spec. of -86 dBc/Hz at 6 GHz and 19 kHz offset, making it suitable for local oscillator substitution and signal-conversion applications.

Timebase stability is quoted as 5×10^{-10} per day, and the unit is fully programmable. Contact Hewlett Packard PO Box 221, Blackburn, Vic 3130 ☎ (03)895 2644.

The art and science of keeping a log

Leo McNamara

While keeping a logbook, or log, is no longer a regulatory requirement for amateurs, many still do — particularly VHF operators. While recording the "bare bones" of contacts is useful for QSLing, your log can actually be employed as a useful scientific record.

HOW USEFUL are *your* logbooks? Do you think they are worth cutting a tree down for? Would they tell the rest of the world anything except that you own a pencil or pen, or perhaps even both? Maybe you keep your log in the "modern" way — using a computer, storing the information on a floppy disk. Would your log simply tell the world you owned a home computer?

While you are pondering the answers to these questions, let me tell you about some useful conclusions which have been drawn from the logbooks kept by amateurs, and then suggest how even more information could have been gleaned from them if a more systematic approach had been adopted in the first place.

Some time ago, when we were all a little younger and wiser, Roger (you guessed it) and I decided to see what the logbooks of 6 m (50-54 MHz) operators could tell us about that very interesting phenomenon known as *transequatorial propagation*, or TEP for short. Our reason for doing this was simply that when the 6 m band was open between Australia and Japan/Korea/China etc, the signals could quite safely be assumed to have travelled via a TEP mode.

In the afternoon, this would be via a "super" mode involving two reflections from the F region of the ionosphere, without a reflection from the ground in between — see Figure 1; and in the evening by some sort of mode involving guiding of the radio waves along lines of force of the Earth's magnetic field — see Figure 2.

Roger spread the word far and wide that 6 m logbooks were in great demand, and soon we had logbooks from operators all over Australia — see Table 1. We then sat down and set up a theoretical "model" to describe the situation of an Australian operator trying to make contacts with as many different operators in Japan as possible. We used contacts with Japan since these were the most numerous. We concentrated mainly on the contacts made with the different areas of Japan (see Figure 3), to study any effects that the latitude of the Japanese transmitter might have on the probability that the 6 m band be open on circuits to a particular Australian city.

The theory of logkeeping

Our full theory was a little messy and using it to interpret what was in the logbooks (rather than what we would *like* to have been in them) became a convoluted procedure which no one else should have to suffer through. What follows is a simplified version of that theory.

Basically, there are three factors to take into account:

1) The 10 areas Japan divides into (see Figure 3) have unequal populations (see Table 2), and presumably unequal numbers of 6 m amateurs. We assumed that the numbers of amateurs in each area, N_i, was proportional to the population of that area, p_i, that is

$$N_i = g.p_i$$

where g is a proportionality factor that we could work out if we knew N_i and p_i. The total population of Japan is denoted by p, and we assume that all areas had the same proportion of 6 m enthusiasts.

2) Whether a Japanese operator was contacted or not would depend on how "good" the circuit was — in other words how likely the 6 m band on that circuit was to be open, and providing a useful signal level. We shall talk in terms of the quality of the circuit to each of the 10 areas, and represent this by Q_i.

3) During each observing period, the same Japanese operator would not be contacted more than once. This is just like radio active decay: once an atom has decayed, it cannot decay again. What we

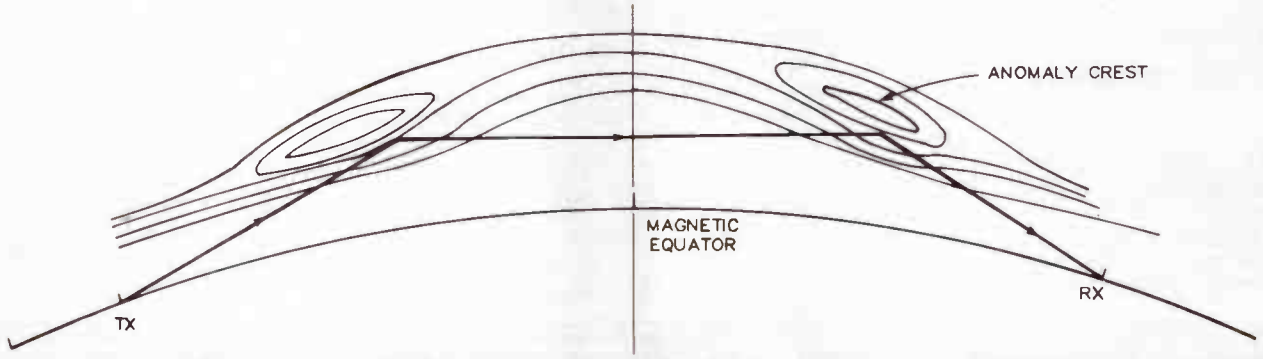


Figure 1. The "super" mode, or FF mode, of propagation responsible for afternoon-type transequatorial propagation (TEP). There is an anomaly in the ionosphere, known as the equatorial anomaly, which produces "crests" either side of the magnetic equator. Because of the upward tilt of the crest of the equatorial anomaly at the first reflection point, the radio waves travel directly across to the opposite crest without an intermediate ground reflection. At this crest, the waves are reflected back down to Earth at the receiver. This mode supports higher frequencies than the normal 2F or 3F mode and is exploited by 6 m operators for long distance contacts across the equator.

mean by "each observing period" has to be left deliberately vague here. What we would like it to mean is each day or night. What it really means is the time which elapses before the Australian operators had very long memories! This is one effect that we cannot eliminate from the logbooks, and which makes the logs correspondingly less useful.

There were two limiting forms which our theory yielded for the number of contacts, $C_i(t)$, made during a time "t" with operators in area "i":

$$C_i(t) = (Q_i.t.g/P)p_i \quad — \quad (A)$$

$$C_i(t) = g.p_i \quad — \quad (B)$$

Equation (A) is the one to use when the circuit is poor (Q is small), or the time "t" is short. [We can't *all* sit in our shacks for eight hours on end!]. In this case, the contacts made with an area "i" depend on the *square* of the population p. Equation (B), on the other hand, applies to the case of the very good circuit, or of a devoted Australian operator who spends most of his life in his shack. His devotion to duty overcomes the inherent poor quality of the circuits. Here, the number of contacts depends only on p_i, and not on p_i.

When we were developing our more exact theory, we had hoped to use the logbooks from different Australian operators to determine the quality figure Q for each Japan-Australia circuit. However, as the astute reader will have already noticed, Q_i is not the only unknown in equation (A) of our simplified theory: we really do not know the time "t" which the operator spent trying to make contacts.

All that we could determine from the logbooks was the time on the clock when a contact was established. We do not know how long the operator spent before he successfully made contact. Thus we are left with a combined unknown,

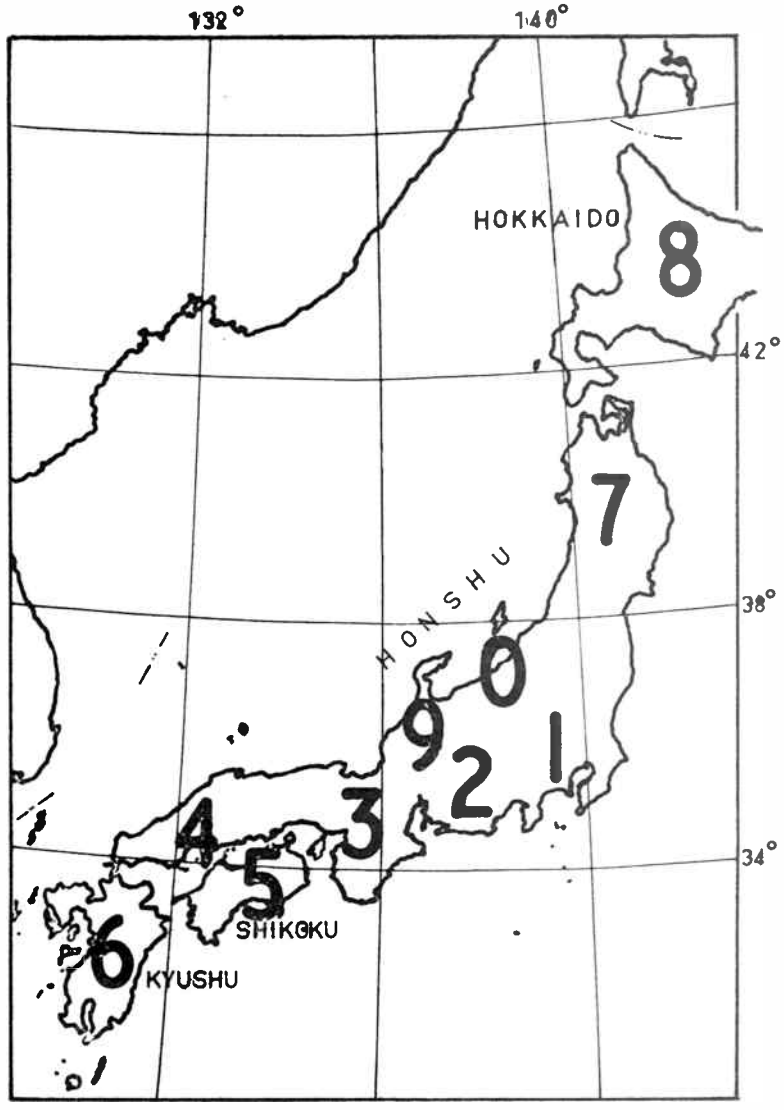


Figure 3. Map of Japan, showing the locations of the areas identified by the callsign prefixes JA0, JA1 — JA9.

