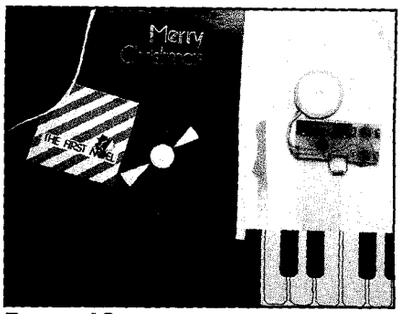
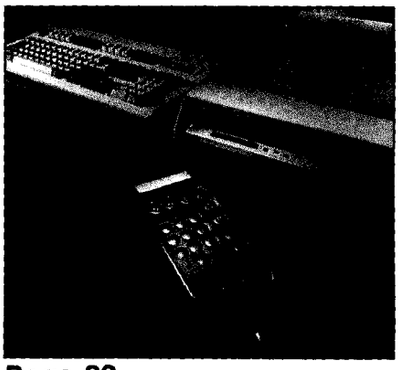
ELECTRONICS · TECHNOLOGY INNOVATION

OCTOBER 1989



Page 18

Page 42



Page 82

Page 109

TECHNOLOGY

Pop technology 18
A look at the latest chip-on-board developments

Horses for courses 24
Conventional versus nuclear powered subs

Amateur radio in schools 29
Helping to educate our children

IREECON highlights 70

ELECTRONICS

Alpha, beta, biofeedback 31
The technology and techniques

Careers in electronics 36
What's on offer

ETI-1550 Telescope drive controller 42

ETI-1545 GSR meter 54

Beginner's series — Building blocks of electronics 50
Part 3 — Transformers and diodes

INNOVATION

The ETI Awards 68

INSTRUMENTATION

Exec-u-log 82

Serialtest review 84

DEPARTMENTS

Frequency 5
News digest 6
Kilohertz comment 14
Politics 16
Roger's column 59
Shoparound 67
New products 88
Dregs 98

SOUND INSIGHTS

Industry news 100
Sight and sound news 102
Thorens turntables 106
Monitor Audio 1200 speakers 109

Cover: Zevac SMD Rework Station. Distributed by T.I.C. Distributors. Pic by John Zenio Lapka.

THE NEW PROFOUND FAMILY HAS A BROTHER!

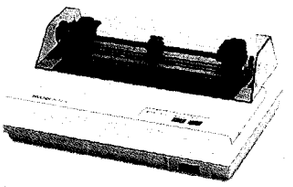
Eastern Micro Electronics and Brother Celebrate A Family Affair.

Profound XT Compact plus Brother 1109 Printer for only $100 more!

READER INFO No. 51

The new Profound XT, a compact footprint case which houses one of the latest design motherboards and an 8088 processor. The LED displays the turbo switching speed of 4.77 Mhz to 10 Mhz. Packed with 640KB of RAM, a 360KB drive, a 20MB Hard Disk and Keyboard. The Profound XT supports a monochrome 14" Amber Monitor, DOS and we'll throw in a pack of diskettes!

$1,995 (For Profound XT only)



Also a compact size, the quiet 100cps, 80 column, 9 pin dot matrix printer has both parallel and serial interfaces, 2Kb buffer, Epson and IBM emulations. Tractor feed as standard. We'll even throw in the cable.

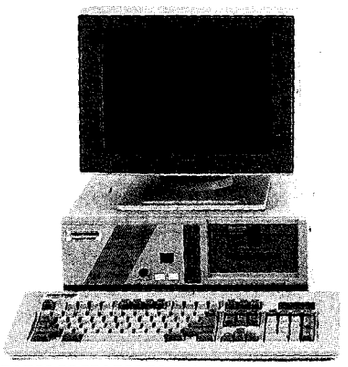
TOTAL VALUE $3,007 for only $2,095

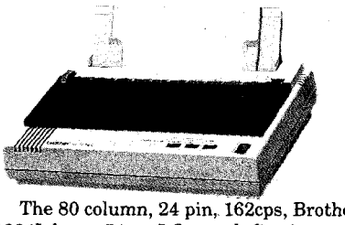
Profound 286 plus Brother 1224L Printer for only $200 more!

READER INFO No. 52

The new PROFOUND 286 is as compact as our XT, and features a vertically mounted 3 1/2" slot. Turbo switching to a full 12Mhz, the 640KB RAM is driven by an 80286 processor on a state of the art motherboard. A 1.2MB drive and 40MB Hard Drive cover all your data storage requirements. Enhanced graphics adaptor card (EGA) and high resolution EGA Monitor measuring 14" and 640 x 400 pixels. Keyboard, DOS and even diskettes are included.

$3,695 (For Profound 286 only)





The 80 column, 24 pin, 162cps, Brother 1224L has a 54cps LQ speed. Coming standard with a 7Kb buffer, pull tractor feeder, Epson LQ500 emulation, dual interfaces and a cable thrown in!

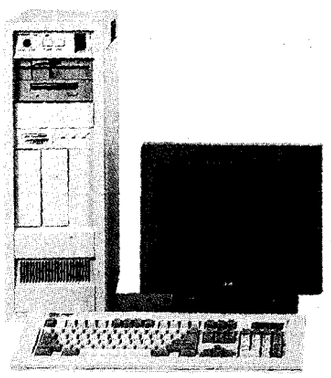
TOTAL VALUE $5,715 for only $3,895

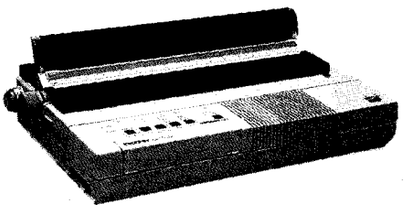
Profound TURBO TOWER 386 plus Brother 1709 Printer for only $300 more!

READER INFO No. 53

The Flagship of the Profound Family is the PROFOUND TURBO TOWER 386. A powerhouse 80386 processor boosts the speed from 16Mhz to a turbo of 20 Mhz. With 2MB of RAM (capable of expanding to 8MB), and both 1.2MB and 1.44MB drives the system is accompanied by a 44MB Voice Coil Hard Drive, which will handle almost every processing and data storage option with plenty of space for expansion. The Video Graphics Adaptor (VGA) and a VGA Monitor give you unparalleled 720 x 400 resolution. Keyboard, DOS and diskettes for a towering price!

$6,995 (For Profound Tower only)





The Brother 1709 is a fast 240 cps, 136 column, 9 pin printer with standard features such as a 24Kb buffer, dual interface, push tractor feeder, paper parking, Epson and IBM emulation and many options.

TOTAL VALUE $10,640 for only $7,295

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ROS BROMWICH

The Etties

One of the major tasks in any magazine's daily round is sorting through the shoals of press releases that arrive by every post. So many products: the new and innovative, the new and me-too, the disguised re-hash, the tired old warhorse, they parade past in a never-ending succession.

Can we do justice to the really good ones? Unless we take time to single them out for special mention, in general the answer's no. A puff in the products pages (if there's enough room and the managing editor lets us have more pages) perhaps a product review, and that's that. So if we're really impressed by something, it gets a fulsome mention in one issue – if you blinked, you missed it.

So we decided that it was time to give a little bit extra to the items that had given most cause for joy this year and we had the ideal forum for presenting these awards – IREECON in Melbourne.

As usual we didn't give ourselves much time to organise it but our three independent judges responded well to the editorial whip and, after submitting their preliminary nominations and ideas in the various categories, we got together and nutted out the final decisions over a beef fillet with snowpeas in Surry Hills. These first winners awards (the Etties?) are described on pages 68/69, along with some of the reasons for their selection. Merely choosing the four categories provided some headaches, let alone picking one winner in each, but in only two did the debate threaten to be unresolvable: board-level products and communications. The team came down in the end on the side of the GSA-Tech secure voice module in the former and SEPac's SWAT in the latter.

The T & M category was taken out by the Fluke 45, which met all the criteria we imposed. The Pro-Sound and Broadcast area provoked considerable debate, not least because technology has produced a plethora of new product throughout the year. Wide applicability and value for money led to consensus on Talia's AVM200.

Every candidate for the special awards for Australian Innovation/Endeavour had its enthusiastic pundit, but the discussion here was free-ranging and open-minded. Austek's A41102 Fourier Domain Processor emerged as our inaugural winner, with a Special Commendation to the OTC AWAM Viterbi chip. The judging panel discharged their duties with appropriate gravitas. We should like to think that the winners will receive universal acclaim but we weren't born yesterday. We should be pleased to learn of your views. Not because we intend to conduct a further debate (the judges' decisions are final, etc, etc) but because the readers of ETI are the end users of the products considered. Let us know your thoughts on the equipment you use. Manufacturers and distributors welcome (or should) constructive criticism and we would like to know how the winners and others fulfil their functions in the field.

All in all a remarkable degree of unanimity was achieved which, whatever you may think, was not proportional to the growing pile of empty bottles at the table. ETI will be at IREECON for the whole week and we look forward to seeing as many people as possible; the awards will be presented on September 14.

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Industry News

Priority Electronics will begin distributing Analog Devices' range of real time interface cards and signal conditioning modules as well as Analog's range of isolation amplifiers. The directors of the company, Tony Coward and John Owens together bring over 60 years' experience in the industry.

★ ★ ★

In a reorganisation of its marketing and sales team, the South Australian-based producer of television broadcasting equipment, Practel Sales International has given Mr John Stankovich responsibility for international sales and marketing.

Mr Ian Fleetwood has been promoted to national sales manager, responsible for Australia and New Zealand.

PSI has also recently appointed distributors and agents on the east and west coasts of the USA, in Canada and throughout south-east Asia.

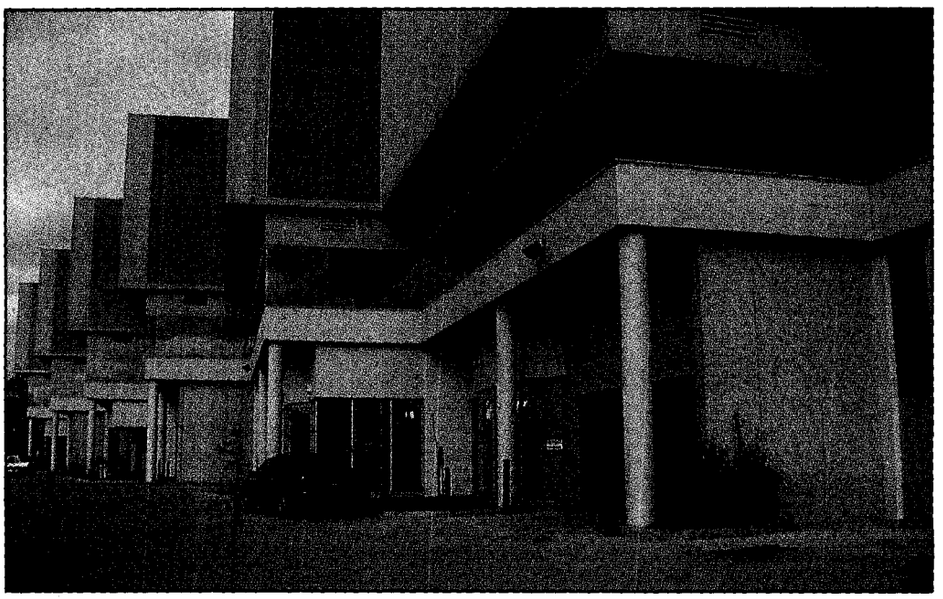
★ ★ ★

In an agreement signed between IPL Datron and Stott and Underwood in late June, Stott and Underwood will distribute Oki faxes through their outlets around Australia.

This follows a recent move by Stott and Underwood to drop GEC, who previously sold Oki fax machines here, in favour of IPL who already handle their printers and cellular radio telephone products, and have dealt with Oki for over six years.

The agreement between the two companies was signed by Mr Stead Denton, managing director of IPL Datron, and Mr H.L. Wallace, chairman of directors of Stott and Underwood.

Multi Electronic Services announces new division



Multi Electronic Services' new premises in North Ryde, Sydney.

MULTI Electronic Services, a long-established manufacturer and developer of security and electronic control equipment has announced the formation of a new division, Multi Electronic Distributors.

Managing director, Mark Rutherford, said that the need for a distribution arm to the company had been foreseen since late in 1988, and that it was an obvious addition to the already successful electronic design and manufacturing operations in Sydney and Melbourne and the sheet metal fabrication plant in Sydney. He said: "We saw that we lacked the means to successfully market our products in Australia and internationally, but rather than settle for having a successful marketing organisation, we saw the opportunity to commence a larger scale distribution business."

Chris Rhodes, well known in the security and communications industries, has been appointed to head Multi Electronic Distributors and is negotiating distribution agreements with Sentrol, Knox Security Engineering, Synergistics, LANtastic and GYYR of the USA; TDS and TDSI of the UK and Australian company IES.

Australian for international radio amateurs' union

THE Federal Council and Executive of the Wireless Institute of Australia (WIA) has announced the unanimous election and ratification of Michael Owen, VK3KI, as vice-president of the International Amateur Radio Union (IARU).

It is the first time a radio amateur outside North America has served at such a senior level, and as such is an honour for the Wireless Institute of Australia which Michael served as Federal President from 1969 to 1972.

Michael has been actively involved in IARU matters for twenty years in a number of capacities including Director of the IARU Region 3 and a member of IARU President Noel Eaton's ad hoc World Administrative Radio Conference (WARC) Advisory Committee prior to the 1979 WARC.

He was also an Australian delegate at the 1979 WARC. Michael presently lives and works in London, England.

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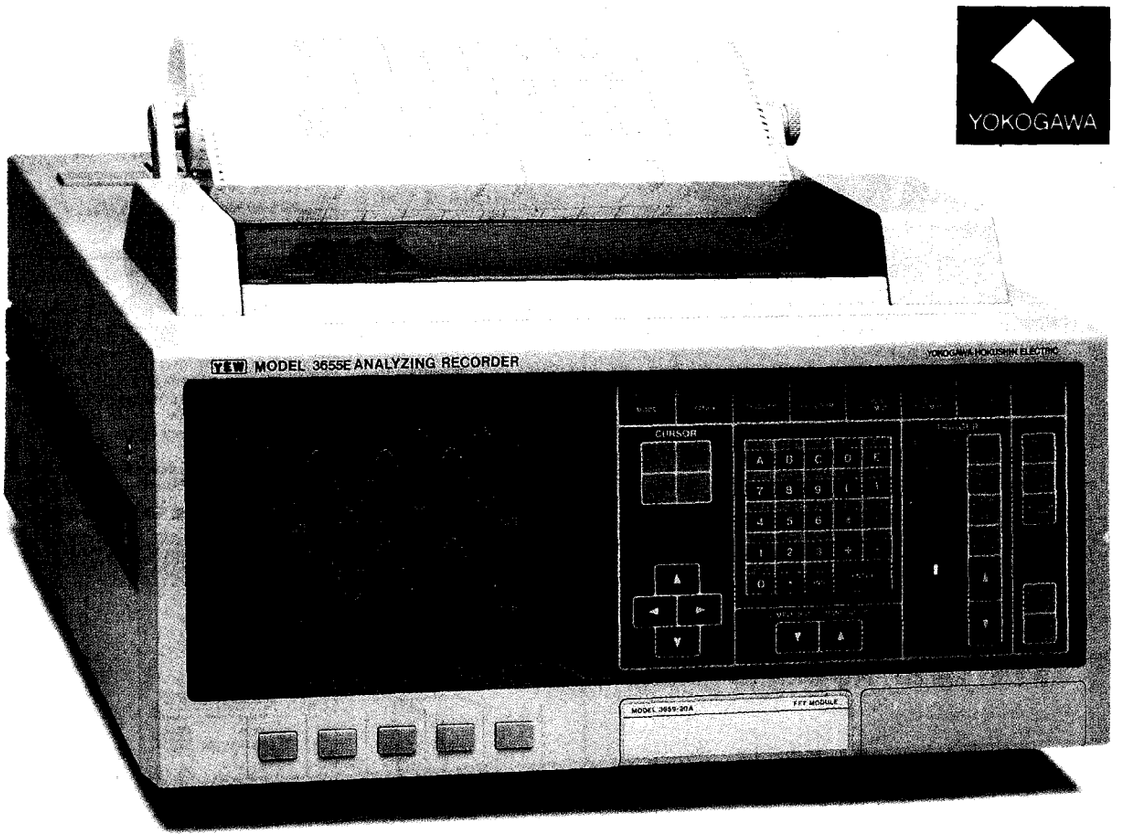

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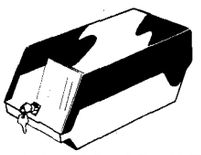

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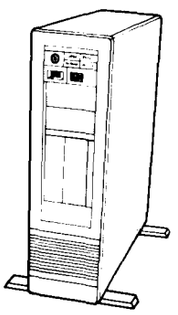

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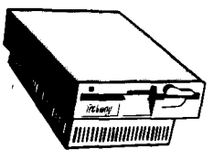

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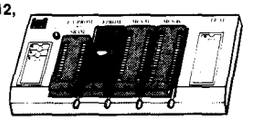

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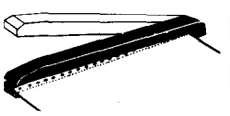

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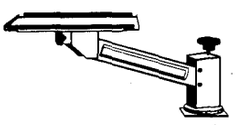

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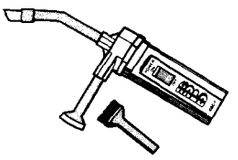

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- Clamp mounting

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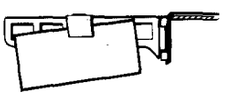

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- Attaches to the top of your monitor
- Put your copy right where you need it spring clip to hold paper
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Pinpointing component problems in IBM* compatible motherboards can take hours. Usually the whole system has to be working to isolate the troubled area. But not so with the new Postcard Diagnostic Module. So no other cards are necessary to test a bare motherboard.
"It now only takes seconds."
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Inspection- Postcard simplifies incoming and outgoing test processes on stand
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- Processor: 80386SX-16MHz (0/1 wait state)
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- CHIPS & TECH NEAT chipsets
- (SMT) Surface Mount Technology for chipsets & CPU
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- Five 16 BIT slots
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- Supports Page Interleave Mode using 100NS DRAM
- BIOS: AMI or PHOENIX
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- Baby size main board

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- 4 Channel DMA
- Keyboard port

Excluding RAM
X18032.....$199
Including RAM
X18033.....$570

BABY AT* MOTHERBOARD (WITHOUT MEMORY)

- 6/12 MHz system clock with zero wait state. 12 MHz, 1 wait state
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Excluding Ram
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Including 2 M/Byte RAM
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U48262.....$18.95
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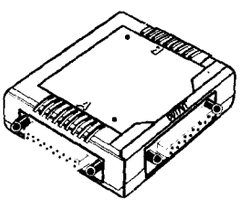
U48260.....$14.95
- 1MB-100ns
U48265.....$43.95

I/O ACCESSORIES



POCKET AUTO AB SWITCHES

- Pocket size, auto-scanning
- Allows 2 PCs to share one laser
- Serial model: MS-201 - Host-powered

X19150.....$79.95

POCKET AUTO AB SWITCHES

- Pocket size, auto-scanning
- Allows 2 PC's to share one laser
- Parallel model: MP-201 - Protocol transparent

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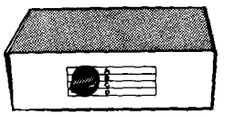
I/O ACCESSORY



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- No power required
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- Switch comes standard with female connector

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4 Way Centronics
X19135.....$79
RS232 2 X 2 Auto Switch
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CASES

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X19091.....$99

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X19093.....$99

P.C ACCESSORY

386 TOWER PC

The 386 Tower PC is a high performance system that's IBM* AT* compatible. However, the 386 Tower PC gives you 2-5 times the performance.
FEATURES:
- Intel 80386-16MHz microprocessor
- Switchable 16/20 MHz
- 2 M/Byte fitted. Total memory expandable up to 16 M/Byte
- Up to 2 M/Byte or 8 M/Byte
- Option for 80287 & 80387 co-processor socket
- Chips and Technology chip set
- AMI Phoenix 386 BIOS
- 50 M/Byte hard disk. 42 M/Byte formatted. Fast access
- EGA card
- 3 1/2" drive 1.44 M/Byte

X20070.....$5,995

286 NEAT MOTHERBOARD

- Processor: 80286-12, -16MHz or -20MHz (0/1 wait state)
- Co-processor: 80287 (optional)
- CHIPS & TECH NEAT chipsets
- 1-4MB dual RAM socket
- 1-4MB module RAM socket on board
- 640KB-384KB memory relocation
- Three 8 BIT expansion slots
- Five 16 BIT expansion slots
- Memory expansion to 8MB
- Supports EMS 4.0
- Page Interleave Technology
- BIOS: AMI or PHOENIX
- Hardware and keyboard switchable Clock Speed
- LED speed display
- Power Good Signal on board
- Baby size main board
- 16MHz

X18090.....$700
- 20MHz

X18092.....$895

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IBM* PC/AT* DECODED I/O CARD

This card is designed for the IBM* PC/AT* expansion slot and includes data buffering and address selection. The wire wrap area features plated through holes. Extremely useful for R&D, it's address range is 0280H to 72 F7H. + -5V, + -12V fuse protection and has location for D type 37 pin or D type 25 pin connector.
H19125.....$99

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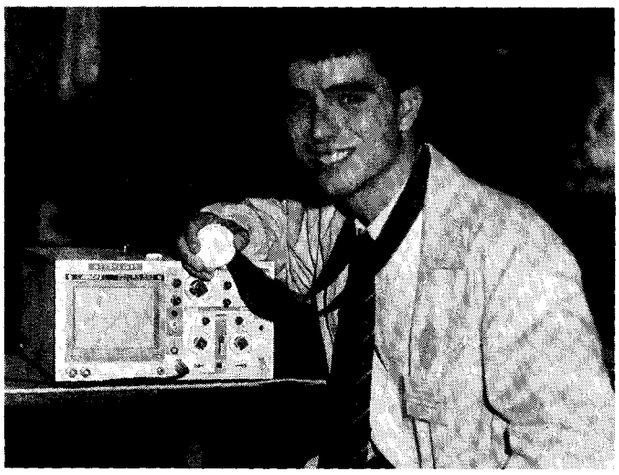
ROD IRVING ELECTRONICS

Skill Olympics



Winner David Zammit, from the Sydney Work Skill region participated in the Consumer Electronics division.

THE Skill Olympics are held every two years in member nations' countries. Last year they were held at Darling Harbour in Sydney where Australia won four gold, five silver and three bronze medals, coming in third after Korea and Taiwan.

This year they were held in the UK in Birmingham.

They began in 1950 as a way to promote vocational training in post-War Europe. This is only the fourth time Australia has taken part.

According to Jack Dusseldorp, Executive Director of Work Skill Australia, the Skills Olympics are possibly the only forum where Australia can measure its skills against other countries.

This is important in developing our international competitiveness, he said.

Looooong life battery

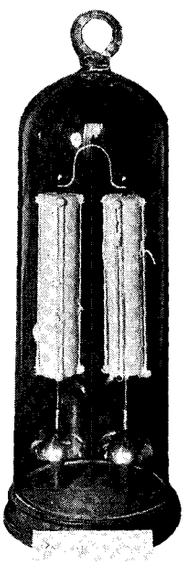
A DRY pile battery has been running in the Clarendon Laboratory at Oxford University for 150 years. What it is made of and where it comes from are a complete mystery.

"We know only that it was here when Robert Walker became Reader in Experimental Philosophy in 1839," said the editor of the laboratory's Historical Notes, A.J. Croft.

Since that time it has been ringing bells in the laboratory.

The battery has a terminal voltage of some 2 kV, but can only supply a current of one nanoamp. Part of the mystery is its composition. If it were truly dry, it would not work, according to Mr Croft.

It is thought the device follows Singer's recipe of around 2000 pairs of discs of zinc and 'silvered' paper.



Photograph courtesy Pacific-Dunlop Batteries Industrial.

Resistor development

A NEW resistor has been developed at the ANU to replace the 3000 number-six sewing needles which were used to keep the ANU's electrostatic accelerator operational. These accelerators give energy to charged particles using an electric field.

The resistors are said to remove the possibility of damaging 'lightning strikes' within the accelerator while enhancing its power.

They were made using customised and numerically controlled lathe and milling equipment. The resulting configuration is said to be both safe and cheap.

It took ten years of thought and two years of work, according to Dr David Weisser, a researcher at ANU.

A recent agreement with Email Electronics will enable the resistors to be manufactured for export. While Email will have access to the technology, ANU will hold on to the patents and will receive royalties on each device sold.

Taking into account the number of overseas universities which are likely to buy these devices, the world market for this Australian product is estimated to be worth $10 million.

The accelerator is used to date objects using carbon-14. Chlorine-36 is used for dating work in hydrology.

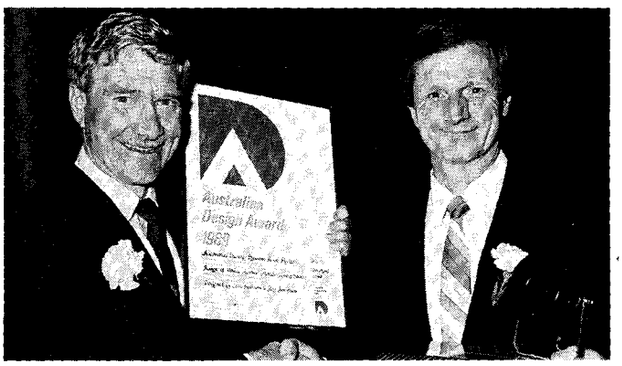
Bright future for electronics

THE Japanese Ministry of International Trade and Industry (MITI) believes the electronics industry is robust and that it will remain so at least until the year 2000. A yearly growth rate of 10% is expected.

In addition to electronic manufacturers accelerating their offshore manufacturing, demand for computers, semiconductors and telecommunications equipment will also grow.

This will lead to traditional technologies combining with knowledge from other industries to produce a wide range of frontier products to fill niche markets, according to MITI.

Design Award for car alarm



National chief executive of the Australian Design Council, Mr Keith Jordan (left), presenting the award to Mr Clive Freeburn, managing director of Yellow Light Car Alarms.

SYDNEY-based car alarm manufacturer Yellow Light has won its third Australian Design Award for its new ultrasonic Series 5000 car alarm.

It protects all doors, bonnet and boot by direct electric connections, as well as disabling the car's starting mechanism.

Among other features of the alarm is the ultrasonic detection system which is said to prevent false alarms caused by climatic changes within a car. It also protects against entry through the windows.

A pre-trigger warning tells the driver if the door is not properly closed when turning the alarm on. The Series 5000 is armed and disarmed by a remote control, and it has a siren with a stand-by battery.

This battery has an automatic test feature so the user always knows if the back-up battery is working.

Industry News

Dr Graham Harris has been appointed as the new Director of the CSIRO Office of Space Science and Applications (COSSA). Through his previous position in the CSIRO Division of Fisheries he was closely involved with COSSA.

"His commitment to the development of space-related technologies for the benefit of the Australian economy made Dr Harris the ideal choice for the position of Director of COSSA," said Dr Bob Frater, Director of the CSIRO Institute of Information and Communications Technologies.

Dr Harris has a number of Australian achievements in remote sensing. He initiated the Side-looking Airborne Radar (SLAR) which has led to a manufacturing agreement between CSIRO and Ericsson Defence Systems.

In more recent times he was selected by NASA to lead one of 28 world-wide multi-disciplinary investigations in its Earth Observing System (EOS) Program. The research planned by Dr Harris' team is a wholly-Australian proposal, and was selected from a field of 455 other ideas from around the world.

Dr Harris says he plans to further develop COSSA's role in space-related activities, and to strengthen its industry and government links. He takes over the post from Dr Ken McCracken who retired as COSSA Director in May this year.

ARTHUR CUSHEN

BBC MOVES TO ELECTRONIC MONITORING

The change to computerised monitoring has been a major one for the BBC, but, hopefully, transmission to the South Pacific will be much improved. Arthur Cushen reports.

The BBC has become the first international broadcaster to use computerised reception forms. Monitoring of the BBC, Radio Canada and the Voice of America, has, in, the past, been typed onto special forms and the reception indicated on a daily basis using the SIO code. In the case of the BBC, the form covered observations on each frequency at hourly intervals and, when prepared, was mailed to London each week. At the Transmissions Planning Section, the information was then manually transferred onto a computer and the performance of frequencies in the target area compared and new sources of interference noted.

The BBC has now moved to a complete computerised reception form in which frequency, for instance, is marked with a stroke on the form and information as to signal level is indicated by crossing the number applicable to the strength of the broadcast.

Recently, Dennis Thompson, head of the Transmission Planning Unit, indicated that this information would now be scanned by the computer and there would be no human involvement in checking incoming monitoring reports. He conceded that human involvement meant the assessment of signals varied from one place to another, but as the BBC is broadcasting to the area in which the monitor is located, they expect the best reception possible on any given frequency. As the forms are scanned optically, any new interference is to be noted by the monitor in a special way, so that engineers are alerted to a change of performance of a particular frequency. The computer will then alert the engineer responsible for that transmission area, and will indicate that action should be taken.

The performance of any frequency is based on the availability of a relatively clear channel. This is becoming much more difficult to obtain. As Dennis Thompson noted, higher sunspots are giving better high frequency reception but there are still too few frequencies for the number of broadcasters operating and this means overcrowding.

BBC RECEPTION REPORT

NAME

ADDRESS

Arthur T. Cushen
212 Earn Street
Invercargill
New Zealand

MARK IF CHANGED

RECORDER CODE

LOCAL TIME

U.T.C.

WEEK BEGINNING

FORM TYPE

RECEIVER, TYPE & AERIAL SYSTEM

REMARKS:

TIME HOUR	TIME MINS.	FREQUENCY	GMD	S	I	O	Int	S	I	O	Int	S	I	O	Int	S	I	O	Int	S	I	O	Int	S	I	O	Int	S	I	O	Int
								Sun				Mon				Tue				Wed				Thur				Fri				Sat			
								Sun				Mon				Tue				Wed				Thur				Fri				Sat			

The new BBC reception form which is now being used by the Transmission Planning Unit and is based on computer analysis.

Caracol expands

RECENTLY, the Caracol network in Columbia, which operates some 75 mediumwave stations and several shortwave outlets, has been heard using the facilities of Radio Sutatenza, a Roman Catholic network. In the past, Caracol has operated on shortwave on 4755kHz from

Bogota and 4945 from Neiva. The use of the facilities of Radio Sutatenza includes a high powered mediumwave station on 810kHz, and the shortwave frequencies of 5075 and 6075kHz. Broadcasts on 5075kHz were the same as on 4755kHz and now the signal is noted on 6075. An English announcement has been introduced at 0815UTC and is as follows: *This is Caracol Columbia, Station HJCY Bogota Columbia, with 250 kilowatts of power on the frequency of 810kHz mediumwave, Caracol Columbia.* The signal can be received in the South Pacific from around 0600 to past 1100UTC.

Radio for peace

THE reception of broadcasts of Radio for Peace International, on 21565kHz, from 2200 to as late as 0300UTC, has been reported throughout the South Pacific. Despite power of only 2500 watts, signals have been received on a regular basis. An alternative channel of 25945kHz is also being used. Reports are requested to be sent to P.O. Box 88, Santa Ana, Costa Rica.

In 1979, Dr Rodrigo Carazo, President of Costa Rica from 1978-82, presented the concept of a University for Peace to the General Assembly of the United Nations.

In 1980, the General Assembly unanimously adopted a resolution to establish the University for Peace in Costa Rica as an institution independent in program and funding.

Radio for Peace International (RFPI) is an international shortwave station created as a joint project of the World Peace University, Oregon, USA, and the University for Peace, Costa Rica. RFPI broadcasts from the campus of the University for Peace on issues of peace, world food supply, social justice and environmental preservation.

The present schedule uses 25945 up to 0000, when the frequencies of 13660 and 21565 are used for a further transmission.

AROUND THE WORLD

ABU DHABI: Broadcasts from Radio Abu Dhabi have been heard in the new 13MHz band with English from 2200-2400 on 13605kHz. Broadcasts open with a reading from the Koran followed by a press review and, at 2300, a full news broadcast. The station is also using 9595 and 11985kHz for that transmission.

CZECHOSLOVAKIA: Prague is broadcasting in English, 0100-0200, 0300-0400 and is well received on two new frequencies, 13715 and 15540kHz. The transmission is beamed to North America. Prague is also using the new 13MHz band.

IRAQ: Baghdad has also appeared in the 13MHz band with its English transmission 2005-2150 using 13660kHz; to North America 0130-0330 on 11945 and to India at the same time on 11810kHz. Reception reports are requested to PO Box 8145, Baghdad, Iraq.

SPAIN: Madrid broadcasts in English for listeners in Europe 1900-2000 and 2100-2200UTC on 11790 and 15280kHz.

The latter frequency gives the best reception and the program includes a DX session on Sunday. Monday to Friday the last 15 minutes consists of Spanish-English lessons.

YUGOSLAVIA: Radio Belgrade in its new transmission to North America is heard 0000-0045 on 15105kHz. These transmissions suffer interference from Deutsche Welle on the same channel. Belgrade also announces that 7215 and 11735kHz are carrying the same program but 15105kHz provides the strongest signal. eti

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

JOHN COULTER

INTELLECTUAL PROPERTY — WHO SHOULD OWN IT?

Is there an inevitable conflict between private, profit-oriented research and the public interest? John Coulter examines the issue.

The Federal Government is attempting to direct this country's education and its science R & D effort towards those areas which are likely to be profitable.

Funds have been withdrawn from CSIRO and the universities have been financially constrained. CSIRO has been told to get 30% of its funding from private sources and the universities are attempting to enter more joint research ventures with private industry. This model of research funding raises a number of questions.

1. Is there an inevitable conflict between private, profit-oriented research and the public interest?
2. Will longer term research continue to be funded?
3. Who funds research into environmental problems such as the Greenhouse Effect, the results of which may be inimical to short-run profit by some funding companies?
4. Should those who pay, in part or whole, for the generation of new knowledge have exclusive rights to the exploitation of that knowledge?
5. Does the source of the funding produce a conflict of interest for the researcher?

A recent study at Harvard casts some light on several of these points. Dr Tseng, an opthalmologist at the Massachusetts Eye and Ear Hospital in Boston, tested a jelly containing Vitamin A on the eyes of some of his patients. He reported that Vitamin A in this form was able to reverse some of the causes of dry eye. This particular jelly was made by Spectra Pharmaceutical Services (SPS) and the company hoped to market the product. Now, it so happened that Dr Tseng owned 530,000 shares in SPS while he was carrying out his research at Harvard. Tseng's research supervisor also owned shares in SPS and Emeritus Professor Maumenee, the founder of SPS, had been responsible for teaching both men opthalmology. All three had written papers on the beneficial effects of Vitamin A. To what extent are financial and scientific interests likely to be in conflict in a situation of this sort? Would such researchers be likely to suppress negative findings in drug trials?

When a double blind trial costing $2m was conducted by researchers with no ties to SPS, it was found that the Vitamin A jelly was indistinguishable from a placebo. Investigations revealed that Tseng's studies on patients had been conducted without either Food and Drug Administration or John Hopkins human studies panel approval. Harvard investigations reported that "proper safeguards were not in place to protect the study from bias".

In January, 1985, Tseng had sought FDA registration of his ointment. This was granted in April, 1985. In June, 1985, Tseng, his supervisor and Maumenee published a paper in *Ophthalmology* very favourable to Vitamin A and, in July, Tseng sold his rights to the ointment to SPS for $310,000 (SPS had been formed only a few months earlier by Maumenee.)

It would seem that a conflict between financial gain and scientific integrity existed in this situation, but whether this led to the publication of papers favourable to the Vitamin A jelly when double blind independent trials failed to show any benefit, it is not possible to say. This is one explanation, however, for the difference in results.

> ***'When a double blind trial was conducted, it was found that the Vitamin A jelly was indistinguishable from a placebo'***

New drugs are likely to be tested in double blind trials sooner or later, and results will be challenged. The truth will out – but how about other research results?

When these are built into products and sold to the public, is the market system a sufficient check on the reliability of the original research? I believe not. The modern market is a far cry from the simple model of economical text books. The market is complex with many products having few close competitors and the feedback path from consumer dissatisfaction to falling sales is often long. Moreover, markets are unstable and tend naturally away from the perfect model towards monopolies. And when information itself becomes a property, increasingly privatised, controlled and directed toward profit, then one of the chief requirements of a self-regulating market system is not met.

The alternative direction, which I would favour, is towards the public generation of new knowledge and public ownership of that knowledge. This would mean an increase in public funding for education for its own sake. It would better equip individuals to deal with the world and make better decisions. It would mean increasing government funding for research at all levels with public ownership of the results of that research.