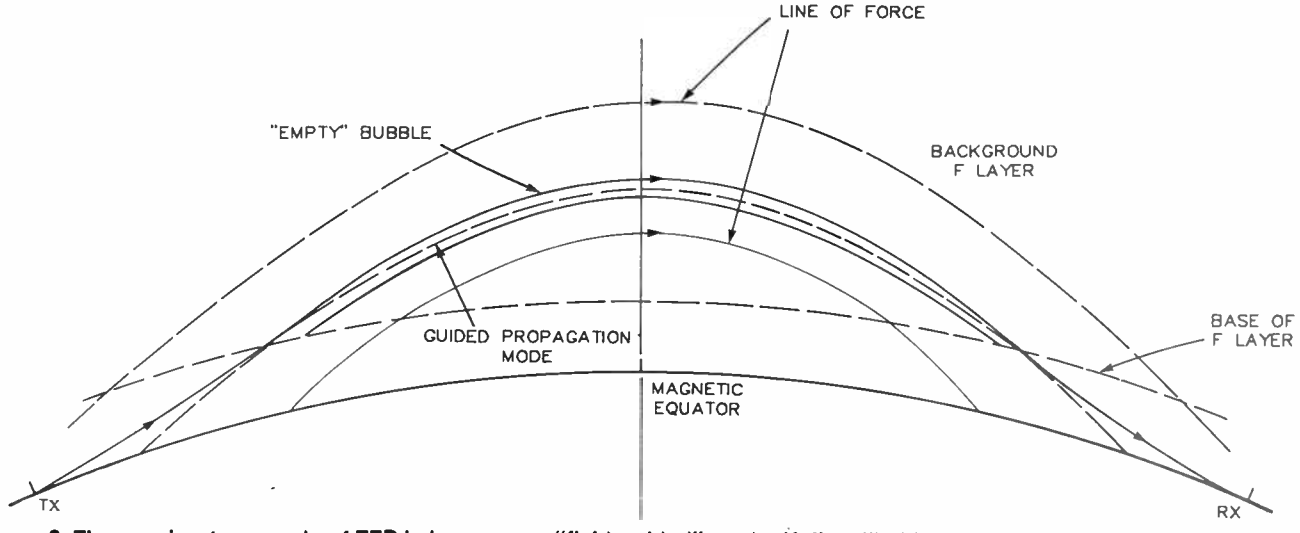


Figure 2. The evening-type mode of TEP is known as a "field-guided" mode. Hollow "bubbles form just after sunset as the F layer rises rapidly, and these diffuse quickly along the lines of force of the Earth's magnetic field, yielding a family of field-aligned "empty" tubes embedded in the background ionosphere. VHF signals are from stations located in favourable locations are guided around the tubes in a sort of whispering gallery effect. Popularly exploited by 6 m and 2 m operators.

$Q_i.t$, and we cannot determine the values of Q_i.

All is not lost, however. There is still some useful information hinted at by equations (A) and (B) which we can use to estimate the relative (but not the absolute) qualities of circuits to the 10 different areas of Japan. To display this information, we can plot graphs of C_i against p_i for each Australian operator and see if the points lie on the lines suggested by the two equations.

Things are a little simpler, believe it or not, if we plot the logarithms of C_i and p_i against each other. To see this, we can consider the equation

$$y = a.x_n. \qquad (C)$$

If we plot "y" against "x" for a range of values of "x" we would get a straight line if n = 2, and so on.

Now one of the first rules in plotting and analysing observed data is to try to arrange that the plotted points lie more or less on a straight line, since this is the simplest possible situation. For the above equation, and for equations (A) and (B), we can get a straight line graph by plotting log y against log x, where the logarithms can be to any base, such as 10. Taking logarithms of both sides of equation (C) yields

$$\log y = \log (x_n) + \log a$$
$$\log y = n.\log x + \log a$$

Comparison of this equation with the equation to a straight line (see Figure 4) passing through the point (X = 0, Y = B) and with a slope or gradient of M,

$$Y = M.X + B,$$

tells us that the slope of the straight line which we fit through our data points will be equal to the exponent "n" in equation (C).

This means that if we plot log C_i against log p_i for a set of observations, we can determine which of the two equations (A) and (B) best fits the data, and thus be able to make some useful deductions about the physical properties of the circuits.

Theory versus real logs

There is no space here to discuss *all* the observations that we had logbooks for, so I intend to discuss only the Townsville data provided by VK4ZBE (W.S. O'Donnell, logs from 1959-67), VK4ZRG (R.L. Grummit, logs from 1965-72) and VK4ZTK (R.C. Tulloch, logs from 1970-71). Having three sets of observations from the same location allows us to look for things that happen at all three locations, and to eliminate the effects of various operator idiosyncrasies which will appear later.

Figure 5 and 6 show the log C_i versus log p_i plots for the three operators for observations made before 1900 LT (local time — 150° E standard time), and after 2000 LT. This separation into two time intervals is an attempt to bring out any differences between afternoon and evening-type TEP. The logarithms are to base 10 and populations are measured in units of a million.

The solid lines are considered to be the straight lines best fitting the data. They are constrained to pass through the data point for area 1 (which should have the least uncertainty associated with it since it corresponds to the greatest number of contacts) and to pass as closely as possible to the data points for areas 2, 3, 4 and 5 which have very nearly the same latitude as area 1. The dashed lines have a slope of one and are shown for comparison.

The position of a data point above the best-fit line is taken as indicating either a conscious effort on the part of the observer to contact that area in particular or a statistical fluctuation. The alternative hypothesis, that the circuit to that area is significantly better than all other circuits, is rejected because it is not consistent with the data of all observers. The areas which were "overcontacted" are almost exclusively those with the lowest populations i.e: areas 0, 5 and 9. The results for VK4ZTK show very clearly that attempts were made to increase the numbers of contacts with these areas. They should not have been contacted at all on the basis of the numbers of contacts with the other areas.

The steep slope of the VK4ZTK line in Figure 5 arises because most of the data considered corresponded to just one or two observations per day. The observing time, t, is thus very small and the limit (A) is valid, yielding a slope of two.

It can be seen from Figure 5 that area 6 in southern Japan was undercontacted relative to its population by all three observers. No additional conclusions can be drawn which are consistent with all three analyses of logs from VK4ZBE, VK4ZRG and VK4ZTK are discussed here.

TABLE 1.
Logs supplied by operators for the study on TEP. The results of the

STATION	OPERATOR		PERIOD
ROCKHAMPTON	VK4ZAZ	J.L. BICKFORD	1957-61 1972
TOWNSVILLE	exVK4ZBE	W.S. O'DONNELL	1959-67
	VK4ZRG	R.L. GRUMMIT	1965-72
	VK4ZTK	R.C. TULLOCH	1970-71
CARNARVON	VK6ZFL	R.F. LESTER	1967-72
	VK6ZJR	P.J. RYAN	1972
TENNANT CREEK	exVK8AU	D.D. TANNER	1970-71
MACKAY	VK4ZAM	A.A. MILLARD	1970-71
DARWIN	VK8KK	D. McARTHUR	1969-71
CAIRNS	VK4MH	D.J. HUDSON	1970-72
	VK4ZIB	J. BATY	1970-71
	VK4TL	J.E. ROBERTS	1970-71
	VK4ZNR	R.N. BOLAND	1972
	VK4YG	E. GABRIEL	1972
	VK4DB	I. BROWNE	1969-70
SYDNEY	VK2ZRH	R. HORD	1970-72
	VK2HZ	W. MOORE	1972
	VK2ATQ	R. CAMERON	1968-72
PERTH	VK6PD	*	1972
	VK6WA	J.L. HARRISON	1970-71
	VK6ZDY	P.L. JACKSON	1969-71
	exVK6FM	R.H. MOULD	1959-61
EXMOUTH	VK6ZDZ	A.P. LEGG	1971-72
MEEKATHARRA	exVK6FM	R.H. MOULD	1958-59

DISTRICTS	POPULATION (MILLIONS)	PREFECTURES
JA1	27.0	Tokyo, Kanagawa, Chiba, Saitama, Ibaraki,Tochigi,Gumma,Yamanashi.
JA2	10.9	Shizuoka, Gifu, Aichi, Mie.
JA3	15.8	Kyoto, Shiga, Nara, Osaka,Wakayama, Hyogo.
JA4	6.8	Okayama, Shimane, Yamaguchi, Tottori, Hiroshima.
JA5	3.9	Kagawa, Tokushima, Ehime,Kochi.
JA6	12.5	Fukuoka, Saga, Nagasaki, Kumamoto, Oita, Miyazaki, Kagoshima.
JA7	9.2	Aomori, Iwate, Akita, Yamagata, Miyagi, Fukushima.
JA8	5.2	Hokkaido.
JA9	2.7	Toyama, Fukui, Ishikawa.
JAØ	4.4	Niigata, Nagano.

TABLE 2.
Districts, prefectures and populations (1965 census) of Japan.

sets of data. Figure 6 shows that during the evening the areas 7 and 8 in northern Japan were significantly undercontacted by all three observers. Again, no additional conclusions can be drawn which are consistent with all three sets of data. (Note that absence of a data point for any area indicates that it was not contacted at all.)

Figure 7 shows the occurrence rates of contacts with all areas as a function of time of day for the three operators. Unfortunately, because the logbooks recorded only successful contacts, and not the times when contact was either not attempted or was unsuccessful, the histograms tell us more about the habits of the operators than about 6 m openings between Australia and Japan!

All three sets of data agree that 6 m openings between Townsville and Japan reached a peak in occurrence around 1900 LT. But what about the later increase indicated by the VK4ZBE data, which is not consistent with the rapid drop-off indicated by the VK4ZBE data, which is not consistent with the rapid drop-off indicated by the other two sets of data? Do the differences just tell us that VK4ZTK and VK4ZRG tended to pack it in a few hours earlier than VK4ZBE (no stamina!)?

The afternoon peak in the VK4ZRG data is also a bit of an enigma: is it really a peak, or does the following dip at 1600 to 1800 just tell us that there was no systematic attempt to make contacts during this period? If the peak is real, why doesn't it show up in the VK4ZBE data? ▷

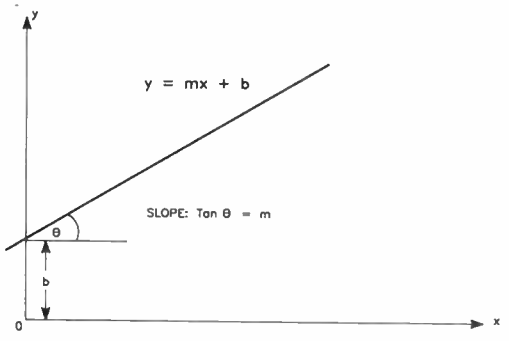
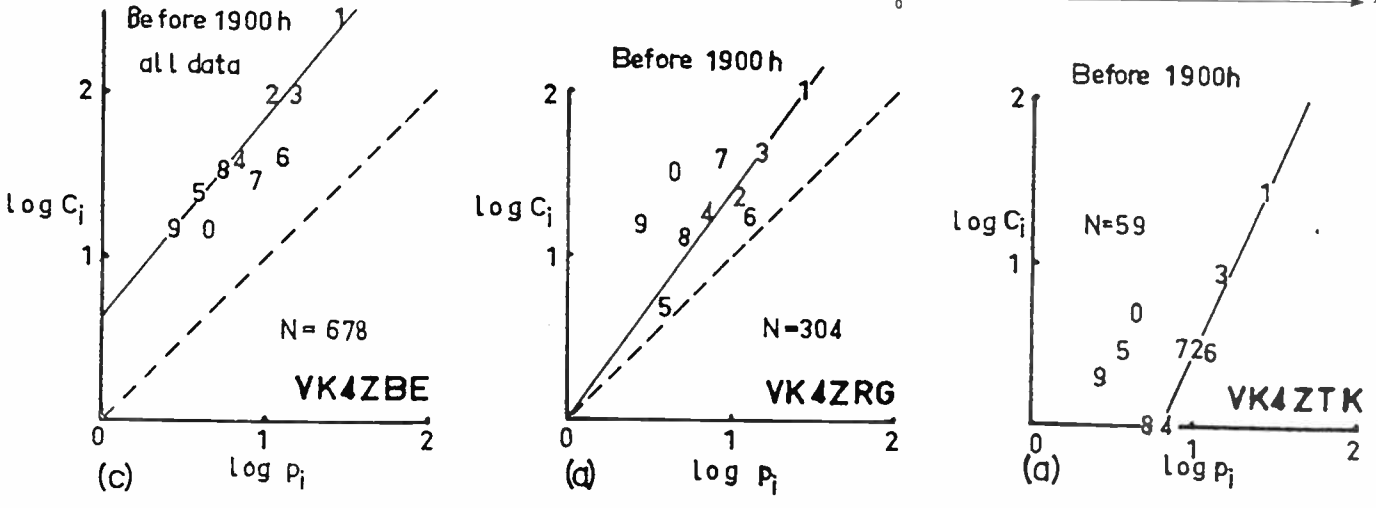


Figure 4. General form of the equation of a straight line.