The direction of the present government, with education as well as scientific R & D bent towards short-term profit, is not only inimical to the survival of a liberal society, it will slowly strangle the very scientific enterprise it seeks to exploit. eti

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Senator John Coulter is the spokesman for the Australian Democrats on Science and Technology.

EME: BIG AND GETTING BIGGER

Eastern Micro Electronics (Aust.) Pty. Ltd. is a wholly Australian owned manufacturer, importer and distributor of high quality personal and business computers, software and peripherals, and is currently listed as one of Australia's top 50 computer companies with an annual turnover in excess of $35m. Products distributed by EME include Profound Computers, CMT Monitors, Brother Printers, Microsoft Software, Hitachi LapTop Computers, Micron Memory Boards, The Psion Organiser II Hand Held Computer and the Compact Modem.

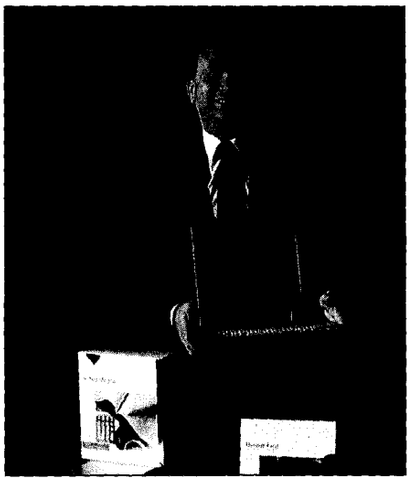
EME was founded in 1980 by Joe and Ann Lazar and remains a family concern with both parties still actively involved as directors of the company. With a nationwide dealer base and offices in four states, EME has experienced a constant and controlled growth since its inception.

Joe Lazar's previous experience in the export industry prior to founding EME has given him a solid grounding in business and trade practices and an ability to perceive market trends as they occur. His business acumen is largely responsible for EME's success in constantly retaining a wider vision of the industry, especially important in the highly charged computer field.

EME operates under the premise that the public and corporate spheres require quality products at competitive prices with the confidence that they will be supported. As a distributor, EME knows that the secret of success is to provide its dealers with everything the public requires – service, support and technical back-up combined with quality ranges of products. These, they believe, are the foundation stones of a successful distribution network.

Eastern Micro Electronics began importing the Profound range of computers from Taiwan in 1983 while operating as a dealer in Bank Street, South Melbourne. By late 1984, with Profound's market share secure, EME decided to source parts overseas and assemble the Profound range on its own premises, thereby greatly enhancing quality control and dealer support. This proved to be a major turning point in the company's development.

In early 1985, with local assembly of the



Joe Lazar, managing director.

Profound underway, EME moved from the retail to the distribution market, further expanding by opening an office in Sydney, and began building the extensive dealer network that is now one of its greatest assets.

Meeting demand

In order to meet increasing local demand and to consolidate its dealer base, EME was compelled to source its own range of monitors. This resulted in the introduction of the OMT range of mono, colour, EGA, Multiscan and VGA monitors to the Australian marketplace.

In September 1985, a new building was purchased in fashionable Park Street, South Melbourne to house showroom, administration, assembly and warehouse facilities. This was a move which proved to be short-lived, for within twelve months it was apparent these new premises were not large enough for the rapidly expanding EME.

Melbourne architect Luciano Palms was engaged to convert an old BHP archives warehouse in Tope Street, South Melbourne. By September 1987, the $3m complex was complete. Encompassing 16,500 square feet, the building includes office and administration space, two reception areas, tele-marketing and training rooms, and conference facilities. Also housed are sophisticated warehousing facilities that include a two level conveyor-belt driven storage area and an extensive technical service and assembly area to ensure timely delivery.

With offices in Melbourne, Sydney, Adelaide, Brisbane and Perth, Eastern Micro Electronics now has a staff of over 50 personnel, with a key management team that boasts over 80 years experience in the computer industry.

Psion PLC of the United Kingdom approached EME in 1987 with the view to distributing the Organiser II product range of hand-held computers and peripherals, with a multiplicity of user options as varied as bar-coder reader for stock control, spread sheet, diary and alarm, and with up to 320K of memory and Comms Link capability. The Organiser II is currently employed as the standard marketing and stock control unit of the Faulding pharmaceutical group.

Looking ahead

During the recent worldwide RAM chip shortage, EME looked ahead for manufacturers of this scarce commodity. Micron Technology Inc. of the United States, which manufactures RAM chips and memory cards, looked favourably on EME's position in the Australian marketplace. EME was then appointed as the Australian distributor of Micron extended/expanded memory boards for IBM PCs and Apple Macintosh.

Microsoft has also been impressed with EME's performance, to the point that EME is now Australia's leading Microsoft distributor. Microsoft, in recognising this achievement, recently named EME as national distributor of MS Dos, and Victorian sub-distributor of the Microsoft range of software. Joe Lazar recently met with Microsoft co-founder Bill Gates to sign a $1.36m bundling agreement.

EME has also been appointed Victorian State distributors for the Brother range of printers which consolidates the relationship established between the two companies over the past four years.

EME, through its dealers, has clients such as National Mutual, CSIRO, Elders IXL, Royal Bank, Hoechst, OCE, Gillette, Fauldings, Pyramid Building Society, Anitek, ASEA, Telecom and Scitek. eti

INNOVATION

The clockwork music box, a popular and ingenious consumer item of yesteryear, has been supplanted by electronics technology. Today's electronic music box may well haunt your Christmas. Roger Harrison writes.

Imagine opening the cover of this issue and hearing it burst into song with "Laugh, Kookaburra Laugh", or some other familiar melody! Imagine wearing a French Bicentennial badge that played the Marseillaise on command!

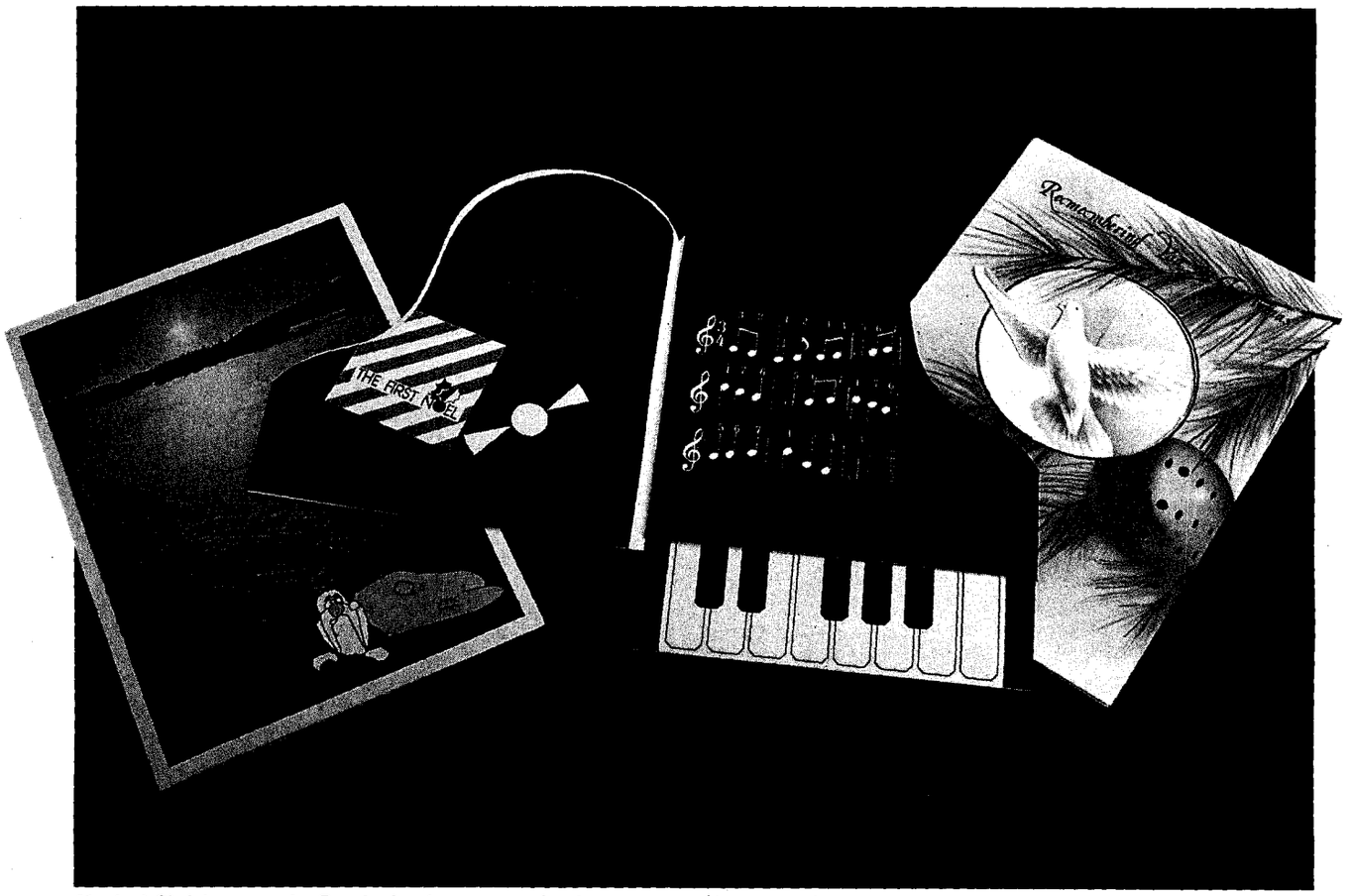
A chip, a tiny battery and miniature speaker can be hidden inside the most remarkable places in popular consumer items, to surprise and delight people with the novelty. Birthday and Christmas cards, lapel badges, children's books, credit card-sized miniature musical organs are widely available products which use this technology.

Singing greetings cards were among the first mass consumer items to incorporate it. Go into any newsagent, gift shop or stationery store, search the card racks and you're sure to come across a selection. As you open such cards, an appropriate tune will begin playing. Wait for it to play right though and ... it might automatically turn itself off, or play another related tune or two. As Christmas is rapidly approaching, musical Christmas cards are beginning to appear, and the number and variety will rapidly expand over the next six to eight weeks.

The idea is not new. It is simply an extension of the old miniature clockwork music box, which developed to what is now considered by some to be an art form in the 17th and 18th centuries and which became a consumer item in the 19th century.

While the music box took a wide variety of forms a simple, popular form involved a little chest or jewel box, which sprang into action when the lid was opened. The action was driven by a spring, which had to be wound up from time to time. Today's counterparts are powered by tiny batteries which supply the electronics that generate the melodies.

So just what is the remarkable technology that these, and other, popular consumer items depend on? It's known as chip-on-



Musical Christmas cards. Pop technology — coming to a newsagent near you!

POP TECHNOLOGY

A chip-on-board melody module from a musical Christmas card. Note the size of the printed circuit board compared to the stamp. The black blob covers and protects the 2 × 3 mm chip. The battery holder, the tiny 7 × 2.5 mm battery and the on/off switch assembly dominate the board.

board and greetings cards and suchlike are not the only consumer products which exploit it.

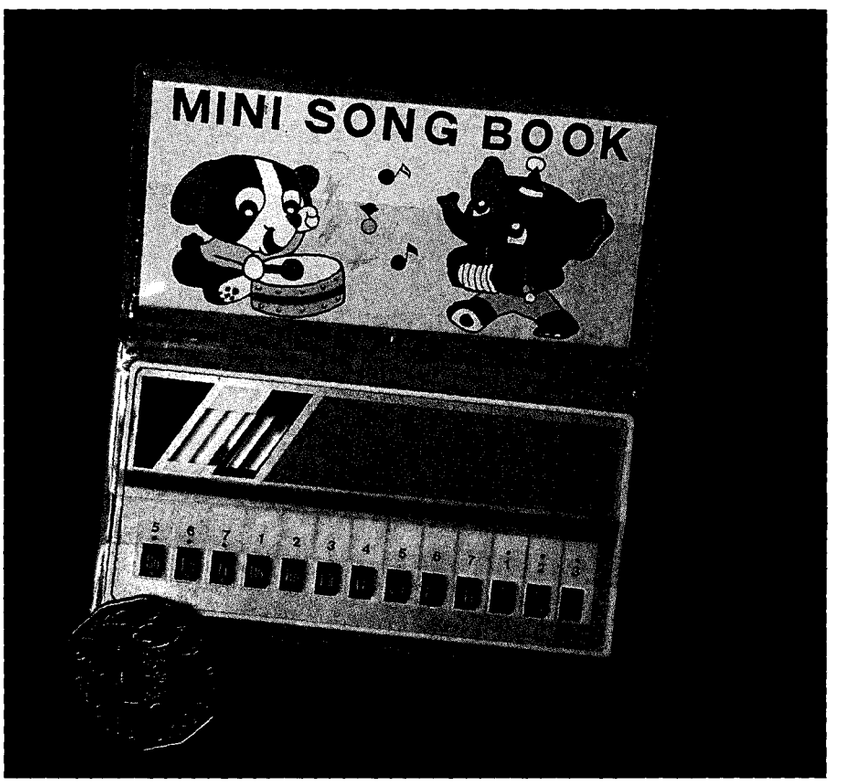
Chip-on-board

A number of technological developments have converged, or more probably been brought together, to make these products possible. But let me first concentrate on the critical development that is the key to these devices.

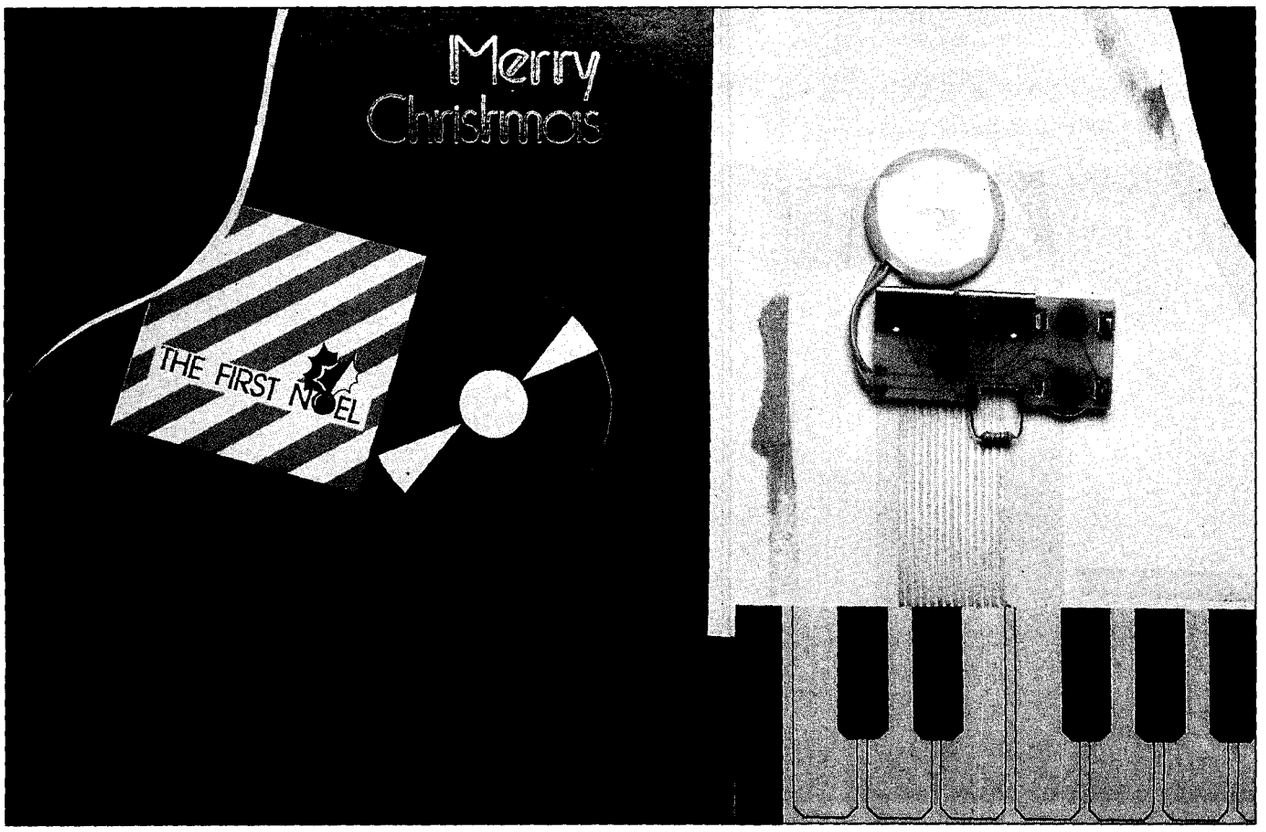
There has been a general thrust over many years in many areas of electronics for ever greater miniaturisation. This has brought about very complex, very dense IC chips capable of astonishing functional power and performance. For less complex, widely used devices, more compact forms of packaging were developed, which led to the development of surface mount technology.

In surface mount technology, as you may know, the electronic components have no leads as their predecessors do, instead they have either metallised areas at suitable points on the component's package, or short metal flanges, allowing the components to mount directly to tracks etched on the surface of a printed circuit board.

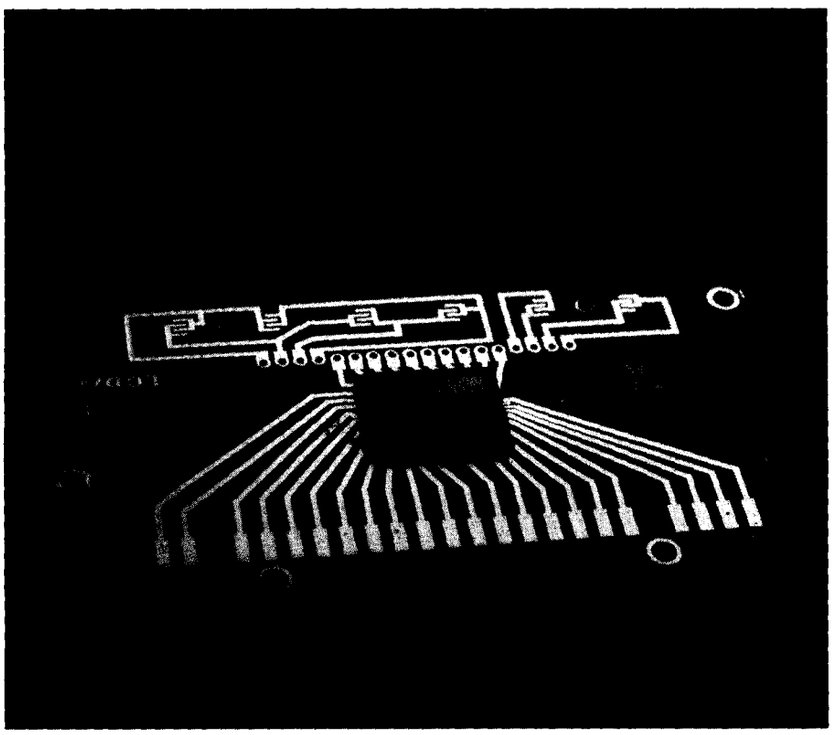
The components don't have leads which need inserting in holes drilled through the pc board. Packages can be considerably smaller, getting rid of all the wasted space and volume taken up by the necessity of



This Mini Piano melody organ uses chip-on-board technology.



Inside a piano greeting card.



Inside a chip-on-board computer ROM cartridge.

having all those large leads or pins. Most of the volume of standard leaded IC packages is wasted space. The smart bit inside – the chip itself – is quite small. In a typical 16-pin IC, the chip inside is smaller than the fingernail of your index finger.

An IC to generate a melody or two and drive a piezo-electric audio transducer is a comparatively simple device, the chip itself measuring no more than about 2mm by 3mm. You could fit half a dozen on your fingernail.

While surface mount technology solved a whole lot of space-limited packaging problems in itself for the electronics industry, it was not the technology needed to allow the development of singing greetings cards and the like, in part because it is basically too costly for the application.

Then some cunning person hit on the idea of putting the chip directly on the pc board. To put the chip in a package involves bonding it to the package substrate then welding tiny wires between the connection points around the chip's upper surface and the metallised tracks that lead to the package's pins. Putting the chip on a minute pc board with tiny tracks would be no more difficult. With those problems solved, the manufacturers were off and running!

The tiny chips, no larger than 2mm by

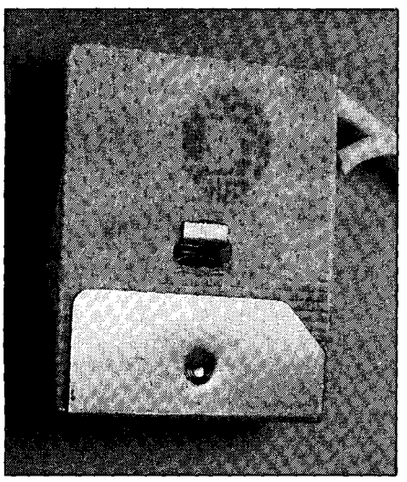
3 mm and sometimes smaller, are bonded directly to the surface of the pc board which, in the case of greetings card melody generators, are much smaller than a 39 cent postage stamp and only 1 mm thick. The tiny interconnecting wires, thinner than a human hair, are welded in place and a blob of epoxy placed over the chip to seal and protect it. With automated assembly, the cost of production per unit is very low, making the products in which they're found a viable consumer item.

Power in, sound out

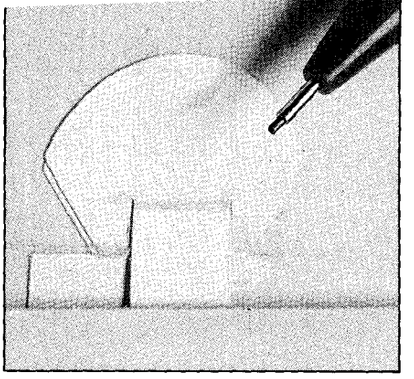
Of course, the circuit requires a source of power and tiny button batteries are used. Battery development has advanced considerably over the past decade, resulting in some remarkable battery products becoming available for a host of applications that call for truly miniature, long-life batteries. Cameras, hearing aids and electronic wrist watches are just a few examples. These batteries were ideal for the application which called for mounting an entire circuit and its power supply inside a greetings card.

The tiniest batteries used are only 7 mm diameter and 2.5 mm thick. Some larger, 10 mm diameter batteries are also seen. Some devices use two batteries, rather than one, to derive a 3 V supply as the batteries deliver around 1.5 V.

Over a hundred years ago, in 1880, when clockwork music boxes were popular gift items, brothers J. and P. Curie discovered that pressure applied to a crystal caused a voltage to be generated between two contacts on it. Dubbed the piezo-electric effect, it has been widely exploited this century. Flintless cigarette lighters generate a spark to ignite the butane by flexing a piezo-electric crystal which generates the spark's high voltage.



This rear-side view of the pc board shows the location of the tiny chip on the other side. It's only about 2 mm wide by 3 mm long. The board itself measures 20 mm by 18 mm, and is only 1 mm thick.



Showing the tongue that activates the switch on the melody module hidden inside the card.

The beeper alarms in electronic clocks, in electronic wrist watches, in personal computers, microwave ovens and a host of other products all consist of a (generally) circular piezo-electric (usually shortened to piezo – pronounced pee'tzo) crystal with electrodes plated on it. With a very small applied voltage, they can make quite a loud sound.

The speakers used on greetings card melody generators are all small piezo transducers. The melody chip drives the piezo speaker directly.

Loony tunes

The manufacturers of these chip-on-board melody generators boast that they can generate virtually any tune you desire. They have a standard list of usually twenty to thirty tunes, but I was rather overwhelmed to see a list from one manufacturer that ran to 144 different tunes!

Among the tunes listed are the perennials: Jingle Bells, We Wish You A Merry Christmas, Silent Night, Joy To The World, Happy Birthday, The Wedding March, Home Sweet Home, The Woodpecker Song, Love Me Tender (Elvis, you've a lot to answer for!) and more.

So, greetings card manufacturers, for example, get appropriate melody modules to suit each card range to be published and insert them accordingly. As I mentioned earlier, some modules only play a single tune, others two or maybe three tunes.

Just how are the modules turned on when you open the card? Well, it's ingenious, and disarmingly simple. If you examine one of these cards, you will see a plastic tongue hinged to the inside of the card's front flap. The tongue has an elongated hole in its far end. The tongue slides between a fixed and a spring contact on the pc board, the battery switch. When you open the card, the tongue slides across until a dimple on the spring contact drops through the hole in the end of the tongue, making contact and turning on the melody module. When you close the card, the tongue slides back, opening the contacts again, resetting the circuit.

Some greetings cards you see now, rather than playing the melody automatically, provide a keyboard and notation for *you* to play the tune – or any other melody you like! The keyboard is a conductive membrane, connected to the music module via conductive strips deposited on a flat plastic ribbon running between them. The chip can generate 13 notes, a complete octave plus one, from C to C'. You even get sustain! Some of the music generator chips for these applications have a range of two octaves, including all the full tones and half tones.

More COB products

Musical greeting cards and pocket melody organs are not the only products to exploit chip-on-board (COB) technology. Many of those low-cost electronic wrist watches that adorn your local chemist's display window are manufactured this way, too. The gimmick electronic wrist watches you see in toy stores do, too.

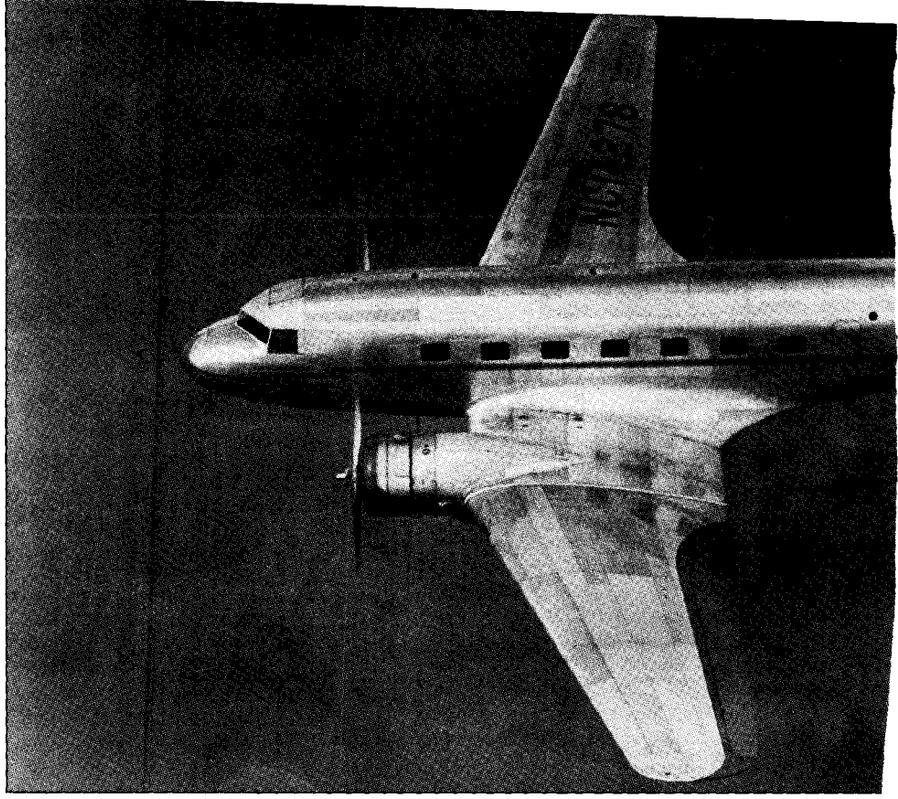
Tiny pocket melody organs are another example. They have a keyboard that is made of a conductive rubber. Press the tiny key and it pushes a little button on its underside to make contact with tracks on the pc board, causing the chip to sound the note selected.

I sat down to gather all my notes together to start on this article on the day before Bastille Day, the French National Day. Being their Bicentennial, this year it's a very special celebration, as well you know. That night, on a news program on television, a reporter was going over some of the Bicentennial products on sale in Paris. Lo and behold, there was a lapel badge (in the tri-colours, of course) that played the Marseillaise! Funny thing, though, I didn't hear of or see any similar products that played Waltzing Matilda (or Laugh, Kookaburra Laugh, for that matter) during our Bicentennial last year.

The plug-in ROM cartridges containing games software for your home computer often use chip-on-board technology these days, also. It's a simple matter to get a 32K or 64K ROM on a cartridge pc board. The ROM is programmed in the usual way, the software then permanently residing in the chip-on-board. It's a much cheaper way to produce such ROM cartridges, particularly in the quantities demanded. Cartridges for video games, like the Atari and Nintendo video games machines, employ chip-on-board technology too.

Who knows where else chip-on-board technology will pop up. Once your 1989 Christmas cards are cleared from your mantlepiece next January, you can salvage the electronics and find a new use for it. Put your imaginations to work – we might be able to do a feature on new uses for discarded greeting card electronics! eti

TECHNOLOGY



Our modern air traffic control system protects us (we hope) from freak accidents such as that described in the article below. But would such an efficient system ever have been developed if it hadn't been for the deaths of several VIPs some 50 years ago? Angie Testa flies us back to the early days.

MIST ON THE MOUNTAIN

18 killed on lonely Mt Dandenong

About 30 kilometres from Melbourne, along a lonely bush track near the summit of Mount Dandenong, one comes upon a small stone memorial. It commemorates the crash, on October 25th 1938, of the Douglas Airliner, Kyeema, which ploughed into the side of the mountain in thick fog. Among the 18 people killed was a politician, Charles Hawker – many thought him a likely candidate for the post of Prime Minister – several leading barristers and the four crew members.

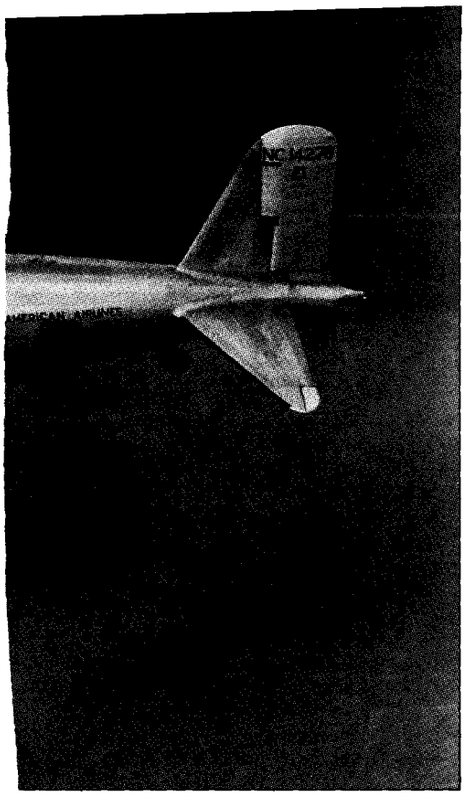
The disaster shocked the community and caused a sensation among the ministers and members of parliament in Canberra. The subsequent open enquiry and findings of the Accident Committee went to Cabinet and various aspects of the Civil Aviation Board were criticised. As a direct result, civil aviation was separated from defence and a new air traffic control system set up by Prime Minister Joseph Lyons, opening the way for safe, dependable, all-weather operations.

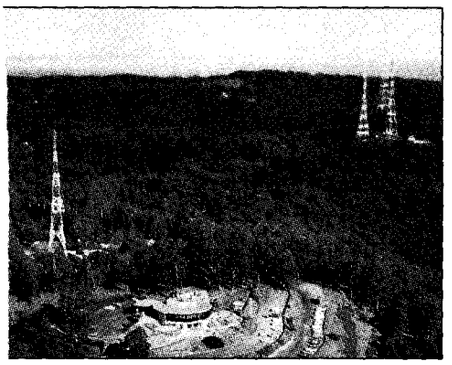
The DC-2 Kyeema belonged to the Australian National Airways, the second airline by that name. The first had been created by Charles Kingsford-Smith and Charles Ulm in 1930 when they established a regular flying service between Sydney, Brisbane, Melbourne and, later, Tasmania. Disaster was not far off, however. On 21st March the Southern Cloud took off from Mascot bound for Melbourne. It flew into a cyclone and the plane crashed in the Snowy Mountains killing all the passengers and crew. The wreckage was not found until 1958. After this accident passenger bookings dropped and the company was forced to suspend operations, eventually going into voluntary liquidation. Kingsford-Smith and Ulm went their separate ways, both going on to achieve fame.

In 1937, the second Australian National Airways was formed when West Australian Airways was bought out by Adelaide Airways and merged with Holyman's Airways Pty Ltd, a company formed four years before by brothers Ivan and Victor Holyman. (By the time ANA came into being, though, Victor was dead, killed in an aircrash over the Bass Strait with ten of his passengers.) Ivan Holyman went on to make ANA the largest internal airline in Australia, his planes flying between Melbourne, Adelaide, Perth and Hobart. It was Holyman also who arranged for the importing of the American DC-2 which was at the time considered the best commercial airliner in the world.

The plane was a twin engine passenger aircraft built by the American aviation company, Douglas. It could carry 22 passengers, although it normally only carried 14 with 4 air crew. Its normal cruising speed was 191 miles per hour. The aircraft was metal-skinned and bore a fairly close resemblance to the aircraft of today. Between 1933 and 1945 there were literally thousands of DC-2s and DC-3s built for civil and military service and they gained a reputation for low maintenance, reliability, flying ease and comfort. They were considered virtually indestructible.

So, Kyeema left Parafield Airport at 10.45 a.m. Adelaide time on its regular morning flight from Adelaide to Melbourne. Apart from a minor problem with the aircraft's radio





Top: a 1930s DC2, considered virtually indestructible at the time. Above: the summit of Mt Dandenong, where the Kyeema crashed in 1938.

equipment, which was rectified at Parafield, all was well.

The weather in Adelaide was mild and pleasant with a cool, southerly breeze flowing off the Southern Ocean. There was a layer of cloud at 3000 ft.

The captain was A.C.D. Webb, aged 32, from Essendon, junior captain was Allan Steen, air hostess Elva Jones and cadet pilot was Philip Pring, aged 20.

It was the voice of the young cadet pilot that Bill Cridge, the traffic officer, heard over the radio. Cridge was expecting the call and it came at 1.30 p.m. He was familiar with Captain Webb and Steen, the First Officer. The cadet gave the message: "Passing Daylesford. Height 7000, course 110". The captain then asked for the weather.

The latest weather, compiled at 1p.m., gave overcast cloud at 1500 feet in the Melbourne area, extending to 4000 feet. Beneath it was a broken layer at 800 feet. The wind was a light southerly. Cridge added that he could see breaks in the cloud to the south over the bay.

"Weather received OK," announced the captain, adding "We may require a bearing from you later. We're about to enter the overcast at 4000 feet."

Shortly afterwards Cridge called the DC-2 again.

"Did you call for a bearing?" he asked. He had been interrupted after his last transmission to the Kyeema by an Ansett Lockheed 10 calling with a position report. It had jammed a further transmission from the Kyeema.

"Yes – what is the barometer, please?"

"Barometer 29.88. If you want a bearing, keep your transmitter on."

The Kyeema acknowledged the call but did not leave its transmitter on. At 1.59 p.m. Cridge called the DC-2 again: "Kyeema, what is your position? Transmit while I take a bearing."

There was silence. Cridge had lost contact with the Kyeema.

Captain Webb would have had only a few seconds' warning of impending disaster. The thick fog had reduced visibility to 50 yards. Had the plane been 150 feet higher, or slightly to the left, it would have cleared the mountains, but, instead, it struck the highest peak. The Kyeema had overshot Essendon aerodrome by about 30 miles.

Some men clearing timber nearby heard the sound of the plane coming from the west. The sound grew louder until it became a roar. Then came a sudden screeching and a terrific, smashing metallic sound followed by a great explosion. After this there was silence. Rushing through the fog into the thick bush the men were guided by the strong smell of burning. Fifty yards ahead, and just a little way down the slope, flames were rising among the trees.

The sight that greeted them was terrible. The propellors of the plane had sheared the tops of the trees for about fifty feet before the wings had been torn from the fuselage. The remains of the aircraft lay crumpled on the ground. It had burst into flames on impact and all except four of the bodies, which had been thrown clear, had been incinerated. The only recognisable portion of the plane, the tail section, had cut into the trunk of a tree. However, the pilot's log book had escaped the flames; it had been thrown 25 yards away from the wreckage. Everybody on board had obviously died instantly and there was nothing anyone could do. Soon more people appeared on the scene, as the noise of the impact had been heard for miles around. Then came police and ambulances and, eventually, the investigators from the Civil Aviation Board.

The investigation revealed that the Kyeema had approached Essendon from the north-west. It had let down into the mountain at the very moment that its crew were expecting to break out of the cloud over the aerodrome. It was realised that the course they had flown was in reality a few miles north of the direct line between Parafield and Essendon. Thus, the Kyeema's report that they were "passing Daylesford" was probably incorrect. It had more likely been Sunbury or Gisborne, towns easily mistakable for Daylesford if momentarily seen through a break in the cloud, though 20 miles closer to Essendon. From this information the enquiry came to the historic conclusion that Flight Checking Officers should be appointed. They would work alongside the radio operators, monitoring the progress of airliners in flight and advising pilots on the weather, alternative aerodromes and their position in relationship to other aircraft.