Figure 5.



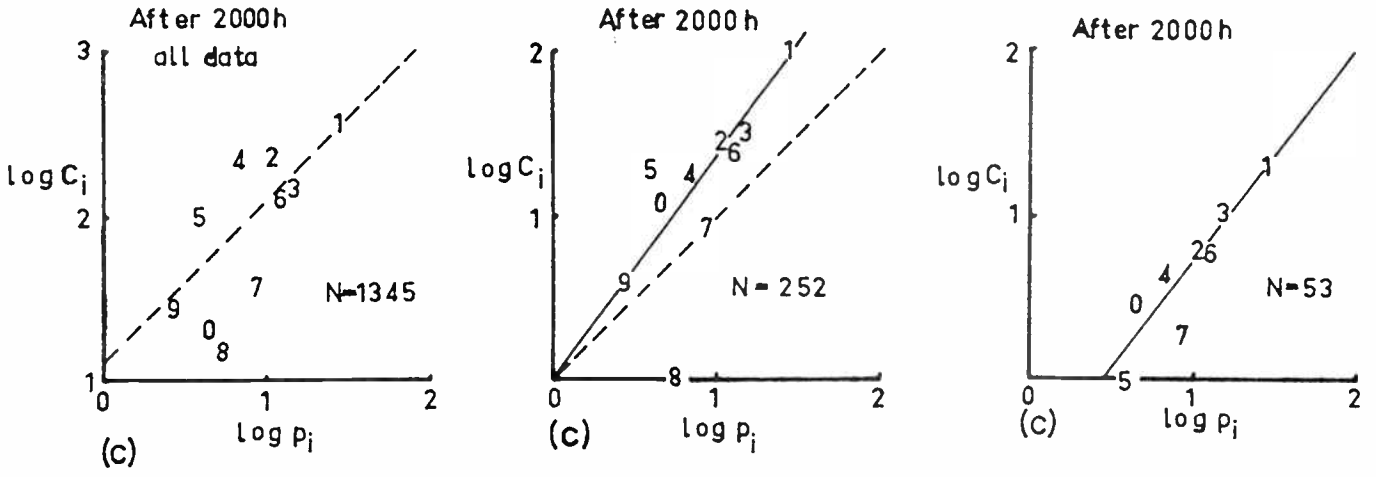


Figure 6.

The only definite conclusions which can be drawn from the observations recorded in the three logbooks about latitudinal effects on the Japan — Townsville circuits are that: (1) during the afternoon (before 1900 h) the circuit to area 6 in southern Japan are significantly poorer than those to all other areas.

(2) during the evening (after 2000 h) the circuits to areas 7 and 8 in northern Japan are significantly poorer than those to all other areas.

The same conclusions can be drawn for locations throughout Australia. It is not possible to compare the qualities of the circuits to two different Australian locations because of the fairly large scatter in the data. The slopes of the lines in figures such as Figure 5 and 6 are determined by the habits of the Australian operators and thus usually cannot serve for comparing two sets of data.

How to make your log more useful

Although it is probably not possible to develop a scheme of observation which would allow application of our exact theory, it is possible to develop a scheme where the limiting forms (A) and (B) apply. To do this, two main shortcomings of the present data must be overcome, namely

(1) areas must be contacted at random

(2) the log books must record *whether or not* you were trying to make contacts.

In other words, we have to ensure that individual idiosyncrasies do not contaminate the recorded observations (for which read "take away all the fun"!).

The following scheme is therefore suggested, and it works whether you're making contacts or just listening:

As an operator, your role is to be entirely passive — that is, you take what comes at you, without concentrating on a particular area. Starting at some noted time, sweep the whole 6 m amateur band (50 — 54 MHz) in frequency (or a given portion, making sure you consistently sweep *that* portion) and record the callsigns of each Japanese (or other DX) operator you can identify (by contact), with no attempt at an identification to last more than a reasonable period (perhaps three minutes). The times at which the identifications, or contacts, were made should also be recorded.

Having reached the top of the band, or segment, you should then repeat the procedure, recording the start time of the new frequency sweep. Those operators contacted in previous sweeps should be recorded again if they are heard and identified again. The time at which the session or observations cease should be recorded.

The suggested scheme obviously overcomes the objection (2). It also overcomes the first objections since no attempt is made to contact a particular area. Adherence to this scheme should allow intercomparison of the data for two Australian stations. For example, the vertical distance of the data point for area 6 from the best fit straight line for the afternoon data would hopefully yield a consistent pattern of the effects of the latitude of the Australian station.

The recording of whether or not you were trying to make contacts would allow inter-comparison of the occurrence histograms for two circuits. Although the histograms would contain the unknown effects of the diurnal variation of the numbers of Japanese operators available, these effects would be common to the two histograms.

This inter-comparison should permit conclusions to be drawn regarding the general quality of circuits from Japan to the two Australian locations. Higher occurrence rates at one station would show better circuits to that station. It would still not be possible to tell whether a peak in the occurrence rate was caused by an enhanced circuit or an increase in the number of available Japanese operators, without independent data obtained by some other means.

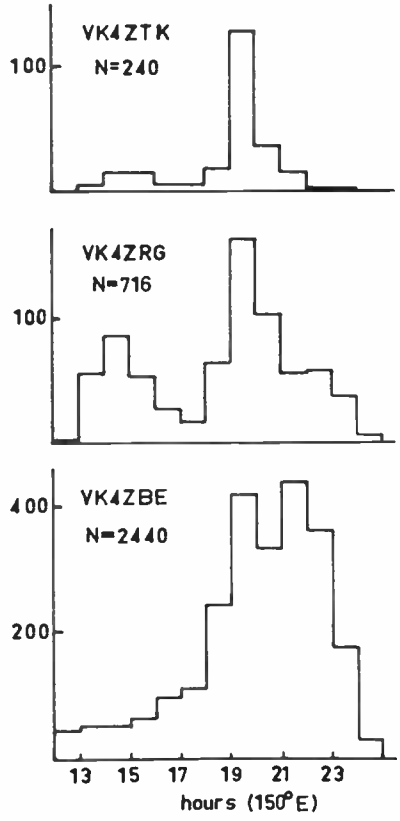


Figure 7. The diurnal variation of the occurrence rate of Japan-Townsville contacts for three Townsville observers.

The moral of this tale is that logbooks can be useful, and this usefulness can be increased substantially by carefully considering just what should be recorded. It is better to record too much than to risk leaving out information which may prove to be invaluable at some later date.

KENWOOD

AMATEUR LINE-UP

Kenwood's amateur lineup for 1988 incorporates the latest developments in communications technology.

Superior front end specifications are accompanied by the latest developments in transmitter design. Automatic antenna tuning and advanced digital & microprocessor technology make these the easiest to operate Kenwoods ever.

Personal computer control is available on several models.

HF

TS-940S

Competition Quality HF Transceiver. Transmitter: SSB, CW, AM, FM and FSK. 160-10 metres bands. Output 250W PEP. Automatic antenna tuner. Receiver: 150kHz-30MHz continuous. 40 memories, programmable and band scans. Power requirement: 240VAC, 50/60Hz

TS-440S

Compact HF Transceiver. Transmitter: SSB/CW/FM/AFSK. 160-10 metre bands. Output 200W PEP. Optional automatic antenna tuner. Receiver: 100kHz-30MHz continuous. Power requirement: 12-16VDC/20A max.

1.8-50MHz

TS-680S

High performance HF & 6 metre Transceiver. Transmitter: SSB/CW, AM and FM modes. 160-6 metre bands. Output 100W PEP (160-10m) 10W (6m). Receiver 500kHz-30MHz continuous. Memory scan/band scan. Power req.: 12-16VDC/20A max.

VHF UHF

TR-751A
TR-851A

All-mode Transceivers. Frequency Range: TR-751A 144-148MHz TR-851A 430-440MHz Transmitter: SSB/CW/FM modes Output: 25W Receiver sensitivity: less than 0.11uV (TR-851A) Features include: Auto-mode selection, dual digital VFOs, 10 memories plus "COM" channel. Optional Digital Channel Link System. Power req.: 13.8V ±15% 7.5A max.

TH-25A
TH-45A

FM Handheld Transceivers. Frequency range: TH-25 144-148MHz TH-45 430-440MHz. Output: 5W Receiver sensitivity: less than 0.16uV (TR-25) 14 multi-function memories, memory scan and band scan. Power req.: 6.0-16VDC/1.2A max.

TS-711A
TS-811A

All-mode Transceivers. Transmitters: modes SSB/CW/FM. Frequency range: TS-711: 144-148MHz TS-811: 430-440MHz. Output: 25W Receiver sensitivity: less than 0.2uV (TS-811) Features include: 40 multi-function memories, programmable band scan and memory scan plus programmable memory channel lockout. Power req.: 240VAC, 13.8V DC/8.0A max.

TM-221
TM-421

FM Mobile Transceivers. Transmitters: Frequency range: 144-148MHz (TR221) 430-440MHz (TR-421). Output: 45W (TM-221) 35W (TM-421). Low power switch to 5W. Receiver: Frequency Range: 130-173.995MHz (TR-221) 438-449.995MHz (TR421). Sensitivity: less than 0.16uV. Power requirements: 13.8VDC ±15%/9.5A max.

TH-215A
TH-415A

FM Handheld Transceivers. Transmitters: Frequency Range: 144-148MHz (TH-215) 430-440MHz (TH-415) Output: 5W/0.5W (Hi/low). Receiver: 141-163MHz (TH-215) 430-440MHz. Scan modes include band, memory and programmable band scans with 3 scan stop modes. Power requirements: 7.2-16V/2.0A max.

VHF/UHF DUAL BANDER

TM-721A **NEW**

Dual band FM Transceiver with across band duplex. New for 1988, with dual watch, selectable full duplex cross band operation, automatic band change, 30 memory channels. Transmitter: Frequency Range: 144-148MHz/430-440MHz Output: 45W (VHF) 35W (UHF) Receiver sensitivity: 0.16uV (UHF).

RECEIVERS

R-5000

Communications Receiver. The R-5000 is a competition class communications receiver. It receives all modes (SSB, CW, AM, FM, FSK). Frequency coverage is 100kHz to 30MHz in 30 bands. Selectable IF filters and dual-mode noise blanking are incorporated. Power requirements: 240VAC or 13.8V DC.

RZ-1

Wide Band Receiver. The RZ-1 covers 500kHz-905MHz. Features include: AM and FM reception, 100 easy to operate multi-function memory channels. Scan modes include VFO scan and memory scan plus programmable channel lockout. Power requirements: 11-16V DC/1A max.

MISC.

STATION MONITOR

SM-220

Based on a wide-frequency range oscilloscope, it combines a two tone generator, a wide variety of waveform observing capabilities.

HF LINEAR AMPLIFIER

TL922

A class AB_2 grounded-grid linear amplifier. Covers 160-10m for SSB, CW and RTTY modes. Drive Power: 80W for full output. RF Input Power: 2,000W PEP (SSB).

ANTENNA TUNER

AT-250

Optional automatic antenna tuner for the TS-680S. Features full coverage of 160-10 metres. Insertion loss less than 0.8dB. Through power 150W.

REMOTE CONTROL HANDSET

RC-10

Connects to models TM-221, TM-421, TM-721. Provides all functions on the front panel. Will link together models TM-221/TM-421.

KENWOOD ELECTRONICS AUSTRALIA PTY. LTD.

4E WOODCOCK PLACE, LANE COVE, SYDNEY, N.S.W., 2066. Ph. (02) 428 1455.

YOUR AUTHORISED KENWOOD DEALER, BELOW, WILL GUARANTEE SATISFACTION:
Further, beware of dealers not listed in this advertisement who are selling Kenwood communications equipment. All Kenwood products offered by them are not supplied by Kenwood Australia Pty. Ltd. and have no guarantees applicable.

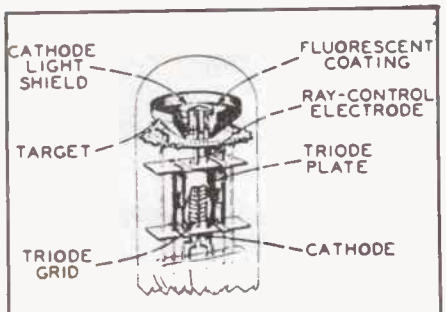
NSW: Sydney, Emtronics (02) 211 0988; **Parramatta,** Captain Communications (02) 633 4333; **Inverell,** Reg Stockman Communications (067) 22 1303; **Cessnock,** Robertson Electronics (049) 90 7908; **Wollongong,** Macelec Pty. Ltd. (042) 29 1455; **Port Macquarie,** DX Engineering (065) 84 9922; **Lismore,** Frank Boundy (066) 86 2145. **ACT:** O'Connor, Alex Johnson (062) 47 9125; **VIC:** Moorabbin, Measure-Tech Supplies Pty. Ltd. (03)553 4566; **Melbourne,** Emtronics (03) 670 0330, **Ballarat,** Brian Stares (053) 39 2808 **Bendigo,** Sumner Electronics (054) 43 1977 **TAS: Hobart,** Watsons Wireless (002) 34 4303; **Launceston,** Marine & Communication (003) 31 2711; **Burnie,** V.K. Electronics (004) 31 7733 **QLD: Albion,** Mitchell Radio Co. (07) 357 6830; **Brisbane,** Emtronics (07) 394 2555 **SA & NT: Port Adelaide,** International Communications Systems Pty Ltd (08) 47 3688 **WA: Victoria Park,** Willis Electronics (09) 470 1118; **Ferndale,** Bay Radio (09) 451 3561; **Osborne Park,** Ford Electronics (09) 242 1766

The "magic eye" tuning indicator — its haunts and habits

Ben Furby

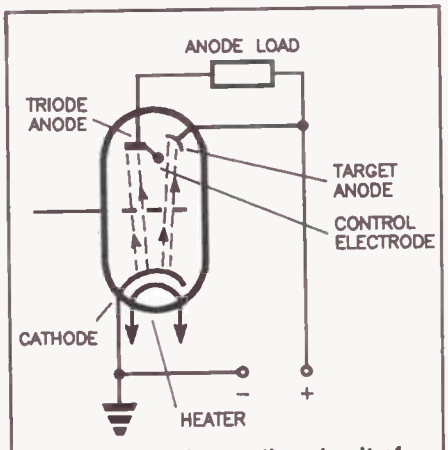
Today's electronics enthusiasts, servicemen, engineers and technicians perhaps do not realise how useful the magic eye was in the '30s and '40s, and it was still widely in use through the '60s. Many receivers and some test gear used magic eyes as indicators.

IN THOSE early years, a moving coil meter cost pretty near as much as half a serviceman's wages for a week, so if you couldn't get away with an el cheapo moving iron meter, it had to be a luxurious job to justify the cost of a meter. The magic eye served instead of a meter in a lot of applications, but not before the mid-30s when it made its début in domestic receivers.



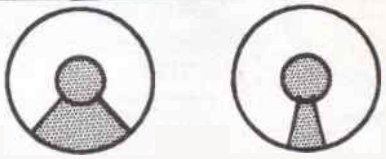
Cutaway sketch of a magic eye tuning indicator valve showing the various elements and features. Bulb shapes and bases varied depending on the maker and type.

Once the '30s the ac-powered superhet with one tuning knob and dial, pentodes, diode detector, voice coil speaker and variable-μ RF valves replaced the '20s TRFs with neutralised triodes, grid leak detector, balanced-armature speaker, three tuning controls and battery or "B eliminator", there was little real change for a long time.



Basic electrical operating circuit of the magic eye. The controlling bias or AVC voltage is fed to the grid of the triode section. A vane, internally connected to the triode anode controls the angle of the shadow appearing on the dish atop the valve.

Shortwave bands appeared, and were useful during World War II for listening to the BBC, Germany, and other overseas broadcasters. Octal valves were introduced, but they were mainly 8-pin versions of existing 6-and 7-pin designs. Along with metal valves they were good for an advertising gimmick but meant little to the listeners. AFC - automatic frequency control — had a brief vogue, and increasing sensitivity did away with the forest of 12 m (40 foot) masts that at one period seemed to festoon the suburbs and towns.



The magic eye is mounted so that the dish at the top of the bulb is viewed end-on. A circle of fluorescent light appears with a shadow in it, the angle of the shadow indicating signal strength. The shadow angle is greatest at zero voltage grid bias, the shadow closing at a certain value of negative grid bias depending on the magic eye's characteristics.

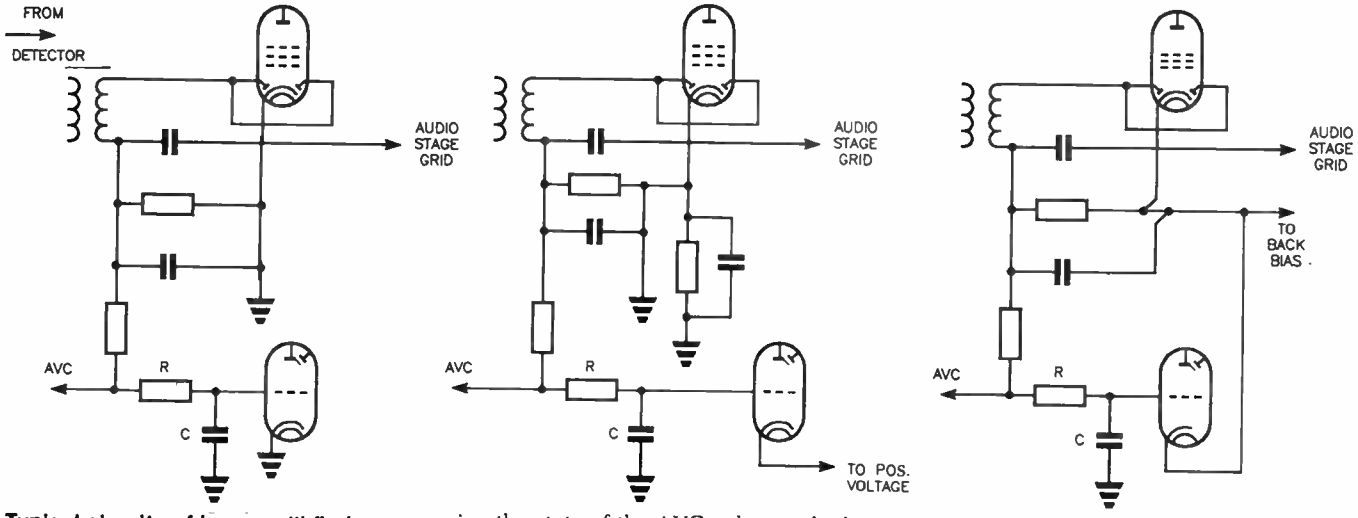
Of all the innovations of the 30s in domestic radios, the one with the most impact in my memory was the advent of the *magic eye*. This green circle of fluorescence, usually set in the dial, would "wink" with electronic speed as you tuned across stations. At the station of your choice, you set it until the segment closed as far as it could go.

Working off the automatic volume control (AVC — better known now as "AGC"), the amount the eye closed depended on the strength of the station you were listening to. Unaffected by modulation, the eye would stay unremittingly steady no matter how loudly George Edwards — playing Dad of Snake Gully — roared at Dave.

The eye was more of a luxury feature, associated with the upmarket radios. To the technical, the eye was an "electron-ray tuning indicator".

Remember that in ordinary homes of those days the radio was an important

If our memory is correct, the 6A8 had an octal socket and a grid cap? And its forerunner was the 6A7, also with grid cap but a seven pin socket? Exactly the same electrical characteristics, of course. Now we can't do such a feat of memory as that with transistors! (Just another gem from the AEM Golden Pages of Memory.)



Typical circuits of how you'll find a magic eye wired-in to receivers employing "simple" AVC. Note that, in each case, the magic eye's cathode is at the same potential as the detector diode's load return point.

purchase, on much the level of a new car today, and costing more than many secondhand cars. It was the focus of the evening to tune into Dad and Dave or similar programmes. The radio was expected to last 10 or more years, with occasional visits to the local serviceman.

The valve emission tester of the era was known as the serviceman's friend: many a valve was discarded for low emission reading on the tester, when probably it had a lot more life left.

The magic eye cropped up in other guises, remembering the high cost of meters in that period. The first domestic tape recorders I saw, at the beginning of 1948, used the magic eye as a level indicator. The first two capacity testers I owned, in the '50s, used magic eyes to show nulls and peaks.

By the '60s the eye was still with us, but in B9A base and form, and displaying a Sydney Opera House shell display on its side.

LEDs, LCDs and cheap meters, and the disappearance of valves with their filament and high tension supplies, finished off magic eyes, so today's technicians barely know what they are.