It was decided, too, that better radio-navigational equipment was needed. In those early days radio-navigational aids were quite in their infancy and there were no 'beam' radio ranges in Australia. To establish his direction a pilot contacting an aeradio station would have to hold down his morse 'key' to send a continuous signal. Cridge requested that Webb leave his transmitter on to obtain a bearing. This would then be passed on to the aircraft. However, it was not possible to know the aircraft's distance from the station. There were two classes of bearings – first class accurate was to within 2-3 degrees and second class could be anything from 10-50 degrees out. In conditions of heavy rain, ice and snow (when accuracy was essential) the bearings could be 180° out! In the case of the Kyeema, the aircraft was east of the station and the bearings showed it as west.

Not only was the equipment deficient but it took time to get a bearing. This, naturally, was not convenient for a fast-moving aircraft and, often, the radio operator on the ground would be busy communicating with other aircraft. If the newly-developed VHF radio navigational system had been in operation on the day of the crash the pilot could have simply 'followed the beam' and the instruments would have shown him automatically that the aircraft was over the top of the aerodrome. So from the enquiry came action, with a radio beacon system that gave pilots instant, accurate information on their course.

It was, therefore, through the horrendous accident 50 years ago on Mount Dandenong, that Australian aviation was brought into line with the latest developments in Europe and America. The new air traffic control system eventually made Australian airline operations among the best in the world. But one wonders whether all this would have happened if those eighteen people hadn't died on the mountain, in particular the tipped-to-be Prime Minister, Charles Hawker. eti

ANNA GRUTZNER

With the advent of a new generation of nuclear powered submarines, naval experts were ready to relegate conventionally propelled vessels to the pages of the history books. Now, important developments in conventional propulsion have forced them to rethink. Anna Grutzner examines the merits of both.

HORSES FOR COURSES

There was a time in the not-too-distant past when naval experts were predicting the new generation of nuclear-powered submarines would relegate conventional propulsion to the history books.

Electric-diesel and other conventional systems would be used only by smaller navies with tight defence budgets or those operating under the political constraints of anti-nuclear government policies.

Certainly both factors were at play in the Australian Government's decision to build six diesel-electric, Swedish-designed Kockums Type 471 submarines, at a cost of $3.9b, at the Australian Submarine Corporation's Port Adelaide dockyards.

But developments in conventional propulsion and problems with nuclear-powered vessels have proved the prediction of redundancy for conventional submarines false. Moreover, the suitability of the Type 471 for Australian conditions illustrates the point that there are horses for courses.

In Australia, the nuclear-powered option was never fully canvassed before the 1987 decision to go conventional. The Federal Opposition toyed with the concept in its defence policy, but even within the Coalition parties, critics argued a defensive regional power like Australia did not need the roaming capability of nuclear submarines. However, the Chief of the Defence Forces, General Peter Gration, has subsequently suggested the generation replacing the Type 471 in the 21st century may be nuclear-powered.

Respective merits

It is worth briefly examining the respective merits of nuclear and diesel-electric powered submarines. Nuclear is faster, deeper and more enduring than diesel-electric – major capabilities that cannot be ignored. It can operate under ice, and, in the case of the stragetic missile-carrying SSBN, is able to sit noiselessly waiting for its prey, as hidden as the proverbial needle in the haystack.

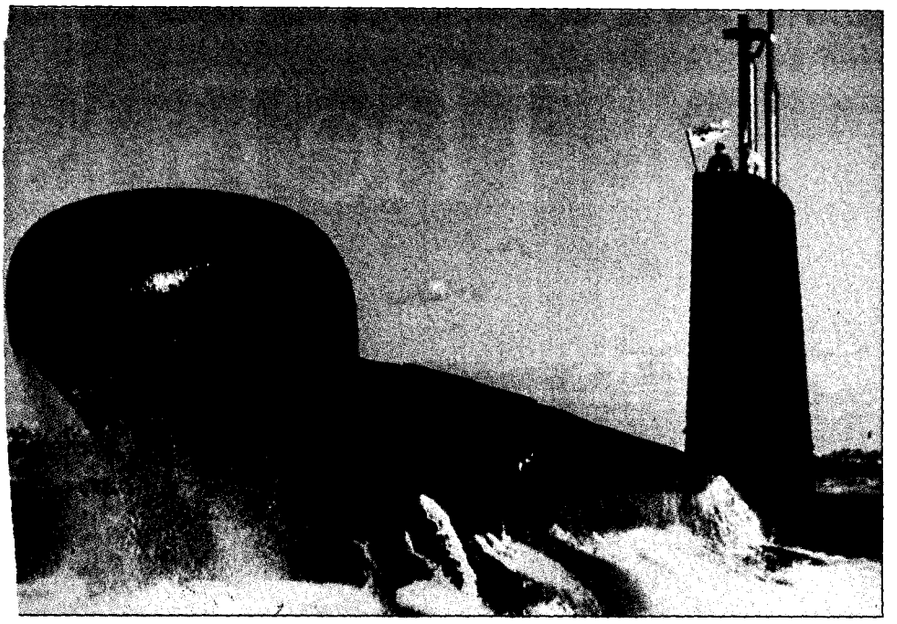
However, diesel-electric is still quieter, and in the submarine game, stealth is just about everything. Being smaller, and with lower thermal and magnetic signatures than a nuclear submarine, the diesel-electric is less vulnerable to active sonar or most other forms of detection.

It also functions better in shallow coastal waters, such as those surrounding much of Australia, because it has better control at very slow speed. Inshore reconnaissance is one of its most effective uses. The diesel-electric is cheap to run both in terms of maintenance and crew. The RAN will be capable, with the Type 471, of making 70-day patrols with 41 submariners – 22 less than required to man the Oberon-class boats.

> ***'The spate of nuclear submarine accidents has made the environment case all the more compelling'***

Ironically, the attention paid to combatting nuclear-powered submarines has made conventional submarines an unexpected headache. The equipment, training and tactics of NATO's anti-submarine forces are now geared so much to detecting the noise of a nuclear submarine that intensive radar surveillance for conventional boats has been neglected. A small electric submarine, which can be almost noiseless, often travels undetected.

The Achilles' heel of the conventional submarine is its need to resurface at regular intervals in order to snort, or recharge its batteries, thereby being forced to expose its masts and to run on noisier diesel engines. Developments in passive sonar mean the submarine can be warned at the surface of nearby surface vessels or other submarines. High sensitivity ESM receivers can also provide a measure of warning of airborne



An Oberon-class submarine — they require 22 more submariners than to man the Type 471.

threats. However, the greatest single hope for conventionally-powered submarines is the research being conducted into anaerobic, or closed cycle, propulsion systems. Important developments in this field will be discussed later in this article.

Cost is the other critical factor in the balancing act between nuclear and conventional. The cost of a diesel (A$650m per vessel in the case of Australia's purchases, or nearly half that for bigger production runs elsewhere) is modest compared with that for the US state-of-the-art SS-N21 SeaWolf attack submarine (US$1.7b for the prototype and US$1b for each subsequent) entering service at the same time as the Type 471 in 1995.

Even in this era of glasnost, and despite the squeeze the new Soviet policy is putting on Western defence budgets, Western navies remain acutely aware of the importance of retaining the technological edge on the Soviets. The USA no longer holds a commanding lead in the area of SSNs and it is watching closely Soviet development of the long-known but unexploited technology of magnetohydrodynamics. While the West has understood the technology for more than 25 years, it has never built a magnetohydrodynamic submarine.

A 'ripple motor' or underwater jet sucks in water at one end of a tube, through a diaphragm and out the other end, causing the ripple effect which propels the submarine through the water. Some Victor III, Sierra and Akula-class submarines are fitted with the pod-shaped fixture on the after-fin that Western experts speculate houses the electro-hydrodynamic system. Requiring no propellor makes the vessel infinitely quieter than earlier Soviet boats, thereby giving it a huge anti-detection bonus. However, the system may simply be used as an auxiliary propellor for low-speed travel during sensitive close-range operations. It could be shut off and switched over to normal protection systems at higher operating speeds.

The priority given to particular improvements in nuclear submarines will probably shift in the coming years. They may not go faster or deeper; the design limits of pursuing those goals have already been stretched to the limit. The new technology will be more likely to produce boats with smarter electronics. Noise elimination will be another major goal.

The blowout in cost to build the latest nuclear-powered submarines is a fundamental reason for the change in thinking. The US Administration, for example, had problems getting Congressional approval for its US$1.76b SS-N21 SeaWolf submarine. Congress was not convinced the new class of attack submarine had the added capabilities which warranted its cost, and argued the US Navy should look more closely at a mix of nuclear and new generation diesel-electric submarines.

The Canadian experience with acquiring nuclear-powered submarines is an interesting lesson to Australia and other medium powers. In April, the Canadian Government scrapped an $8b scheme, which had been some years in the pipeline, to construct eight SSNs. The decision was taken in the context of a severe general cutback to defence spending because of the country's budget deficit, though the controversial project was hardest hit.

Traditional trade rivals, Britain and France, whose experience with nuclear propulsion dates back to the 1950s, fought a fierce tender competition for the contract. However, both the British Trafalgar and the French Rubis-Amethyste lost to budgetary considerations, as with many proposals to build nuclear-powered submarines in the future.

Canada drifted into the nuclear club in fear of Soviet exploitation of the Arctic icecap. It decided to discourage Soviet SSNs and nuclear ballistic missile submarines using the Arctic, much of which is Canadian territory, by upgrading its own under-ice capability. Conventional submarines and surface vessels are simply no match for nuclear submarines in this environment.

Moreover, Canada's navy straddles both the Atlantic and Pacific Oceans. In that respect it faces similar coastal water surveillance problems to the RAN, which must also travel huge distances to relocate its fleet. However, Canada has the added difficulty of having to transfer submarines from one coast to the other via the frozen Arctic route. For the US Navy, which travels long distances between home bases and forward operating areas, the nuclear option was not negotiable.

Political lobby

The political lobby against nuclear propulsion has, certainly in the West, placed extra pressure on navies to explore thoroughly the non-nuclear options. While the Australian Government says it ruled out nuclear propulsion on its own merits for the Oberon replacements, it is no secret the left-wing of the ALP and much of the ALP-voting electorate would have fought nuclear submarines to the death.

The spate of nuclear submarine accidents in recent years has made the environmental case all the more compelling. The Washington-based Insititute for Policy Studies and the environment group Greenpeace say there are at least 50 nuclear warheads and nine nuclear reactors lying on the seabed as a result of incidents.

Many nuclear submarines are reaching the end of operational life and the disposal of their nuclear reactors also has become a sensitive issue. The Royal Navy in Britain, for instance, is considering dumping its decommissioned nuclear submarines in international waters, most likely in breach of the international convention on sea-disposal.

With six known major accidents involving Soviet nuclear submarines – the latest in April

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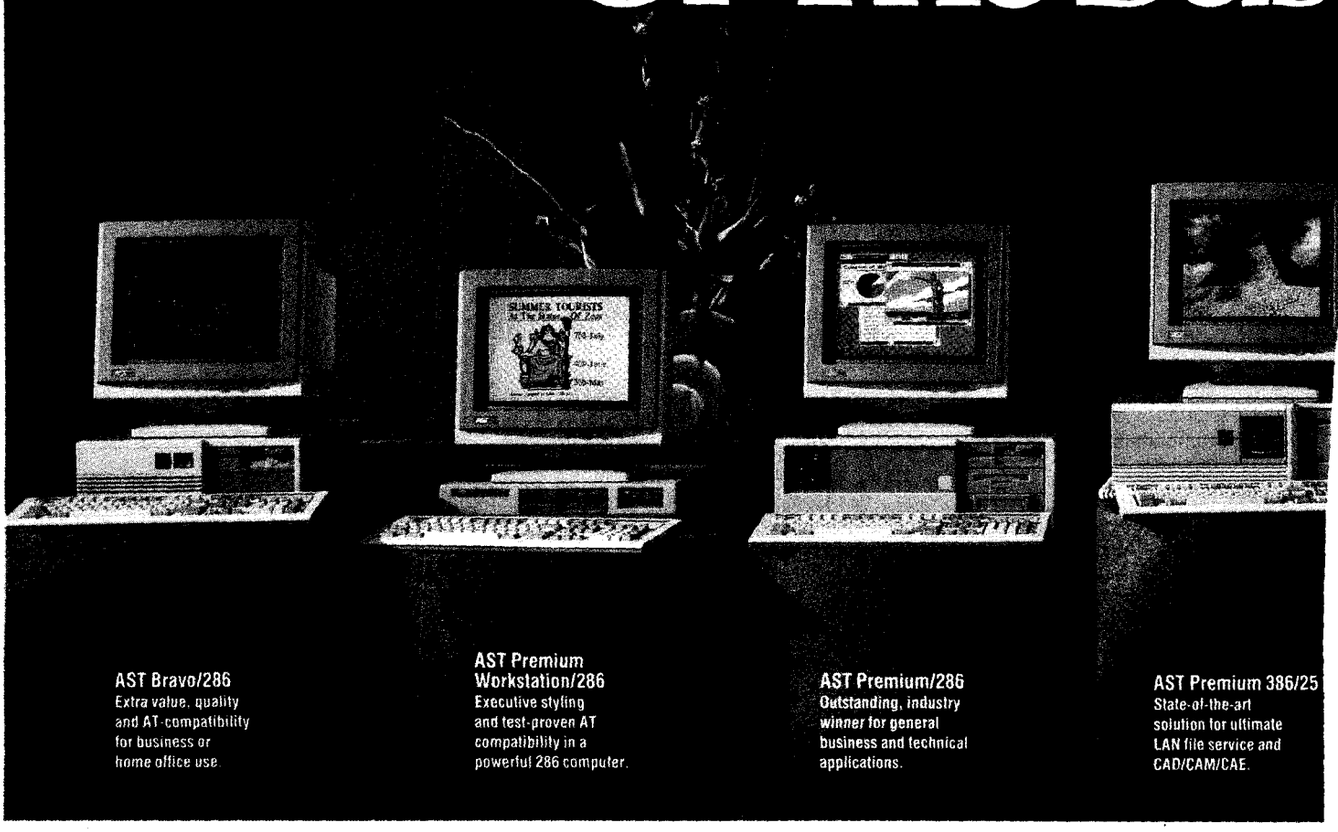

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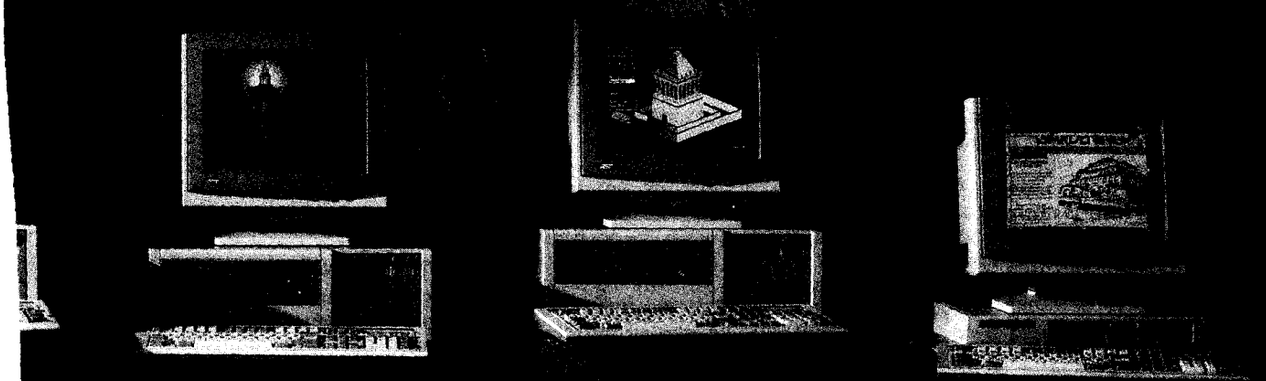

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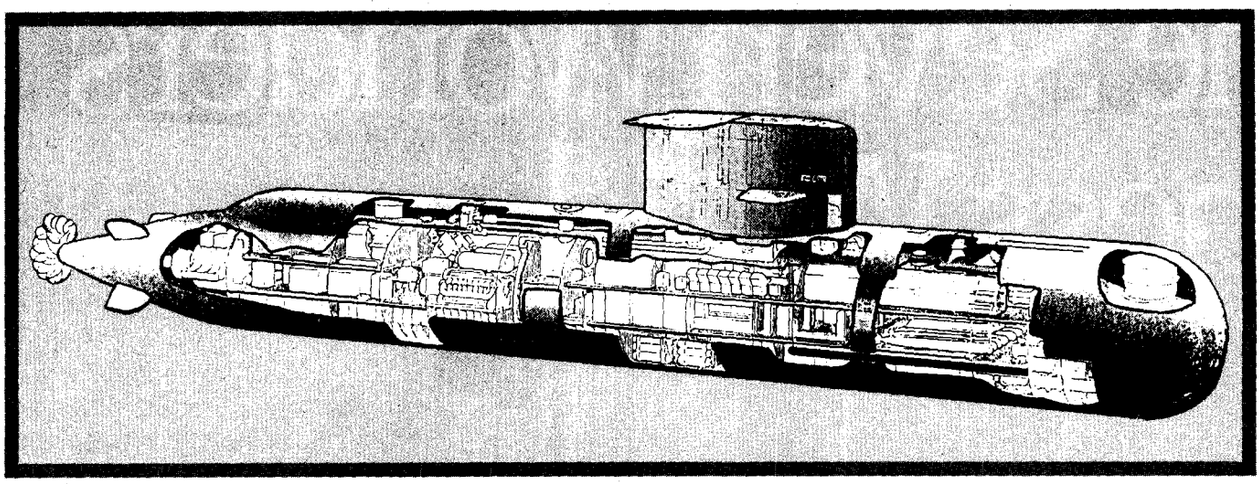


Artist's impression of a cut-away section of the Type 471.

when a 9700-ton Mike-class boat sank near Norway – the Soviet Union's nuclear technology and safety procedures are seriously under question. The sole Mike-class boat in the Soviet fleet, which was the biggest hunter-killer submarine in the world, was powered by sodium-cooled liquid-metal nuclear reactors. Liquid coolants require a more volatile process to create nuclear energy and the reactor can be taken to far higher temperatures, thereby producing far more thermal energy. Powerful and efficient as they may be, they are also regarded as an extreme safety hazard.

The Russians have stuck with the technology long after it was abandoned by the US Navy. The quantities of radioactive material used for nuclear propulsion are less today than in older submarine models, and their reactor compartments are better sealed. However, had the fire on board the Mike spread to the reactors, and the sodium coolant come into contact with seawater, the reactor may have exploded, dumping its radioactive components into the sea.

Progress being made in research to extend the submarine capacity of conventionally-powered vessels augurs well for their future viability alongside nuclear-powered submarines. Most major submarine constructors are investigating the options for anaerobic propulsion, that is, systems, operating independent of air.

If a boat is moving relatively slowly, the new system would reduce the need to snort at the surface in order to recharge the batteries to every few days. The strategic implications of such technology are obvious – conventionally-powered submarines will be capable of staying underwater longer and of diving slightly deeper, thereby reducing the vulnerability that comes with the need to be at or close to the surface.

Typically in an anaerobic system, oxygen and steam are formed by a catalyst breaking down an oxygen compound such as high test peroxide. The gases then are combined with ignited oil fuel in a combustion chamber, as well as water, which increases the volume of gas and reduces the temperature. The gas is pumped into the turbine to provide power and then to a condenser to separate the water and gases. The end product is mostly carbon-dioxide and is discharged into the seawater.

The Swedish Kockums group has been testing the limits of anaerobic propulsion with Stirling motors for nearly 5 years, in the belief that they offer the best short-term prospects for attaining closed-cycle diesel, combustion

'In the submarine game, stealth is almost everything'

or powerful battery powered. The Stirling system separates the centre of thermal heat production from the motor itself to minimise the risks of overheating and corrosion. Thermal energy is thus transferred from the combustion chamber to the diesel in separate pipes.

The Swedish Navy's initial testing shows an improvement of at least five times in the diving capacity of a 1000- ton attack submarine equipped with Stirling propulsion and with half its batteries replaced by liquid oxygen. However, Australia's new Kockums Type 471 submarine will have a single Jeumont-Schneider electric propellor powered by three diesel engines.

British engine manufacturer, Cosworth Engineering, has devised the Argo engine which operates on recirculated gas using an ordinary diesel turbo-compressor. It also has refined the concept to reduce the amount of water required, as the pump for the water itself draws on valuable energy supplies. The system is capable of discharging the waste products to the equivalent pressure of 500 metres depth. Cosworth claims the Argo allows a diesel-electric submarine to sail and dive with acceptable noise levels for three weeks.

Limited success

German and Dutch experimentation with the closed-cycle diesel engine and with Stirling engines has been of limited success. Engineers there argue the system requires too many complex accessories and that the manipulation of hydrogen and oxygen aboard a submarine poses other problems.

Still at the experimental stage, another variation on the anaerobic theme is a new Italian-designed Maritalia system. Built into the submarine hull, a network of concentric pipes several centimetres in diameter are filled with liquid oxygen at about 350 times atmospheric pressure. The submarine's diesel engine thus has a long-enduring oxygen supply without having to resurface. The closed-circuit operation even stores the gas discharges until it is safe to dump them overboard.

West German fuel-cell technology is entering service in the West German Navy's submarines. The Germans lead research in this field, which has been under examination for more than 30 years. The fuel-cell system works on electricity being generated – and water being made – by continuously feeding chemicals into a cell and adding a catalyst. The most common type feeds oxygen and hydrogen to electrodes to create an electric current, and the electrified ions produced then combine to form water.

The technology has proved successful when operated at a constant current corresponding to a medium power rate.

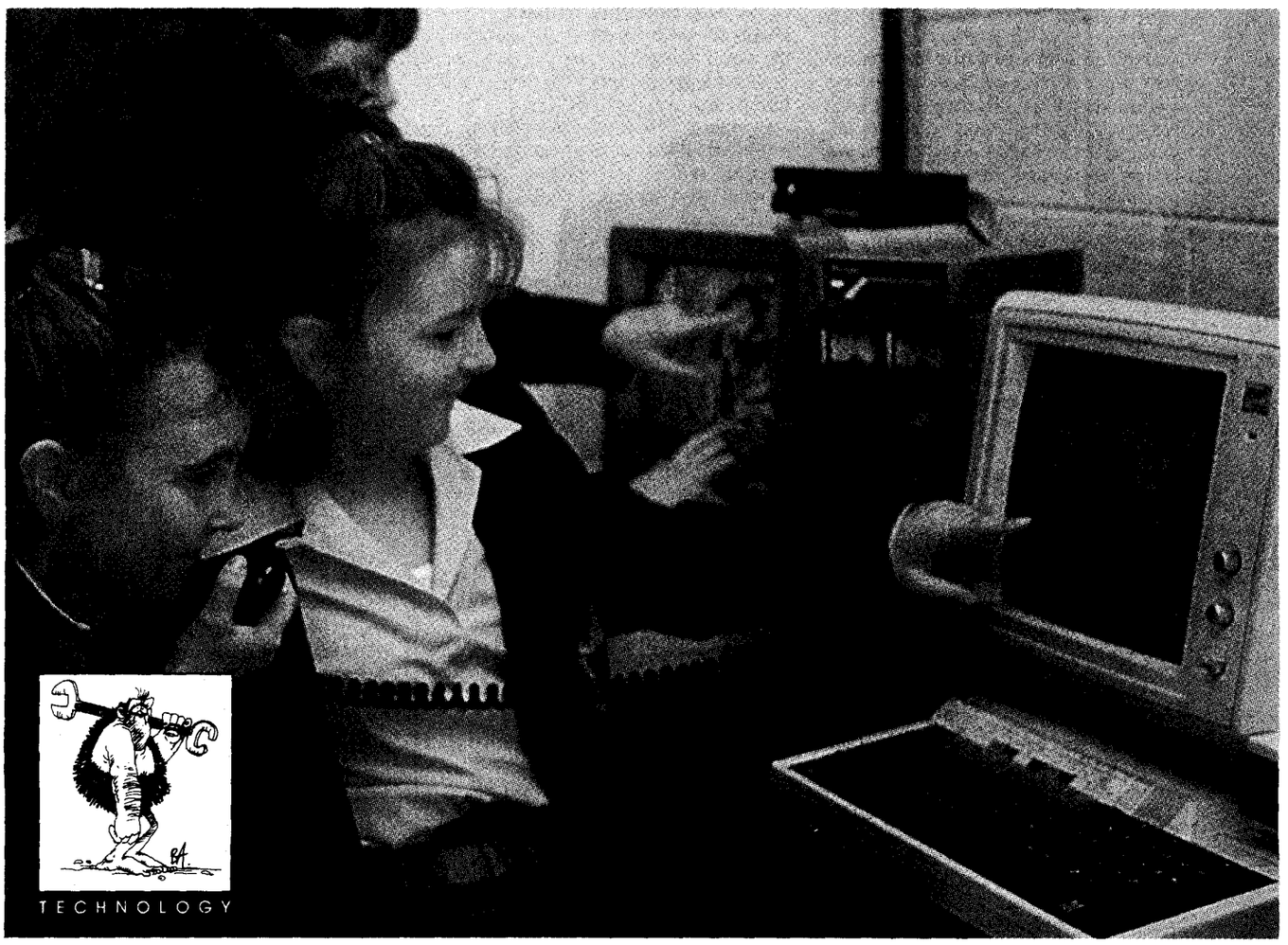
However, its power results under higher rate discharges have meant the best fuel cell systems are hybrids which use a lead-acid battery for high performance. eti

AMATEUR RADIO BENEFITS SCHOOL CHILDREN

This decade has seen the rapid decline of communications skills. Introducing the hobby of amateur radio to schools or groups of school-aged children can remedy this, and can also have tremendous benefits in terms of personal development and scholastic improvement. By Jim Linton VK3PC.

In any class there are students who do not cope well outside their own small group of friends. There are the loner types who do not like team sports and who often lack confidence; although they have the capacity they are low achievers in school.

It has been clearly shown through a number of school programs that when this kind of child participates in the hobby of amateur radio he/she gains confidence and personal esteem. This translates into higher



TECHNOLOGY

Amateur radio figures in the lessons at Mentone Girls' Grammar School in Melbourne, along with satellites and computers, while they learn about physics and electronics. (Photo courtesy Amateur Radio magazine.)

achievement with other school work.

Before being exposed to amateur radio, they do not realise how easily they can make friends. Talking to other amateurs via radio encourages them to open up.

Getting on a microphone and talking to someone over the airwaves also aids students in public speaking and social skills. The sense of achievement in contacting and talking to someone in a foreign country can be very enjoyable and can be a catalyst for a turnaround in their classroom performance.

This practical kind of experience often motivates children who can easily be turned off the study of physics and electronics by a dry text-book approach. For instance, the basics of electricity and magnetism can be picked up more quickly and with enthusiasm.

Studying for and passing the exams to qualify for their own amateur license has at times resulted in students progressing with their school work beyond their teacher's expectations.

Geography is another area where amateur radio can help children, through checking the atlas to locate the countries or towns they wish to contact via the airwaves.

Students can learn about the lifestyles and social aspects of other countries by speaking to people from other parts of the world. Each amateur radio station usually carries a QSL card. Children are thrilled when they receive one from overseas confirming their on-air conversation.

Schools with their own radio station find the inter-school communication is a great means of exchanging information. And the use of a shortwave radio receiver to pick up foreign broadcasts helps in the study of world news events.

Reports of major events from various broadcasters can be compared. For example, the reports on the nuclear disaster at Chernobyl carried by Radio Moscow and the Voice of America differed greatly.

Often in Australia an event will not appear on commercial television unless there is good visual footage. A major foreign event will often be covered in more depth by the shortwave broadcast stations. Current events and media studies can be enhanced this way. The study of foreign languages can also be supplemented by listening to foreign broadcasts.

But there is more to the field than just broadcast stations – a whole host of utility stations, emergency services, air traffic control and a vast range of radio communication users.

The discovery of a wider world through amateur radio by children broadens their horizons. Being able to communicate proficiently through amateur radio is a safety factor on school camps and outings. It can provide an emergency link to help if needed.

Other uses include sending television pictures, using it to link personal computers, studying how signals reach the classroom and venturing into the world of satellite communication. And the cost need not be high. Schools with simple, low-cost equipment are communicating through orbiting satellites or receiving data and pictures from a range of weather satellites which pass over Australia.

An exciting development this year will be Project Dove – an orbiting satellite beaming peace messages supplied by children from the world over.

Whether you are a teacher or parent, your children can benefit through amateur radio. It has provided stimulus to children who, through their exposure to electronics, communications and the application of computer technology, take the step to related work careers.

However, these benefits are being enjoyed by only a few schools which have adopted it as an activity or incorporated it into their curriculum. Hopefully more schools, with the help of radio amateurs, will reap the benefit from this hobby. A list of teachers who are radio amateurs and willing to share their expertise with other teachers is given at the end of this article. eti

Project Dove

Helping teachers take advantage of amateur radio as a teaching tool in the science or social studies curriculum, the Digital Orbiting Voice Encoder (DOVE for short), a micro-satellite, will be launched soon.

It will be sponsored by the Brazilian branch of AMSAT, the amateur radio satellite organisation. As it circles the earth it will transmit digitised voice messages, interspersed with spacecraft engineering data as telemetry on the amateur two metre band. Narrowband frequency modulation will be used on a frequency of 145.970 MHz.

DOVE's first purpose is to provide a creative vehicle for students around the world to express their thoughts about the need for peace on their planet. Tape-recorded messages on peace are being encouraged from schools around the world.

These messages are to be handled via AMSAT and national radio societies. They will be sent to AMSAT command stations and uploaded to the microsat computer in a digitised form. The messages will be broadcast in groups of five on each orbit, and changed twice a week.

DOVE will also act as a scientific and technological teaching tool in orbit. Once it is launched, a teacher's guide is expected to be available from the Wireless Institute of Australia. DOVE's downlink will be easily received on the ground by a simple scanner or receiver, with modest antennas, or by amateur radio equipment tuned to the two metre band.

Satellite images boost school science

Jason, a new remote controlled submarine developed by Dr. Robert Ballard and other scientists at Woods Hole for the US Office of National Research, is operated in conjunction with Argos, a large camera-laden submersible that houses Jason during descent to the sea floor. Together, they telecast images via satellite back to thousands of US school children and to museums.

This has enabled 200,000 children so far to observe the excavation of a well-preserved Roman ship. The images came from the Pliny Sea Mount, an active volcano in the Tyrrhenian Sea area of the Mediterranean where researchers found the ship.

Dr Ballard, who is supervising the exploration, has suggested that there could be more ships. Artifacts from ancient times have been found over a 32 km sq radius. The technology is arranged so that the students can not only see what is happening but can also ask Dr Ballard questions, and hear his answers.

According to authorities, since this project has been underway, demand for science subjects, which have been virtual non-subjects in US schools, has jumped by over 200%. They have been further boosted, it is said, by the coincidence of the flight of the Atlantis space shuttle and its dispatch of the Magellan probe to Venus.

Sponsoring the Jason Mediterranean project is the National Geographic Society. It is planning a TV documentary of the affair for broadcasting next year.

TEACHERS' ASSISTANCE

Ron Smith, Science Master, Oakey High School, 6 Cribb Street, OAKEY, QLD 4410.
Paul Butler, Head of Science and Computing, Mentone Girls' Grammar School, 11 Mentone Parade, MENTONE, VIC 3194.
Harry Lodder, Head of Audio Visual Department, Camberwell Grammar School, 55 Mont Albert Road, CANTERBURY, VIC 3126.
Sue Gordon, Science Department, Christ Church Grammar School, Queenslea Drive, CLAREMONT, WA 6010.
Tony Clayton, 10 Wrenswood Drive, QUOIBA, TAS 7310.
Richard Jenkins, 88 Companion Crescent, FLYNN, ACT 2615.
Ken Hargreaves, 52 Marlin Avenue, FLORAVILLE, NSW 2280.
Hans van der Zalm, Secretary WIA, South Australian Division, 16 Central Avenue, HALLET COVE ESTATE, SA 5158.

ELECTRONICS

ALPHA, BETA, BIOFEEDBACK

Biofeedback involves the use of electronic instruments to provide information about your body's responses of which you may otherwise be unaware, and which you may learn to control or change. Biofeedback is being used in relaxation training and stress management, sports medicine and physiotherapy. Roger Harrison reports on the technology and techniques.

Every activity involves some kind of feedback; walking, driving, breathing, etc. Some kinds of bodily feedback are conscious – like when you're driving – some are automatic, such as your heart racing when you're frightened or your palms sweating when you're anxious. Using electronics to parallel or bypass the automatic feedback paths in the body – biofeedback – has a number of applications.

The nature of feedback

When you use a new typewriter, or computer keyboard, your actions will feel different. You know within reason how hard you will need to strike a key on the new keyboard. But the very first time you use it a feedback loop comes into operation. The nerves in your fingers will signal your brain that the force needed to be used on the keys is greater or lesser than you anticipated. Your brain will then signal your hands and fingers to increase or decrease the force applied as necessary. Within a very short time, your response becomes automatic.

When you try to open a cupboard door, applying a certain amount of force, and it is stuck, feedback tells you that more force is required. So you apply more. This is called external feedback.

Playing a violin involves several feedback loops, both aural and physical. You have to place your left hand fingers to obtain the correct note when a string is held against the fretboard. You also have to apply the correct force with the right hand and arm to produce the required length, loudness and timbre of the note. Aural and physical feedback are at work here.

Essentially, feedback can be represented as a system such as that shown in Figure 1. An action is started (do something), a controller causes the action and some

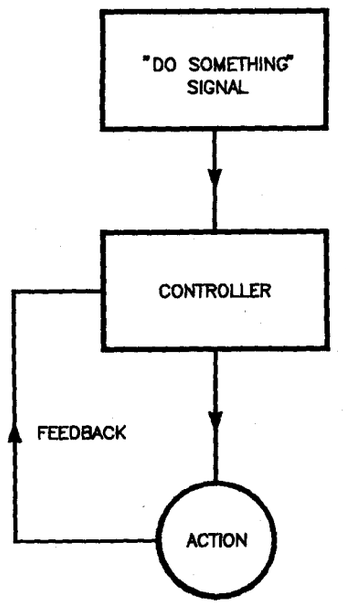


Figure 1. The essentials of a feedback system.

connection path back to the controller modifies the controller's operation.

There are a large number of automatic internal feedback systems in the human body. Together, they are termed the autonomic nervous system.

Whenever you increase your exertion, your autonomic nervous system increases your respiratory rate. When you walk from a lighted house on a dark night, your pupils automatically dilate – open up – to let in more light.

When you get a fright, a host of internal bodily feedback systems are activated; your adrenal glands release large amounts of adrenalin into your blood, your heart rate increases, the pupils of your eyes dilate, and so on.

Your body also has an effective feedback temperature control system. If you get too hot or too cold, the brain instigates a variety of changes to stabilise your temperature.

When you get too hot, the blood vessels just beneath your skin will widen to lose heat, a process called vasodilation. At the same time, your skin will sweat so that it cools by evaporation.

When you become too cold, the same blood vessels will narrow, this process being called vasoconstriction, to reduce heat loss. If it continues, goose pimples will appear, and your muscles will shiver, improving blood flow and producing heat.

Early investigations

Since the turn of the century, various researchers have examined how our physiological system works. There have been many attempts, particularly in the past two decades, at teaching people to control parts of their autonomic nervous system by

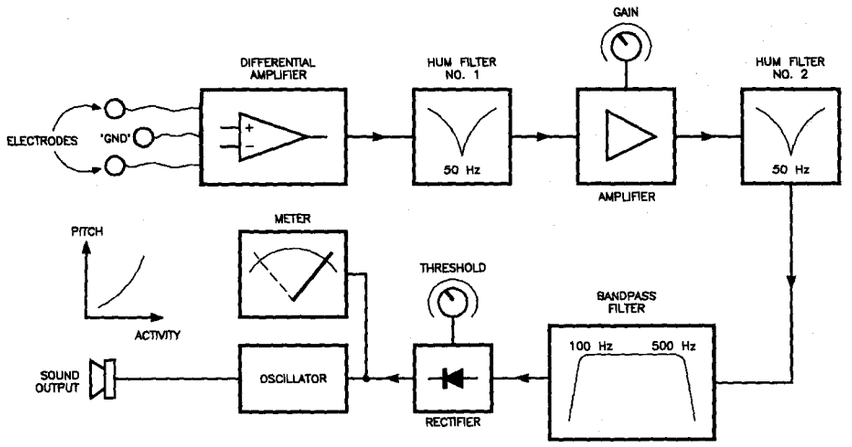


Figure 2. Block diagram of the general arrangement of an electromyogram biofeedback instrument, or EMG, fully explained in the text. To get good contact with the electrodes, a conductive paste is generally applied to the skin. A build-it-yourself EMG project was described in ETI in the September and October 1979 issues (ETI-576). The meter and sound output show muscle activity level, the indications decreasing with decreasing activity. Sensitivity can be such that you can detect muscle activity although no visible activity is discernable.

external feedback from sensors or instruments connected to the body. In 1901, a psychologist called J.H. Blair observed how subjects learned to control muscles by mental command. He taught them to wiggle their ears.