How it works

The magic eye starts off as a conventional valve, complete with filament, cathode — because it was powered by 6.3 Vac — grid and plate. With high tension dc on the anode ("plate") through a resistive load, and the grid tied to the AVC line, the anode voltage will vary as the AVC voltage varies. This variation takes place as you tune across stations, pushing up the AVC voltage.

So you have an anode voltage reflecting the state of the AVC voltage which, in its turn, has responded to the strength of whatever carrier you are tuned to: so what? Well, at this point the magic eye stops being your common or garden triode and turns into something else.

Sitting on the top of the electrode structure is a concave dish, conveniently filling the visible space of the glass dome at the top. This dish is coated in a material that fluoresces in the same way as a cathode ray tube fluoresces when struck by electrons.

The dish is the "target anode", and where the triode anode has a resistor between it and high tension (HT), the target goes directly to HT, putting it at higher positive potential than the triode anode.

The triode anode also connects to the "control electrode", which is in the centre of the dish. The cathode extends through the triode to "look at" the target anode through the control electrode. There is a flow of electrons from the cathode to the target anode, exciting it to fluorescence.

Right, now how does it all work? Well, if there is no AVC, there is no negative voltage on the grid. There is a large plate current flow, therefore there is a large voltage drop across the anode resistor, and the anode voltage is low.

With all this going on in the triode section, the target responds in sympathy. The control electrode, tied to the triode anode, is low compared with the target voltage, which is at full HT

The result is that the highest current flows to the target, which severely restricts the area that fluoresces. The viewer sees a large shadow in the target.

Now, say you tune-in a strong station. The AVC voltage goes high, so the triode grid gets a high negative voltage on it. Anode current decreases and anode voltage rises. A high triode anode voltage means a high control electrode voltage, meaning in turn less potential difference between the control electrode and the target.

Result: all the target area fluoresces, there is no shadow, so the viewer sees a circle of glowing green, with perhaps only the overlapping line which appears as a radius pointing down. Intermediate voltages produce, of course, varying degrees of shadow.

Remember that the generation tuning-in sets with magic eyes had ears conditioned to acoustic gramophones, tinny headphones, and distortion generators in the form of horn or balanced armature loudspeakers. Coming from the pre-AVC receivers, they were accustomed to strong signals indicating they had tuned-in, and suffered some distortion in those pre-variable μ valves until they decreased filament voltage (!) or bypassed or switched out one stage (!!) to reduce gain.

AVC "blurred" the strong signal at centre carrier for those pioneer wireless listeners. Off-tuning a superhet markedly increases distortion. It was a case of what the ear didn't grieve for the eye did see, if you get my meaning.

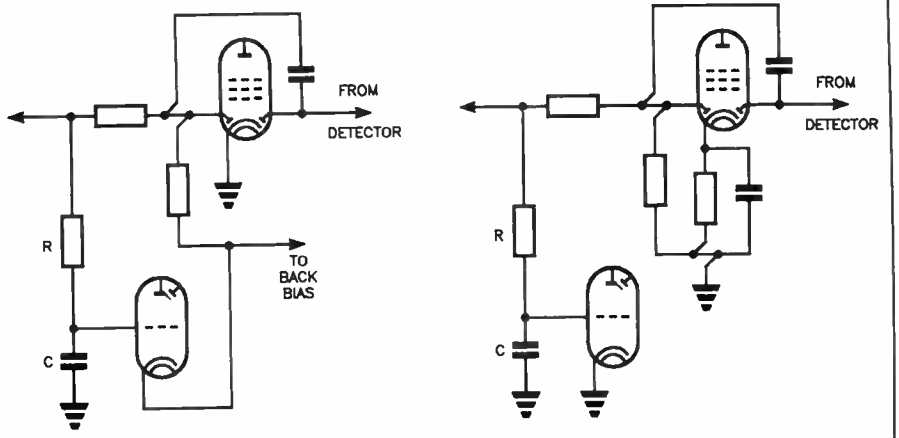
There were different magic eye types made, with differing characteristics. The 6E5 was a common one, with a sharp cutoff and needing only 8 V for full cutoff. Another popular one was the 6U5/6G5, a remote cutoff valve which needed -22 V for a shadow of 0°. This was able to respond sensitively to weak signals.

Magic eye tubes were also known under such names as *electron-ray tube* or *electron-ray tuning indicator*, or sometimes *cathode-ray tuning indicator*.

Typical magic eye circuits

If you are restoring a receiver with a magic eye, you should appreciate some aspects of the circuit.

First, does the receiver have *simple AVC*, or delayed AVC? Simple AVC is where the one diode does the two jobs of detecting the modulation and supplying the AVC voltage. In the usual double-diode triode or pentode "second detector" (Wow! I haven't said that for many a year!), the two diodes would usually be tied together to make one single one for simple AVC. ▷



Where "delayed" AVC is employed in a receiver, you'll find the magic eye generally wired into the circuit in either of two ways, as shown here. Here, too, the magic eye's cathode is at the same potential as the detector diode's load return point; usually at ground or returned to the back-bias line.

Delayed AVC had its own diode, and the "delay" in the name meant that AVC action didn't commence until a certain signal threshold voltage was reached. Don't expect your magic eye to indicate weak stations with delayed AVC, until the signal voltage is strong enough to rise above the delay threshold.

Restoration tips

When you are restoring an old set, expect to find a capacitor on the triode grid. This is to decouple the line and suppress any tendency to instability through connecting a lead to a high impedance line — the AVC line — and running it all around the set where it could get up to mischief or pick up stray fields.

Be sure you test the capacitors in the AVC line for leakage. This is a very low current area, and leakage will play havoc with the AVC.

I use a 250 V megger — any sign of leakage, and out it goes! It's amazing, too, how general performance improves with new capacitors all round. Most of the old ones leak after all these years, and the modern ones are far better.

In winding up this treatise on the magic eye, let me say, "In old age colours, don't seem as bright as they used to be. But in my last remaining example of a magic eye, it isn't my decrepitude that makes it seem dim, it's the eye itself that has faded to the point you can hardly see its fluorescence!"

Information exchange

From Christchurch, New Zealand, where AEM is making itself a reputation among Kiwi enthusiasts, professionals, computer whizzes and others, retired serviceman and now valve radio restorer *Mr Keith McIlraith* has been quick to point out one of our few mistakes.

"*Your October magazine, page 84,*" Keith writes.

"*The 6B8 valve illustrated is not a mixer/oscillator, presumably it was a 6A8 or 6K8.*

"*The 6B8 has twin diodes, plate and screen.*"

Thanks, your interest is noted, along with the way AEM is getting around the Pacific these days. The 6B8, of course, was a diode detector/AGC rectifier and pentode voltage amplifier. All that without cheating and looking up the RCA valve manual, too!

We note you are hunting for an early Stewart-Warner horn speaker to match your model 300 Stewart-Warner 1923/24 five-valve three-dial battery set, and that you believe in swapping rather than trying to price these artifacts and have several Aussie sets you do not intend to keep.

Any owner of such a horn speaker who wants to swap for Oz vintage valve receivers can write to Keith McIlraith at **2/28 Konini St, Christchurch 4, New Zealand. ☎ 0011 64 3 481 842.**

Also quick off the mark to spot the error in the valve description was *Mr Stuart Irwin*, of Queensland, whose letter appears on the correspondence page. We therefore declare Stuart an Honorary Life Member of the Ancient and Honourable Order of the Leyden Jar.

Trophies for VK2 amateurs made of old ceramic valves by Peter O'Connell. The trophies are given for the VK2 Division's monthly VHF/UHF contests.

All the rest of you can consider yourself as failed and will have to spend another year in Ye Olde Valve Wireleff Reftoration Courfe. Spotting the mistake but not reporting it is as bad as making the mistake and no excuse for not writing. Do not pass "Go". If you don't write to say we are wrong, how are we to know what level of sophistication we should be editorially aiming at? (Didn't think of that, did you? Do not collect $200, either!)

Around here we expect to be dobbed in by our mates as well as our enemies. There will be no prizes but a Mention in These Pages for spotting this month's Deliberate Mistake.

Peter O'Connell of Oatley, Sydney, introduces a dimension to the valve discussion not previously raised for debate. Known on the amateur bands as VK2EMU, Peter challenges us over an item in last month's "Last Laugh" column. He refers to this paragraph: "*I did once make a gavel for an electronics society and mounted a TO3 package on each hammer face. If the chairman ever got excited — like judges do in Hollywood films when they try and stop the uproar in court by pounding away - those TO3s would have had it hard. And that's something you can't do with valves!*"

Peter writes: "*I have enclosed a photograph of a series of trophies I produced for the VK2 division of the Wireless Institute of Australia. These trophies consist of an old ceramic valve (4CX250B, 4CX1000) mounted on a wooden base.*

"*Now try doing that with a transistor!*"

OK, Peter, good point. So you can pass "Go" and we're only sorry we can't pay you the $200, or present you with the AEM Order of the Golden Valve, with Swords and Diamonds, but we're out of them just now. But just keep subscribing to AEM. We warrant you'll get far more return than a few dollars for what you spend on the sub.

Acknowledgements

Last month, embarrassingly, we omitted acknowledgement of the most consistent contributor to this column, *Stephen Moignard* of *Resurrection Radio*. Stephen's wonderful little store is a veritable treasure trove of old valve radios and related gear, ranging from the earliest to the latest eras.

Stephen's staff have had wide experience in restoring sets of many makes. From time to time, Stephen has "clearance sales" of all sorts of spares and other items. Write for list. Resurrection Radio is located at **14 Chapel St, Prahran Vic 3181 ☎ (03)529 5639.** For non-Victorian readers, write to **PO Box 1116, Windsor Vic 3181.**

MITSUBISHI RF POWER MODULE

M57716

430~450MHz, 10W, SSB FOR MOBILE RADIO APPLICATION

DESCRIPTION

M57716 is a thick film RF power module specifically designed for 430 ~ 450MHz, 10W SSB mobile radios.

FEATURES

- Frequency Range . . . . . 430 ~ 450MHz
- High Power 17W
- High Linear Power Gain 21dB
- High Ruggedness: Ability to withstand more than 20:1 load VSWR when operated at V_{CC} = 15.2V, P_O = 14W.

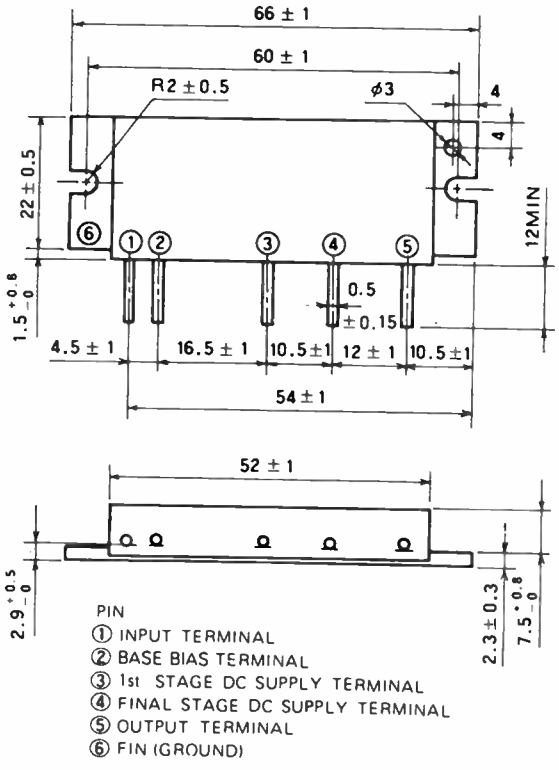
APPLICATIONS

Output stage of 10W output mobile radio set (SSB) in 430 ~ 450MHz UHF band.

We are grateful to Mitsubishi Electric Australia for providing the material from which to reproduce this data and for permission to do so.

OUTLINE DRAWING

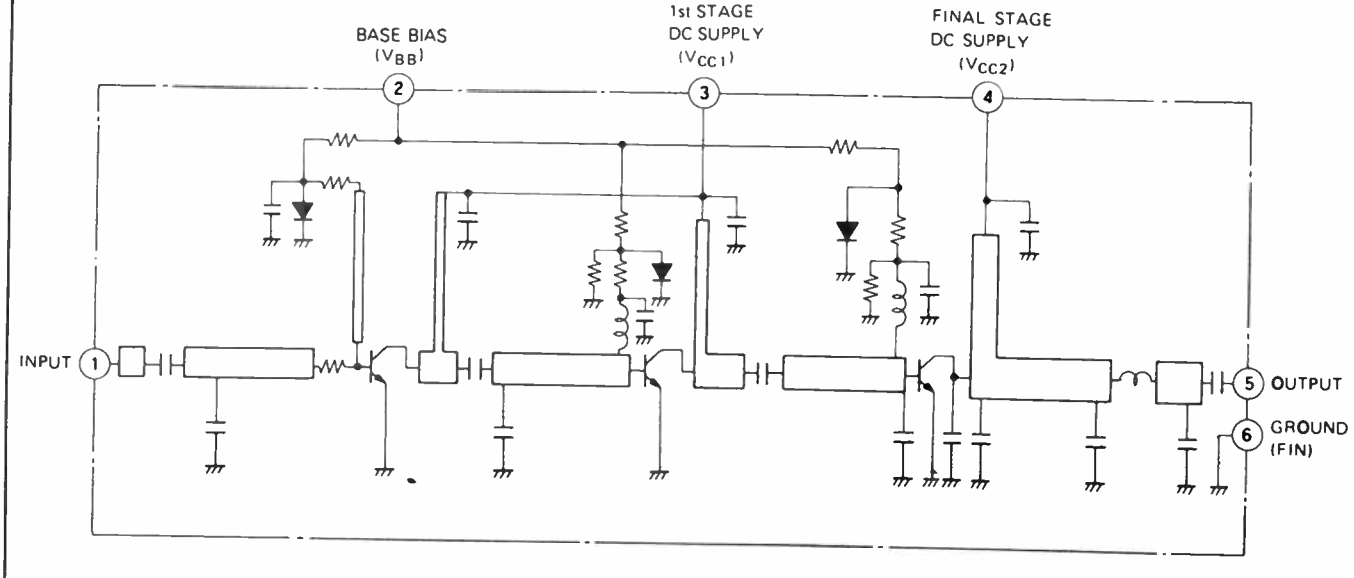
Dimensions in mm



PIN
① INPUT TERMINAL
② BASE BIAS TERMINAL
③ 1st STAGE DC SUPPLY TERMINAL
④ FINAL STAGE DC SUPPLY TERMINAL
⑤ OUTPUT TERMINAL
⑥ FIN (GROUND)

MITSUBISHI ELECTRIC

EQUIVALET CIRCUIT



M57716

430~450MHz, 10W, SSB FOR MOBILE RADIO APPLICATION

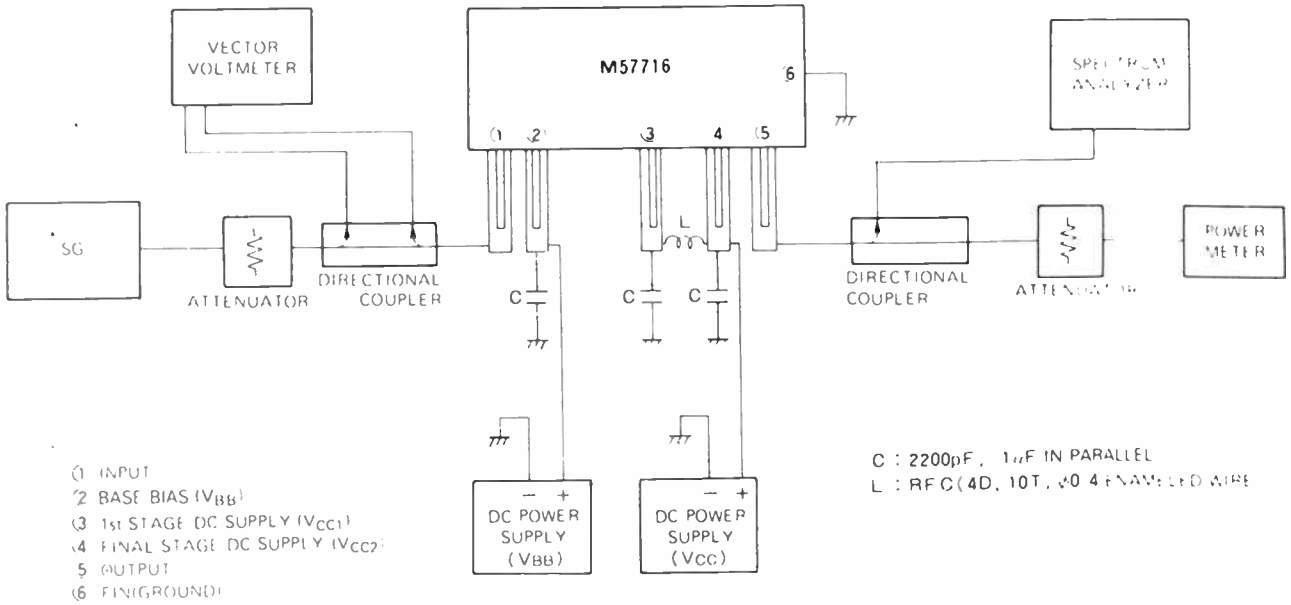
ABSOLUTE MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		17	V
V_{BB}	Base bias voltage		10	V
I_{CC}	Total current		6	A
P_{in}	Input power	$Z_G = Z_L = 50\,\Omega$, $V_{CC1} = 12.5V$, $V_{BB} = 9V$	0.3	W
P_O	Output power	$Z_G = Z_L = 50\,\Omega$	28	W
$T_C(op)$	Operation case temperature		−30 ~ +110	°C
T_{stg}	Storage temperature		−40 ~ +110	°C

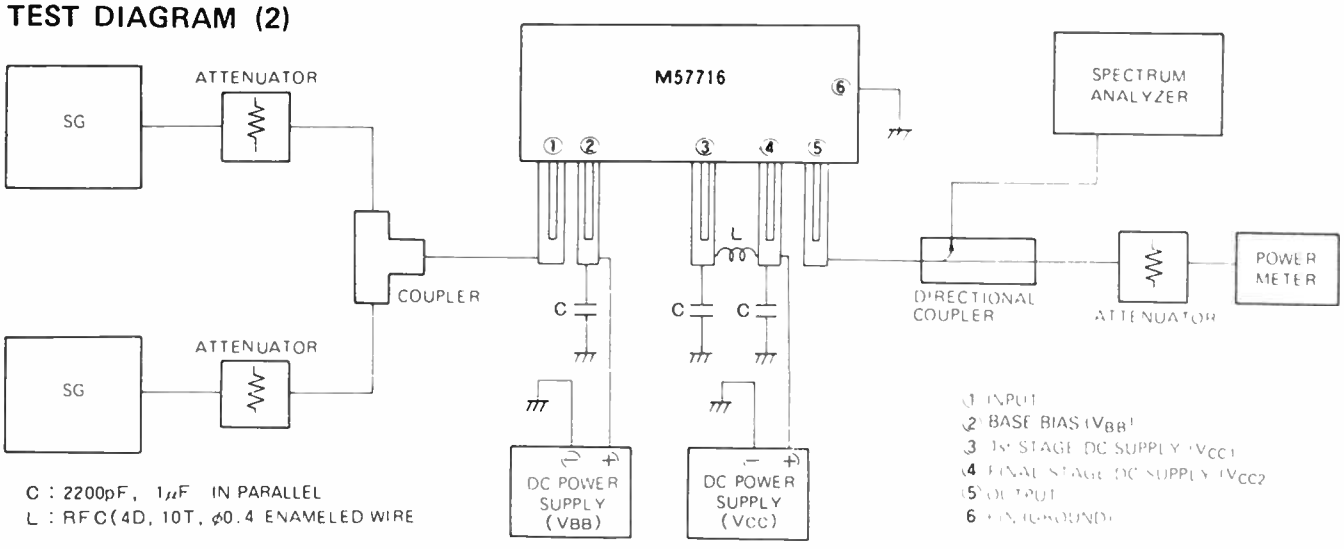
ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
P_O	Output power	f = 430 ~ 450MHz V_{CC} = 12.5V, V_{BB} = 9V P_{in} = 0.2W $Z_G = Z_L$ = 50 Ω	17	19		W
η_T	Total efficiency		35	40		%
	2nd harmonic				30	dB
	3rd harmonic				30	dB
ρ_{in}	Input VSWR				2.5	—
ρ_{out}	Output VSWR			2.0		—
G_P	Power gain	f = 430 ~ 450MHz, V_{CC} = 12.5V, V_{BB} = 9V P_{in} = 10dBm, $Z_G = Z_L$ = 50 Ω	21			dB
	3rd IMD	f_1 = 430 ~ 450MHz, $f_1 - f_2$ = 2kHz, V_{CC} = 12.5V, V_{BB} = 9V, $P_{O(PEP)} \leqq$ 14W $Z_G = Z_L$ = 50 Ω		−30	26	dB
	5th IMD				31	dB
	Load VSWR tolerance	f = 430 ~ 450MHz, V_{CC} = 15.2V, V_{BB} = 9V, P_O = 14W, Z_G = 50 Ω, 5sec.	20 : 1			—

TEST DIAGRAM (1)