This is difficult for most people because these muscles are often long-disused. Blair amplified the tiny muscle movements with a crude mechanical chart recorder, rewarding his subjects' efforts with movement of a pen on a chart. This could probably be considered the earliest documented biofeedback experiment.

During the first half of the 1960s, a Dr J. Basmajian looked into the ability of subjects to control the motor units which are responsible for muscle contraction. But before we go into how this works, let us look at how the body's muscles work.

Muscle fibres

So, how do muscles act and how do we control them? To understand that, we first need to look at how they're made up and what makes them work.

A muscle consists of long, thin cells, called muscle fibres, which are bundled together. Embedded in each one is a motor nerve ending. A motor unit within a muscle is made up of some 100-500 muscle fibres, each controlled by a motor nerve cell.

Each muscle fibre contains interlocking strands of two different proteins – actin and myosin. When an impulse from the brain reaches a fibre, a chemical transmitter is released. This releases energy into the cells, causing the strands of actin and myosin to move closer together. The muscle contracts, becoming shorter and fatter.

Contraction actually results from the rhythmical discharge of the motor nerve cells; the more units that are activated among the hundreds comprising a muscle, the greater the intensity of the contraction. Each nerve impulse in a series generates a brief cycle of contraction in the related muscle fibres.

Certain conditions will bring about synchronisation of the rhythms of many muscle motor units or groups of units, resulting in muscle tremor.

Myo-electricity

What Dr Basmajian did was to insert tiny needle electrodes under the skin of his subjects to contact a large number of motor units. The contacts were hooked up to an oscilloscope.

The motor unit firings resemble random noise. However, traces of single rhythms can be discerned and, with practice, Dr Basmajian's subjects were able to recognise single motor unit firings and to control them at will. This represents control over a single body cell in isolation through biofeedback.

His work led to myo-electrically (muscle-electrically) operated prosthetic replacement parts for people who have lost the use of hands or arms, through birth defects or accidents.

Dr G. Shannon of Queensland University produced a myo-electrically controlled hand in 1978. The device was remarkable in that it gave sensory feedback regarding the strength of grip provided by its electric motor drive. A set of strain gauges attached to the mechanical fingers provided a sense of touch. The sense of applied force was provided by biofeedback from an electromyogram (EMG).

The electromyogram is a device which amplifies a muscle's electrical nerve activity, converting it to a control signal for the motor. The muscles in the forearm to which the EMG was attached were those previously used for controlling movements of the fingers.

EMGs (with aural and/or visual feedback) and electromyographs (with chart or graphic output) have been in use for some time. These instruments can give a more graphically direct indication of the body's state of tension or relaxation than other methods, but are generally more complex electronically and operationally, with perhaps the exception of so-called brain wave monitors.

The EMG

The electrical signals generated from muscle activity arise from the motor units attached to the muscle fibres, as we saw in the Basmajian experiments. A large number of motor units fire to contract a muscle, but they are not synchronised. Thus the electrical signal generated resembles amplitude modulated noise extending from under 100 Hz to about 1 kHz.

Studies of the myo-electric signal have indicated that it appears to be a weighted sum of the tiny electric potentials produced by the motor units, modulated in amplitude, the signal as a whole therefore being a function of the number of motor units, their rate of activation and how good a contact is made with the skin.

A typical arrangement for an EMG biofeedback monitor is shown in Figure 2. The muscle motor unit firings are picked up as a differential (that is, the potential difference between two points) signal by a pair of electrodes placed on the skin, with a third contact to provide a ground reference. The myo-electric output of a relaxed muscle is in the order of a third to one microvolt or so peak-to-peak.

The EMG has to sort this out from the other electrical activity taking place on the skin. In addition, hum induced on the body from the 50 Hz ac mains can be volts in amplitude which can swamp the instrument's input stage; hence it must have a wide dynamic range.

The input stage is immediately followed by a 50 Hz hum filter to reduce the hum's effect on following stages. Further amplification and 50 Hz filtering is provided to bring the signal level up so that it can be more easily dealt with. The amplifier gain is made variable to vary the instrument's sensitivity.

A bandpass filter following the amplifier brings out the motor unit signals, the strongest signals lying in the 100-500 Hz frequency range. The signal is subsequently rectified to provide a dc output proportional to muscle activity.

A threshold adjustment may be provided here, so that, with relaxation, as muscle activity declines, the threshold can be

gradually lowered. This gives some indication of performance from session to session with the instrument.

Most EMG biofeedback instruments provide either an aural output and/or a meter, for visual feedback. An integrator may be switched in, or permanently wired-in, to average the feedback response. Typical integration times range between 0.5 and five seconds.

With aural feedback, a low-pitch tone or low repetition rate pulse is used. The pitch or pulse repetition rate decreases with decreasing muscle activity. Some EMGs these days also include a computer interface to display your response on the computer's screen and to store data for later comparison.

The electromyogram has proved useful in the study of diseases. For example, poliomyelitis, which reduces the number of motor units, and diseases that diminish the number of muscle fibres in a motor unit, as happens with muscular dystrophy and myasthenia. EMGs have also proved useful with diseases that abolish the nerve supply leaving muscle fibres to spontaneously twitch, weakly and independently, rendering them useless.

EMGs are used in research for monitoring muscle activity. They are also widely used in medical applications for relaxation (anti-stress) training, sports physiology, and for the relief of migraines, tension-related muscular aches, hypertension, etc.

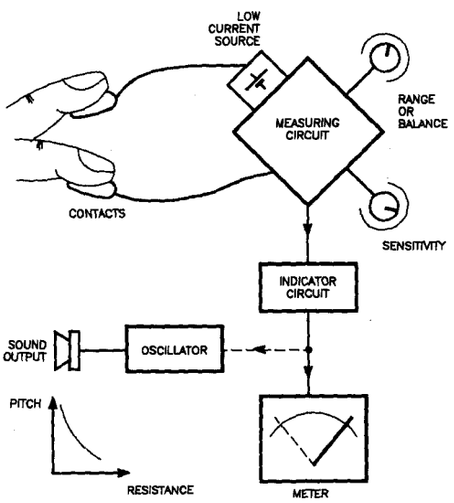


Figure 3. General arrangement of a Galvanic Skin Resistance meter, or GSR. Both meter and sound output may be used. A very low current is passed through the skin (you can't feel it) — usually between two fingers or in the wrist area. The range or balance control is set to bring the reading on-scale because actual skin resistance differs widely from person to person and time to time. Sensitivity is adjusted to show the required response.

Skin resistance

Experiments in the past forty years with sensitive measurements of electrical responses of the skin to direct and indirect stimuli showed that skin resistance, temperature and emf all showed reactions. Subsequent research showed that, with feedback from measuring these quantities, subjects could learn to control these parameters.

The skin is a remarkably sensitive organ. It is quick to react to stress. The layer immediately under the skin's outer surface, the dermis, undergoes quite large and readily measurable changes in electrical resistance (or, conductance, if you like), regardless of whether the tension is localised or general or where it may be centred. If you measure the skin on your forearm and tense your neck muscles, a similar reaction may be gained from tensing your calf muscle.

One simple biofeedback device which grew out of this research was the Galvanic Skin Response or Galvanic Skin Resistance instrument, generally referred to as a GSR meter. This instrument is used predominantly in stress relief and tension reduction.

GSR, originally termed psychogalvanic reflex, is now referred to as an electrodermal or skin electric response. It refers to a transient change in certain electrical properties of the skin related to sweat gland activity.

The skin of a relaxed person has a low electrical conductance and therefore high resistance. When a person is stressed or otherwise agitated, their skin has high electrical conductance, that is, a low resistance.

A GSR meter, shown in block diagram form in Figure 3, is simply a wide range ohmmeter. Two electrodes connect to either the forearm near the wrist or between two adjacent fingers on one hand. Feedback may be via an analogue meter (visual feedback) or via an audible pulse or tone (aural feedback), or both may be used. Some manufacturers provide an output that may be interfaced to a computer so that results may be graphed on the computer's screen as well as stored for later comparison.

Skin resistance differs widely from person to person and with your activity, general state of health, etc. Thus a range control is provided to obtain an initial on-scale reading. The sensitivity is then adjusted to allow the meter or output to give the required response. As the indication lowers, the range is adjusted to bring it back on-scale.

Skin resistance rises with decreasing muscular tension but, as one associates a decreasing indication with decreasing activity, the feedback tone or meter reading is arranged to decrease with increasing skin resistance.

GSR meters are easy to use, but it is impossible to get a benchmark against which to measure other responses. This is because a whole host of physical, physiological and psychological influences cause variations from day to day, hour to hour. The response gained from using this device is therefore never the same twice.

But that doesn't matter, as what you are looking for is a change. The object during each session of use is to cause a decreasing indication and, with repeated use, you can train yourself so it takes less and less time to bring about a marked decrease in the GSR.

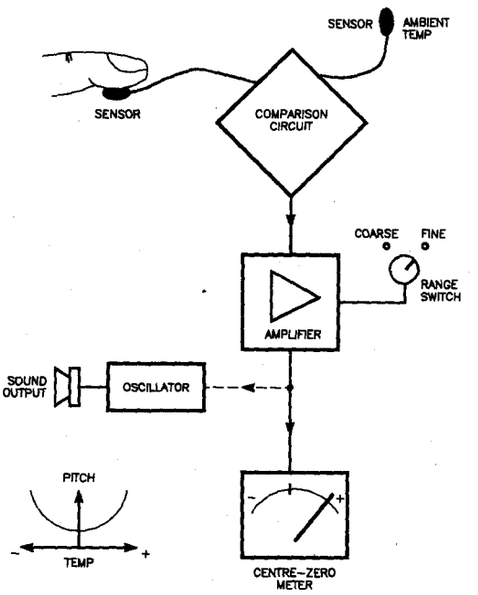
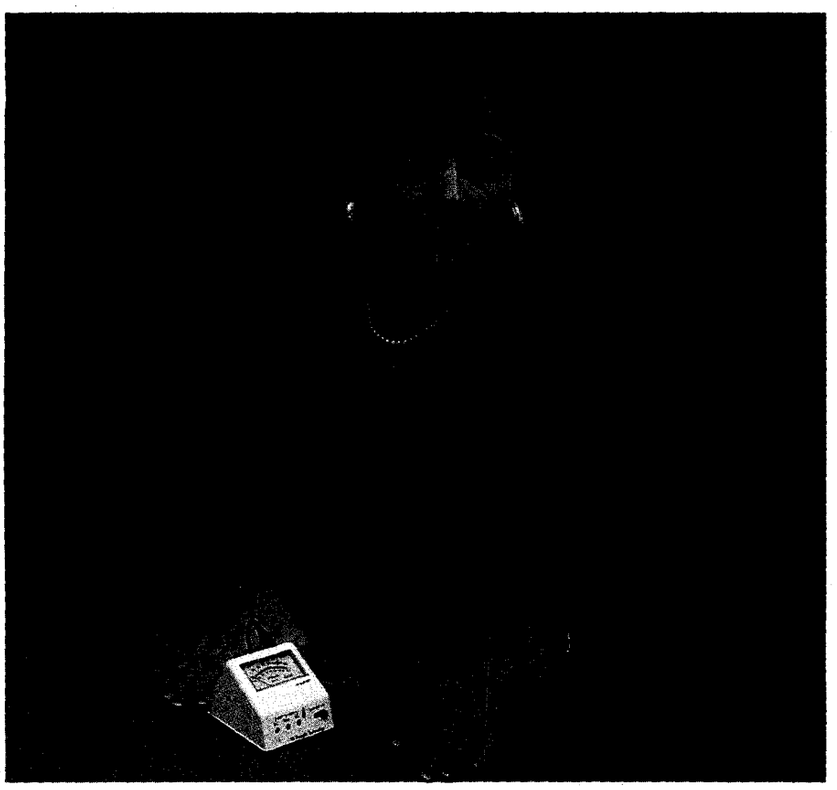


Figure 4. Diagram showing how a skin temperature biofeedback instrument works. Two sensors are used, one measuring ambient temperature, the other measuring the temperature of the skin in the area where it is located. The two sensors' outputs are compared, the differences amplified and applied to a centre-zero meter. Sound output feedback may also be provided.

Hot heads, cold feet

The skin is a remarkable barometer of your physical and mental state of being. To take an extreme example by way of illustration, your epidermal temperature drops sharply when you get a fright. This is due to vasoconstriction, as mentioned before and gives rise to the expression white with fright.

Conversely, when you flush with embarrassment or exertion, your skin temperature rises as a result of vasodilation which pumps blood into the immediate area, raising the temperature. The most sensitive areas are those richly supplied with small blood vessels, particularly the hands. Skin temperature of the hands can vary by as much as five degrees Celsius, or more.



Thought Technology of Canada manufactures a range of biofeedback instruments. The Heart Rate and Blood Volume Pulse monitor shown here uses a simple sensor which attaches to a finger. It can detect changes as small as a half beat per minute in heart rate and 1% in blood volume pulse. (Instrument courtesy of the Australian distributor, Innovative Technology).

By measuring skin temperature and providing visual and/or aural feedback, it is possible to train people to consciously raise or lower skin temperature with respect to ambient (room temperature). When you are in a mentally or physically excited state, skin temperature is typically raised with respect to ambient. When relaxed, your skin temperature will approach ambient.

Physiological factors may mean an individual's skin temperature is typically below ambient (below average vasocirculation – the cold hands/warm heart syndrome). Certain classes of headache – migraines and cluster headaches, for example – cause dilation of the blood vessels in a localised area of the head, increasing skin temperature there. The small blood vessels in the extremities – hands and feet – often sympathetically constrict at such times, and the skin temperature there drops. In addition, both cold stress and heat stress affect skin temperature through the autonomic nervous system.

Skin temperature biofeedback devices measure epidermal temperature compared to ambient, generally over a range of around plus/minus three to five degrees Celsius (coarse) and plus/minus one to 1.5 degrees Celsius (fine).

Figure 4 shows the general arrangement of a skin temperature biofeedback instrument. One sensor is placed on the area of the skin to be measured, another sensor measures ambient (air) temperature. A comparison circuit compares the output of the two sensors; any change in the difference between them is amplified and applied to a centre-zero meter which indicates any increase or decrease in skin temperature.

One of the problems of skin temperature measurement lies in the reaction time (thermal time constant) of common electronic sensors – usually thermistors. While their response is linear, their reaction time can be longer than that of the body. Another problem arises in that some subjects' reactions are opposite to that expected!

Temperature biofeedback has been found useful for people who suffer cold hands or feet under stress, as increasing stress levels cause the small blood vessels in the extremities to constrict (vasoconstriction). It is also used to help people who suffer from stress-related headaches, cluster headaches and migraines.

Listen to the beat

The heart does a remarkable job at keeping you going. It pushes blood through your lungs where oxygen is exchanged for carbon dioxide, the re-oxygenated blood then being pumped through the rest of your body.

The rate at which your heart beats, the number of times the valves open and close each second, is related to the metabolic requirements of your body. In addition to psychological triggers mentioned earlier, it appears that many physiological triggers also affect the heart rate. Many areas in the brain play a role in determining heart rate and the volume of blood pumped at any particular time.

Because heart rate measurement is indirect – counting the number of beats per unit time and converting that to a rate – it is not possible to establish a benchmark which is universally applicable from person to person.

Heart rate monitors use opto-electronic sensors employing a light source to sense the changing blood density, and hence its ability to transmit light, that occurs with every pulse. The light shines through a convenient area of the skin, picking up the changes in light transmissivity as the pulses of blood course through the small blood vessels.

The finger or ear lobe are good places for heart rate sensing using this technique. Figure 5 shows how it is done. A light shines through the skin. The sensor picks up the small variations of light as it is transmitted through

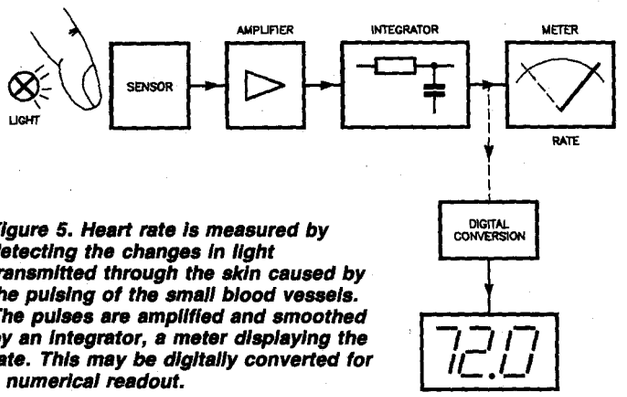


Figure 5. Heart rate is measured by detecting the changes in light transmitted through the skin caused by the pulsing of the small blood vessels. The pulses are amplified and smoothed by an integrator, a meter displaying the rate. This may be digitally converted for a numerical readout.

the skin and small blood vessels. The pulses are then amplified and integrated, or smoothed. With fewer pulses, or beats, per minute the average or smoothed level is low and reflects a low heart rate. With more beats per minute, the smoothed level is higher, reflecting a higher heart rate.

These instruments can also be adapted to provide a reading of relative blood pulse amplitude, measuring the changes in pulse amplitude from the light source. With more blood volume per pulse, proportionally less light is transmitted. Relative blood pulse amplitude is said to be an extremely responsive measure, registering beat-to-beat changes in sympathetic arousal or relaxation much more rapidly than skin temperature.

Many researchers working on relaxation training employ heart rate monitoring to teach subjects using biofeedback. As I have said before, the heart rate slows when bodily tension is reduced. If you can do this at will, tension and stress can be consciously alleviated.

Brain waves

Brain functioning is characterised by a great deal of electrical activity in the cells. As a whole, this activity can be seen as noise, divided into four categories, or rhythms:

- **Alpha rhythms.** These signals range between 8-12 Hz and are associated with feelings of well-being.
- **Beta rhythms.** These are known to be associated with increased attention and/or anxiety, and generally range from 13-30 Hz.
- **Delta rhythms.** These are very low frequency waves, ranging between 0.5 and 4 Hz. Generally they are found when you're experiencing a dreamless sleep.
- **Theta rhythms** also occur in the low frequency range, between 4 and 8 Hz and are found during deep relaxation and meditation.