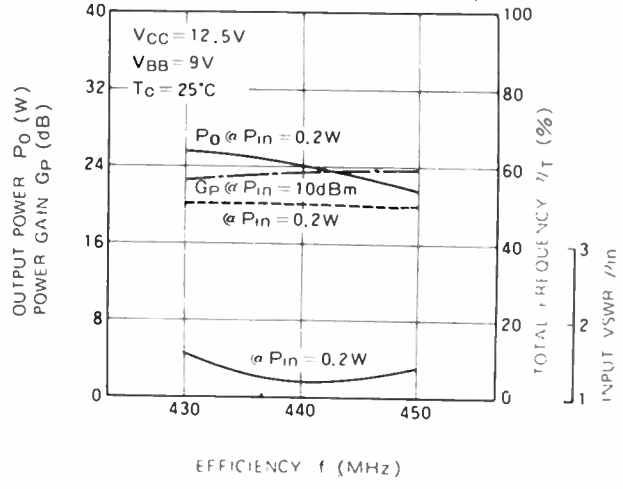
TEST DIAGRAM (2)



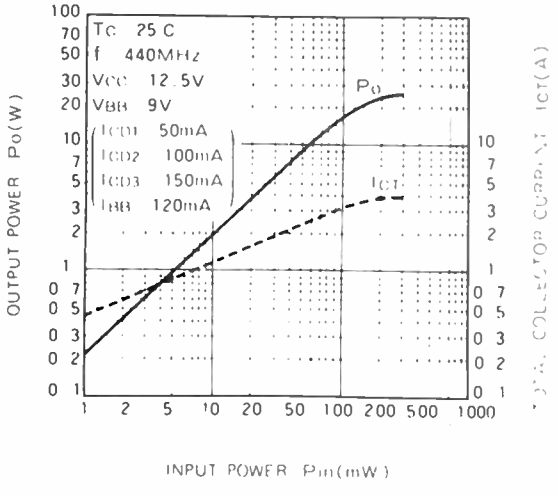
C : 2200pF, 1μF IN PARALLEL
L : RFC(4D, 10T, φ0.4 ENAMELED WIRE

TYPICAL PERFORMANCE DATA

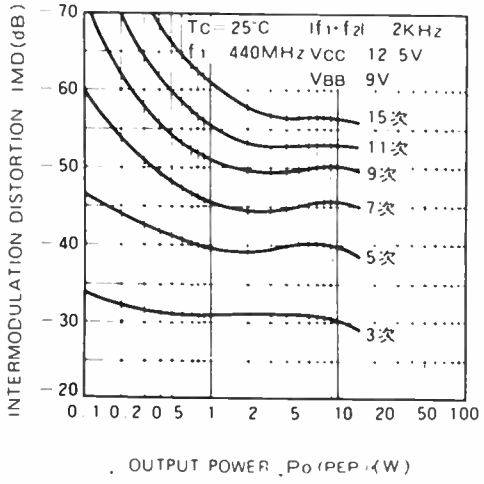
OUTPUT POWER, POWER GAIN, TOTAL EFFICIENCY, INPUT VSWR-FREQUENCY CHARACTERISTICS (M57716)



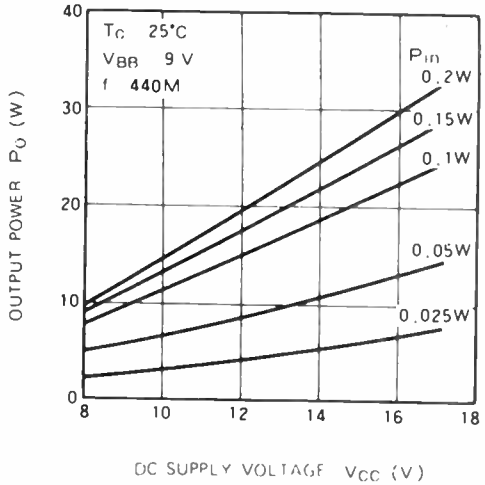
OUTPUT POWER, TOTAL COLLECTOR CURRENT VS. INPUT POWER



INTERMODULATION DISTORTION VS. OUTPUT POWER



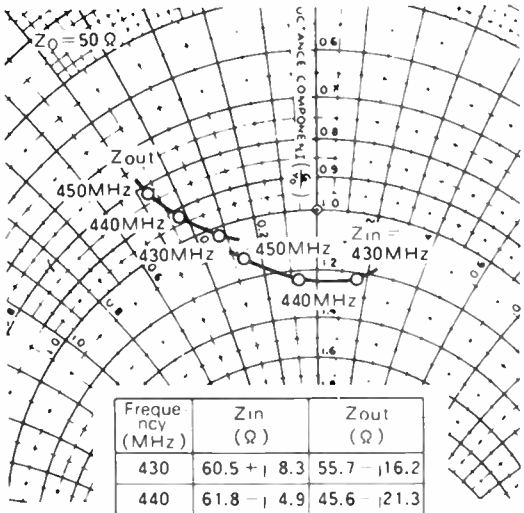
OUTPUT POWER VS. DC SUPPLY VOLTAGE



M57716

430~450MHz, 10W, SSB FOR MOBILE RADIO APPLICATION

INPUT IMPEDANCE, OUTPUT IMPEDANCE VS. FREQUENCY



Frequency (MHz)	Zin (Ω)	Zout (Ω)
430	60.5 + j 8.3	55.7 − j16.2
440	61.8 − j 4.9	45.6 − j21.3
450	58.3 − j14.8	41.3 − j23.4

Test condition : V_{CC} = 12.5V, V_{BB} = 9V
P_{in} = 0.2W

DESIGN CONSIDERATION OF HEAT RADIATION.

Please refer to following consideration when designing heat shink.

1. Junction temperature of incorporated transistors at standard operation.

(1) Thermal resistance between junction and package of incorporated transistors.

a) First stage transistor
$R_{th(j-c)1}$ = 15°C/W (Typ.)

b) Second stage transistor
$R_{th(j-c)2}$ = 6°C/W (Typ.)

c) Final stage transistor
$R_{th(j-c)3}$ = 2°C/W (Typ.)

(2) Junction temperature of incorporated transistors at standard operation.

- Conditions for standard operation.
  P_O = 14W, V_{CC} = 12.5V, P_{in} = 80mW, η_T = 35% (minimum rating), P_{O1} (Note 1) = 1W, P_{O2} (2) = 4.5W, I_T = 3.2A (I_{T1} (3) = 0.15A, I_{T2} (4) = 0.55A, I_{T3} (5) = 2.5A)
  Note 1: Output power of the first stage transistor
  Note 2: Output power of the second stage transistor
  Note 3: Circuit current of the first stage transistor
  Note 4: Circuit current of the second stage transistor
  Note 5: Circuit current of the final stage transistor
- Junction temperature of the first stage transistor
  $T_{j1} = (V_{CC} \times I_{T1} - P_{O1} + P_{in}) \times R_{th(j-c)1} + T_C$ (6)
  $= (12.5 \times 0.15 - 1 + 0.08) \times 15 + T_C$
  $= 14.4 + T_C$ (°C)
  Note 6: Package temperature of device
- Junction temperature of the second stage transistor
  $T_{j2} = (V_{CC} \times I_{T2} - P_{O2} + P_{O1}1) \times R_{th(j-c)2} + T_C$
  $= (12.5 \times 0.55 - 4.5 + 1) \times 6 + T_C$
  $= 20.3 + T_C$ (°C)
- Junction temperature of the final stage transistor
  $T_{j3} = (V_{CC} \times I_{T3} - P_O + P_{O2}) \times R_{th(j-c)3} + T_C$
  $= (12.5 \times 2.5 - 14 + 4.5) \times 2 + T_C$
  $= 43.5 + T_C$ (°C

2. Heat sink design

In thermal design of heat sink, try to keep the package temperature at the upper limit of the operating ambient temperature (normally T_a = 60°C) and at the output power of 14W below 90°C.

The thermal resistance $R_{th(c-a)}$ (7) of the heat sink to realize this:

$$\text{Note 7: } R_{th(c-a)} = \frac{T_C - T_a}{(P_O/\eta_T) - P_O + P_{in}} = \frac{90 - 60}{(14/0.35) - 14 + 0.08}$$

$= 1.15$ (°C/W)

Note 7: Inclusive of the contact thermal resistance between device and heat sink.

Mounting the heat sink of the above thermal resistance on the device,

T_{j1} = 104.4°C, T_{j2} = 110.3°C, T_{j3} = 133.5°C at T_a = 60°C, T_C = 90°C.

In the annual average of ambient temperature is 30°C,

T_{j1} = 74.4°C, T_{j2} = 80.3°C, T_{j3} = 103.5°C.

As the maximum junction temperature of these incorporated transistors T_{jmax} are 175°C, application under fully derated condition is ensured.

☞ NEW UHF CHANNELS, from page 25.

"So we have a reasonably good ¾" edit system and we've installed a Betacam edit system of broadcast quality.

"For production we shoot off Betacam, edit on Betacam, and then we distribute on U-matic or VHS."

The two main users of TV were biology and physics. Next departments using TV but to a lesser extent were education, architecture and archeology.

"There are still a lot of people in teaching who feel TV could put them out of a job, and that has been a problem," Mr Ellis said.

"If only they would look at TV and use it more in a teaching session or lecture, as it has tremendous possibilities, but it is this initial response from people who haven't used it before that is a problem."

Apparently, as well as surviving in politics and trade unions, dinosaurs are still alive and kicking merrily in universities also. Mr Ellis said Sydney University was part of the consortium described by Dr Hedburgh of the University of NSW.

"People are getting very tired of some of the rubbish that's on TV."

Curiouser and curiouser, as Alice of Wonderland fame said. This seems to be the unofficial slogan of alternative TV. Mr Ellis said the TV unit had three Amiga computers.

"They are excellent, reasonably-priced machines for computer graphics.

"We have a Genlock 4 which means we can take graphics on to tape and mix it with other sources."

There is a Betacam edit suite, based on the home use ½" Beta tape used by TV news.

"The cassette runs through at six times speed so you get very high quality," Mr Ellis said.

"So on a normal three hour Beta home tape we get about 30 minutes."

The system was computer controlled by an IBM computer in this suite, Mr Ellis said.

"It's called A-B roll editing.

"You have tapes playing and one machine recording.

"The computer will take a section of the first tape and do a transition to the second tape.

"That could be via the mixer, and it can be a wipe or a mix, or insert a graphic or whatever.

"There's about 200 000 dollars' worth of equipment here."

This equipment does not include one of the page-turning effects machines — a digital effects unit — which would cost about $100 000.

"One wonders if educationally they're worth it."

The section also has an OB van for outside work.

"We do educational outside work," Mr Ellis said.

It is equipped for three cameras but these were retired as they became unusable.

"At the moment we just have one professional camera — a Betacam. Everything in the studio is usually single camera, and a single camera goes out and shoots on location."

Audio control in the OB van is an 8-track system.

"We can take audio from a videotape, time code it, on to the eight-track, add music effects or whatever, and transfer it back to the videotape."

Equipment used at Sydney University is mainly Ampex, JVC, National (Panasonic), Pye, and Sony.

"We generally fix all our own equipment," Mr Ellis said.

"When we have time we fix equipment for other departments of the university.

"We also design and build our own equipment at times."

Mr Ellis said that if the only way to run a station was to scrounge equipment, that was fine but not their way.

"Here we are professionals and we are expected to do a professional job, and we like to do it on professional equipment.

"It makes the job easier."

☞ PROJECT 9508, from page 79.

bottom of the case using 10 mm spacers (at least), mount the antenna to the component side of the board and drill a hole in the appropriate position in the lid to allow the antenna to pass through. Also drill a hole in the side of the case to allow access to the sensitivity trimpot.

As a motion detector, the unit is best mounted in a room or area where it is not obtrusive, high on a wall or on the ceiling — even in the cavity above a false ceiling. Mounted high on a wall, the antenna is best protruding horizontally; mounted beneath a ceiling, the antenna should point downwards. It may be mounted at one end of a room, near an entrance, or centrally within a room or area. Always plan carefully where you place the unit.

Setting it up as a motion detector to provide coverage of a given area is a matter of setting the sensitivity control and the length of the antenna to achieve the desired result. You also need to plan the placement so that "usual" movement outside the room or building does not trigger the unit. You may need a little trial and error to get the required result without false triggering.

The telescopic antenna shown here was obtained at Dick Smith Electronics, cat. no. L-4902; Tandy also stocks one, cat. no. 270-1401. You don't have an antenna this fancy, a length of 18g or 22g tinned copper wire will also do. However, the telescopic antenna proved more rigid and is certainly easier to adjust.

In general, a longer antenna will provide more sensitivity than a shorter one, but don't overdo it. With an antenna length around 40 cm, it was possible to detect movement up to 10 metres away across a large room.

With the unit positioned and the antenna set to a trial length — I would suggest you keep it short at first, say 15 cm (quarter wavelength) — turn it on and allow half a minute or so for the unit to stabilise. Carefully adjust the trimpot until the relay operates, then back it off slightly so that the relay just drops out. As you're close to the unit, keep quite still. Get someone to take a few steps into the area and note where they are when the relay operates. Lengthen the antenna and repeat the exercise until you're satisfied with the result.

If used in conjunction with a burglar alarm system, you can wire up the normally open (N/O) or normally closed (N/C) contacts according to what your burglar alarm system requires. The relay may be made to "latch" on by connecting the "B" set of contacts as shown in the auxilliary circuit. The pushbutton is used as a "remote reset" and should be mounted somewhere convenient.

Well, that's it. A little experience with this project will show you just how versatile it is.

IT WAS THE DAY after I had been to Zenith and saw the LCD screens on their portable computers.

"These LCD screens are bringing the day of the paperless newspaper closer," I said.

"But there's nothing new about LCD screens," Roger retorted.

Of course, I agreed. Even I had known there was nothing new about LCD screens. But I have been saying for years that once we had practical flat TV screens, the day of the newspaper as we know it would be over. I claim no credit for saying that electronic communications will end the Gutenberg era. Anyone in electronics has seen it under their noses, as Teletext, electronic cameras, LCD CTV receivers, wordprocessors, computerised page layout and fibre optics have been steadily revolutionising communications. These steps in technology can have only one end.

Most of the objections come from print media journalists, whose main argument against the electronic newspaper boil down to saying that you can't wrap fish and chips in old, clapped-out TV receivers. And we all know that TV sets today have plenty of chips already in them.

In the era of the electronic newspaper, you'll charge your memory chips in the early morning by fibre optic landline to your home or by using the TV channels' early morning broadcasts, given over for an hour to transmit data, at a time when in Gutenberg days (like now) they printed the morning papers. You'll have your thin screen to read instead of a paper in messy black ink that comes off on your hands.

Colour, in your electronic newspaper, does not involve expensive separations, so every photo can be colour. Since we are moving away from film based on ever-scarcer silver, we kill two birds with one stone by going to the still camera that charges a mosaic like in a TV camera, and discharges to RAM for optical readout, printer, or data transmission, or storage on mini-floppies. So if you haven't got SV in your latest handbook of initials, better get it down. "Still vision cameras", they are called. Canon, Konica, Fuji and Polaroid are all at it.

By the way, let me interpolate that there will always be room for printed paper. As books are supplanted by CDs as easier to store in a home or shop, and cheaper to produce (in glorious techicolor, of course) paper will assume a rôle in specialty areas — like the little room out back.

Telecom already sees the phone directories as more of a pain than its ever-moaning subscribers. The moment their pages are 'locked up' and sent to the printers, the directory is obsolete. The electronic directory, accessed by a keypad on each phone and an LCD readout will never be obsolete because it is continually updated as changes take place.

A reporter friend of mine who had been confined to daily newspapers all his working life made the move to radio journalism. He was delighted to find, that, where he used to write a story and send it off to be printed while he made a beeline for the pub, in radio he was constantly updating a story, and sticking with it as events continued throughout the day. The electronic newspaper would similarly be continually updated, offering journos more work satisfaction than the print medium can.

There are more ramifications that we do not have space to cover, so just two final points.

Have you noticed that international passenger aircraft are beginning to be fitted with individual, small TV screens for each passenger?

This wasn't a case of airlines seeing the new, small and thin CTV screens and saying "Ah! That's just what we wanted for our aircraft!" No, it came about because Sony had developed its LCD CTV screen and looked around for places where it could sell it. The airlines happened to be standing in the way when Sony went through, spotting the high-flyers as prime targets. Think about it.

Finally, I wrote a story about electronic newspapers a few years ago but never offered it anywhere for publication. But I wanted to include an answer to this "what's good enough for grandad's good enough for me" mentality where I've had print medium journalists say to me "you can't beat the feel of handling a good newspaper, you know".

This is the sort of thinking fletchers and bowyers used when gunpowder began to supplant the bow and arrow, or sailormen used about steamships. Also printers who saw the linotypes crash and disappear and don't realise they are next for the chop.

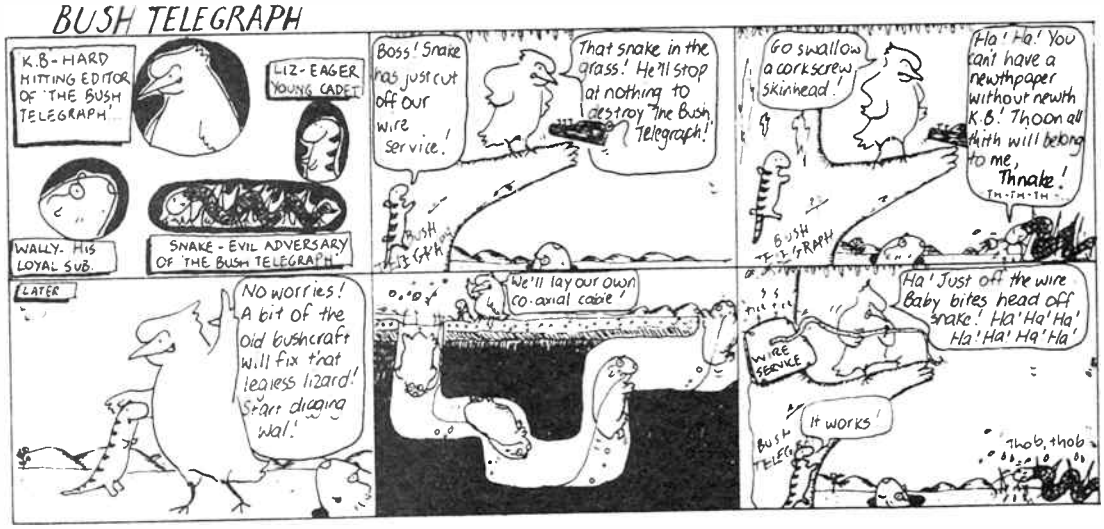
But while it took several generations for the British army to phase out the bow and arrow for the arquebus and pike, everything's happening faster today. So I finished my story by imagining two Sumerians talking to each other, in the heady days of Ur of the Chaldees sort of era.

"What do you think of this foreigner, Rameses, from Egypt, with his new fangled papyrus stuff for writing on?" I had one Sumerian asking the other.

"It'll never catch on," I had the other one reply.

"You'll never beat the feel of a solid, baked clay brick with cuneiform writing on it, you know!"

Well, yes. Who did have the last laugh there?



THE WORLD WIDE HOBBY!
AMATEUR RADIO
ARE YOU A MEMBER OF THE WIA?

Why not become a radio amateur by joining the Wireless Institute of Australia? The Institute can assist and advise you in how to obtain a Department of Communications licence, which will allow you to communicate with others having similar interests in Australia and throughout the world.

The Wireless Institute of Australia is a non-profit society founded in 1910. Since its inception it has nurtured the interests of all Australian amateurs by liaison at all Governmental levels.

Apart from many other benefits as a member, you receive a monthly plastic encapsulated 64 page magazine called Amateur Radio in your letter box each month.

This magazine contains information on all aspects of the hobby such as Technical Projects, Hints and Kinks, Computer Programs, Free Classified Advertisements and Technical Reviews. Regular columnists give details of Contesting, Awards, DX News, Ionospheric Predictions and Solar Activity, Overseas News and VHF/UHF Activity, to name but a few.

SUPPORT YOUR HOBBY — become a member!

For further information, including a sample magazine, write to:
WIRELESS INSTITUTE OF AUSTRALIA
PO BOX 300
CAULFIELD SOUTH, VIC. 3162

Registered Address: 3/105 Hawthorn Road, Caulfield North, Vic.

BKP—AD87012

GOLDSTAR SERIES 7000 "AT."

High speed stand alone or fileserver system.

SYSTEM MOTHER BOARD.

8/10 MHz 80286 CPU.
I Mb RAM standard.
Six 16 Bit I/O Slots and two 8 Bit I/O Slots.
7 Channel DMA Controller.
Low Power CMOS Technology.
200 Watt Switch Mode Power Supply.
Dual Floppy Controller (1.2Mb or 360k).
Built in Diagnostics.
Socket for Maths Co-Processor.
Gate Array Technology.
Battery Backed Real Time Clock.

GRAPHICS ADAPTORS.

Monochrome and Colour Graphics Card.
Enhanced Graphics Adaptor (E.G.A.).
V.G.A. and Plantronics.
132 Column Display.

I/O CARDS.

Two RS232 Serial Ports.
One Parallel Port.

DATA STORAGE.

1.2Mb and 360k Disk Drives (3½" or 5¼").
20 to 600 Mb Hard Disks.
ESDI and SCSI available.
20 to 150 Mb Tape Backup Units.

MAIN FEATURES.

Extremely fast CPU operation (Switchable 8-10 MHz).
Competitively Priced.
Comprehensive Mother Board functions.
Full 12 Months Warranty and optional 5 Year Goldcare Cover.
*IBM Compatible.
DOS and GW Basic.
External Reset Button and Keyboard Lock.

Dimensions: 46 x 40 x 15cms.
Weight: 17.5kg.
Environment: 10C to 40C.
Humidity: 20 to 90% (Non Condensing).

*IBM is a Registered Trade Mark