While this electrical activity of the brain is of low amplitude, measuring a few microvolts, the signals can be quite easily sensed using electrodes on the skin and filters to select the desired brain wave pattern. Figure 6 shows a typical brain wave biofeedback instrument.

A low-noise differential input stage, much the same as used in the front end of the electromyogram of Figure 2, picks up all the signals present. As with the electromyogram, mains-induced 50 Hz hum can be the biggest problem to overcome. Usually two electrodes sense the differential voltages induced on the skin surface with a third electrode providing a ground reference or common source. Muscle activity can generate pulses within the frequency ranges given, possibly masking the desired signals.

Filters select the required brain rhythm signals, attenuating mains hum and other unwanted noise. The selected filter output is further amplified, the output being applied to a detector which drives the visual and/or aural (sound) feedback output. Some recent instruments, like many of the other biofeedback devices, incorporate a computer interface enabling results to be graphed on the computer screen and stored on disk for later comparison.

It is claimed that, through training, you can teach yourself to produce particular patterns at will. Using brain wave biofeedback instruments to induce Alpha wave activity was popular a decade ago.

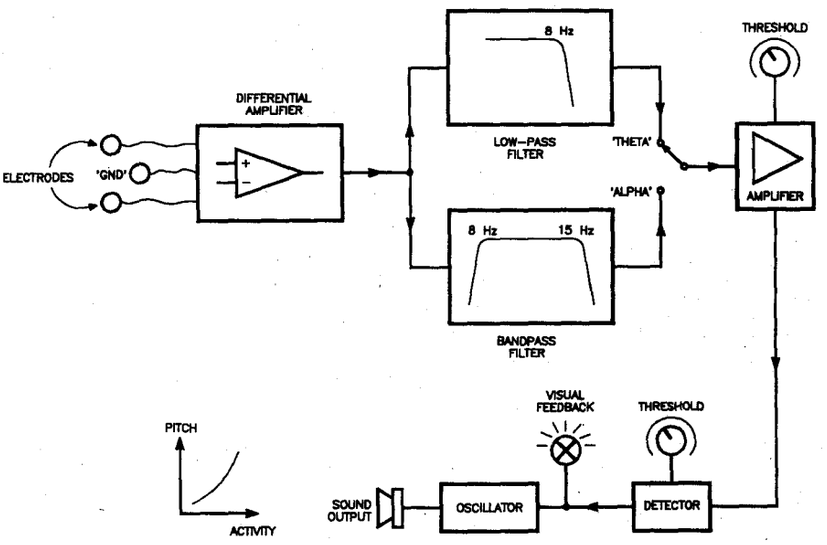
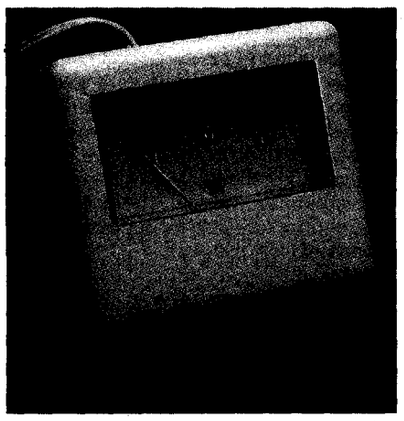
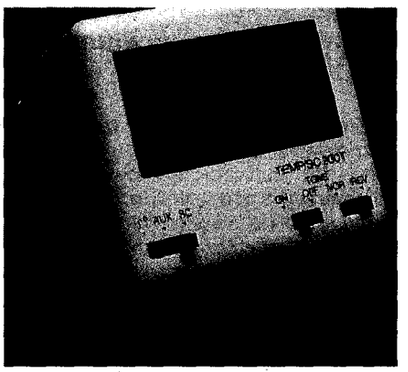


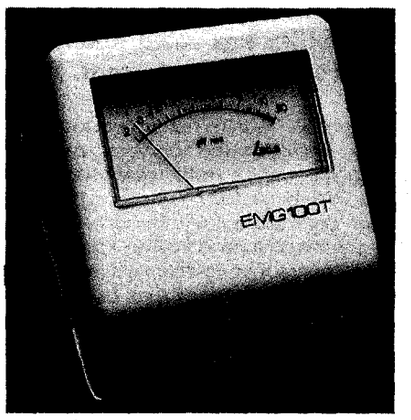
Figure 6. Block diagram of a brain wave monitor. The input stage is similar to that for the EMG. Here, too, a conductive paste is generally applied to the skin to get good electrode contact. Filtering selects the Alpha or Theta waves, as required, attenuating mains hum and other electrical noise. The detector system drives aural (sound) and visual feedback outputs.



Skin Temperature biofeedback meter, by Thought Technology. This model has analogue meter readout.



Thought Technology's digital readout skin temperature meter. It also provides an audio tone output and boasts resolution of 0.1 degree on the readout, 0.05 degrees audible.



The Thought Technology electromyogram features two ranges and audible tone feedback.

TECHNOLOGY

The Army Electronic Tradespersons' Course covers four years.

CAREERS IN ELECTRONICS

There is a serious shortage in Australia's electronics industry. Largely, it's in favour of the aspiring electronics technician or engineer, as there are simply not enough qualified people in the country. There are two options: bring in technicians from overseas, which is expedient but fraught with political and economic consequences; or train young Australians to make up this near-crippling shortfall. Overall, it appears that sensibility has ruled and the latter option is most favoured by the Federal Government. By Gerard Knapp.

This ETI feature has canvassed major employers who train young people in electronics and communications (E & C). As a rule, the amount of information each provided is fairly indicative of their respective attitude to training. For example, the response from Telecom was surprisingly poor, while a company such as Australian Airlines displayed tremendous enthusiasm for its avionics training.

It was encouraging to speak to senior engineers from Australian Airlines and the ABC, who both showed strong commitment to training, including fighting for funds at board meetings. This is good news for students, as it is hard to think of two more interesting employers for the aspiring technician or engineer.

As for private industry, well, its representative body – the National Electrical and Electronics Training Committee – was too busy to supply any information. This is not surprising, as people are rarely in a hurry to divulge their bad news. Industry, generally, offers an appalling level of training in the E & C field. A recent report from Canberra showed that 30% of employers offered no employee training whatsoever.

Pilfering trained technicians and engineers from government instrumentalities is still industry's approach to hiring qualified staff. Understandably, the Federal Government is not impressed and is seriously considering slapping a de facto payroll tax on industry to pay for its cheap-skate attitude to training.

Certainly, it appears that the Government is at least attempting to make training schemes more attractive to companies which claim – some quite justifiably – that they simply cannot afford it.

Hopefully, there are many employers willing and waiting to offer interesting and rewarding training in E & C, and not just rip off the system by using it as a source of cheap labour. But, that's capitalism for you.

Overall, if there is one helpful point to be made, it's that taking the initiative to begin full time study of E & C at a TAFE college will give you a head start in securing a highly sought-after, fully paid-for apprenticeship or traineeship.

Ansett — big hype, no action

Ansett offers "traditional" apprenticeships in the airline business, largely based on becoming a trained aircraft mechanic. This extends to training on the electrical system

of an aircraft, but it doesn't include the sophisticated communications and aircraft landing systems.

These components and the on-ground flight simulators are serviced by trained technicians normally hired from industry or government. A spokeswoman for Ansett said "we get them, no problem" when asked on the availability of these specialised staff.

Apparently the career path for an Ansett aircraft mechanic (electrical) to progress to an electronics technican involves studying relevant courses at TAFE colleges in your own – not company – time. She added that "they earn a little more pay, but there's no incentive from Ansett to progress."

These comments contrast sharply with those from its employee relations manager, Michael Gay, who said that "Ansett has always been dedicated to the youth of Australia and is continually upgrading and expanding its various training schemes to ensure young people receive the best possible on the job training."

However, Mr Gay was extremely short on detail. In fact, there were no specific initiatives announced in his statement, just pure rhetoric, such as the following: "As we head towards deregulation next year it is becoming increasingly more important to ensure staff are trained to the highest possible standard, which will reflect well on both the company and the individual."

As a commercial enterprise, Ansett's priority is profits, not training. Presumably, it offers excellent training for aircraft mechanics at its centre in Melbourne, but this doesn't extend into the more sophisticated – and interesting – avionics area.

From ETI's enquiries, Ansett appears to be seriously lacking in its training of avionics technicans. What it does appear to have is a well-oiled corporate public relations machine, which has been essential for its protected existence.

What is the govt doing to improve your chances?

Serious skill shortages in the electronic and communications industries should ease as training reform policies are implemented, according to the Department of Employment, Education and Training.

The boom in sales of communication, micro-computer and other office equipment, combined with the recent deregulation of the communications industry has led to a critically short supply of computer technicians and tradespeople.

Demand for computer professionals such as programmers increased 100% between 1981 and 1986 and further strong growth is predicted.

Shortages of apprentices in the installation, maintenance, repair and assembly of electrical and electronic equipment were serious following the 1982-83 recession, but should ease as post-recession apprentices qualify in 1990.

Shortages may also be a result of technology phobia, with evidence that young people are not attracted to the industry because of myths about the mystique of computers and high technology.

Industry, unions and Government are co-operating in the award restructuring process to implement training reform to resolve skill shortage problems. These reforms are key factors in improving productivity and international competitiveness, particularly in the electronics and communication industry.

A major problem being addressed is the lag time between identifying industry needs and the development and implementation of training and graduation of trainees, currently averaging six years.

The development of career paths and reform of the current training process will help alleviate the problem, which is hampered by the long-term, rigid training process.

Workers will need broad-based training before specialising into highly skilled areas. Given the dynamic nature of the industry, constant reskilling is necessary.

Education and training investment will increase to support the increasing complexity and range of electrical and electronic work.

People coming out of learning centres are not properly skilled for the continually changing technology, and a major study needs to be made of the available training and its relevance to industry.

The Electrical Trades Union is doing a study into the skills and training required for electronic technicians and tradespeople.

Industry has quite a positive attitude to training, and many large firms run training courses for themselves and their customers. They also demand and pay for outside courses. Small firms tend not to train as the costs often exceed the benefits as the technology changes so quickly.

The National Electrical and Electronics Industry Training Committee (NEEITC) has commissioned a labour force planning survey to identify what training is needed, which will help industry and government develop practical and effective policy and training decisions.

NEEITC is one of 18 industry training committees across Australian industry which comprise industry, Government and

The RAAF offers careers as radio technicians via three different entry schemes.

employee association representatives. They advise on training policy, skills requirements and standards, and develop training programs and facilities.

NEEITC advises education institutions, particularly TAFE, in the development of curriculum and relevant training courses. It evaluates local and overseas courses and advises companies as to the most appropriate.

Another tripartite body, the Information Industry Education and Training Foundation (IIE&TF), is identifying specific skills shortages among information companies and their user firms, with the aim of developing short and long term strategies on education and training to overcome these shortages.

Both NEEITC and IIE&TF are involved in the implementation of entry-level training through the Australian Traineeship System – twelve months on and off the job training in job specific, broad-based and personal/work effectiveness skills.

Electrical manufacturing, electrical harness assembly and electronic assemblies traineeships and the two year computer programming traineeship in NSW are well established. An information technology (software support) traineeship is being implemented in all states this year and a business equipment maintenance traineeship next year.

Higher education places for computer science and information technology students increased 16% in 1989 and extra funds were made available to TAFE for equipment.

Addressing the shortages

Persistent skills shortages across the electronic and communications areas are being addressed through the award restructuring process.

Australian industry lags well behind other industrialised nations in the amount of training employers give employees, with as many as 30% of employers providing no formal training to their employees.

Reform of vocational education and training arrangements is necessary to meet the skills needs of industry and to improve productivity and international competitiveness.

Under the award restructuring process, job classifications are based on certain skill levels and promotion is linked to achieving those levels.

A high priority is given to training and skills development for people entering the labour force and for the existing workers. Australia's apprentice intake is at record levels and trainee intake is expected to increase to 10% of school leavers by the early 1990s.

The Federal Government has taken several initiatives to improve the quality and quantity of training, including reforms to the apprenticeship and Australian Traineeship System, industry training advisory mechanisms and TAFE.

A National Training Board to set national training standards and procedures for accreditation of training providers across all industries will start operations early next year.

Special funding for training projects associated with award restructuring has been allocated over the next three years, including the analysis of training needs, curriculum development, competence assessment and national standards and accreditation.

The Employment and Skills Formation Council (ESFC) recently recommended that industry take more responsibility for training and proposed a minimum training expenditure obligation on all employers of one per cent of their payroll in 1990-91, increasing to two per cent by 1992-93. Any shortfall would be collected and spent on training for industry. The Federal Government is currently considering the recommendation.

The Australian Army

To the aspiring electronics technician, the Australian Army has much to offer. In return to your commitment to the defence forces, the Army provides excellent training and career prospects, but you will be expected to complete a minimum nine year enlistment period. There is a four year apprenticeship then a "return of service obligation of five years".

The enlistment period is a major stumbling block for many students – as well as the military aspects of the job – but if you decide to enlist, the Army has a modern, well-equipped training school with top shelf RF and electronics equipment. Away from work, it offers a range of extra-curricular activities that Club Med would find hard to beat, such as scuba diving, sailing, canoeing, etc.

Other benefits of Army apprenticeships include subsidised meals and accommodation, free books, tools, instruments, uniforms and work clothes.

The training school is in the Albury/Wodonga area at Bonegilla, Victoria. All the Army's apprentices are trained here, with training divided into five broad areas: military training; trade training; education training; character training; sport and recreation training.

The course for electronic tradespersons involves spending three of the four years at the training school, with the final year completed in a Royal Australian Corp of Signals or a Royal Australian Electrical and Mechanical Engineers unit.

The course meets both military and civilian requirements, while the apprentice also has the opportunity for further study to gain an electronics technician (radio communications) certificate.

The training at the school consists of three elements taught concurrently: theory; laboratory and workshop practice. Subjects include electrical circuits, series/parallel circuits, fundamentals of semiconductors, semiconductor amplifiers, transistor transmitters and receivers (rip valves), microprocessors and logic.

On successful completion of the third year, the soldier (apprentice) is posted around Australia in the rank of Signalman or Craftsman, depending on the nature of the unit.

Despite the titles of the above ranks, the electronics apprenticeship course is open to both men and women.

In the first year, the salary is $8649 going up to $22,741 in the fourth year. Once apprentices leave the school they are also entitled to an additional $4122 per annum service allowance.

OTC

OTC offers secure careers in electronics and communications, providing a level and diversity of training which most private companies cannot offer.

The technical facilities at OTC cover the radio frequency spectrum, from long distance high frequency transmitters through to satellite-based and optical fibre systems.

There are three entry levels to OTC for the career-minded student: apprenticeships; traineeships and cadetships. Up to 50 positions are available to counterbalance the natural attrition rate. At present the numbers stand at: apprentices (four to five persons); trainee technical officers (30 – 40 persons); cadetships (engineering 8 – 10, computer programming 4 – 5 persons).

Telecom is restricting all its traineeships for technicians and technical officers.

At the first level, apprentices at OTC become qualified telecommunications trades officers after a four year training period. Normally, persons recruited come from schools, or are already apprentices and students progressing through the TAFE colleges. The salary ranges from $8,633 in the first year through to $19,275 in the final year.

The next level is technical officer traineeships. The work and TAFE course is to the semi-professional associate diploma level. Trainee technical officers are normally school leavers, people undertaking relevant courses (such as Advanced Certificate in Electronics and Communications) or apprentices from industry who wish to attain a higher level of knowledge of radio communications (which therefore leads to more opportunities for advancement).

The traineeship is a three and a half year program. The trainee technical officer is required to undertake two years full time education with a TAFE college and an 18 month internal training program. During training, the salary ranges from $12,334 to $22,518.

Finally, there are cadetships, which are offered to undergraduates studying at university. Cadetships are usually offered to those students who are in their final year of their degree, while exceptional students will be accepted with two years to go.

The cadetships in OTC are offered in engineering and computing. Currently, OTC has an ongoing cadetship number of 12 engineering students and five computing students. The salary on offer, while studying full time, ranges from $6224 to $10107.

Also, OTC offers approximately 20 positions for students wishing to undertake industrial training and vacation employment. Application forms can be lodged with the careers and appointments services at all major universities.

To assist students who can't survive on the meagre TEAS allowance, OTC also offers assistance via a program of scholarships and student awards.

There is the Women in Electrical Engineering Scholarship which is provided by OTC through its equal employment section. As an attempt to help redress the male/female balance in electrical engineering, six scholarships are offered around Australian universities, with one scholarship going to each of the following: University of Sydney; University of NSW; University of Queensland; James Cook University; University of Adelaide and University of Melbourne.

First year women students in electrical engineering receive a scholarship of $1500, payable in two amounts of $750 in March and July respectively.

The scholarship is based on HSC results and can be split between two candidates if the university so recommends.

Another initiative is the Co-operative Education Program – also provided by OTC through its training services section. Three universities participate in this program: University of Sydney (Bachelor of Engineering program); University of NSW (Bachelor of Engineering program); University of Technology, Sydney (Bachelor of Information Technology).

A scholarship of $8000 per annum is offered to students in the engineering and information systems areas at universities. The respective university advertises the OTC scholarship as being available and interviews are conducted jointly by members of the university and OTC representatives. The criteria for selection are academic excellence and motivation to succeed.

The scholarships are an ongoing program for the duration of the students' course.

OTC also offers awards to telecommunications students, the objective being to encourage excellence in the study of telecommunications. OTC offers three Telecommunications Student Awards to final year undergraduate or postgraduate students majoring in communications, or related fields in selected tertiary institutions. These awards were first made in 1988 and will also be made this year after which its continuation will be reviewed.

OTC invites selected institutions which have contributed significantly to telecommunications research and have good interaction with industry to participate by nominating a final year undergraduate or postgraduate student for an award.

Each award carries a maximum value of $30,000, including a $5000 cash prize.

After students have successfully finished their degrees – and have been selected by OTC for employment – they are immediately assigned as Grade 1 engineers.

These new engineers, fresh from academia, then begin work on OTC's systems and facilities, such as satellite earth stations, submarine cables, exchanges, computer systems, maritime radio, etc. New graduates are usually assigned to each of these areas, especially in development or installation, but also to a lesser extent in operations and planning.

OTC also has a policy of moving new engineers every eighteen months, but they are not forced to and many continue in their current area.

The induction course for graduate engineers is conducted one day each month to provide: an overall understanding of OTC and the various kinds of work done by engineers in OTC, with talks given by senior managers from each area; an opportunity to mix and make new contacts with other new graduates.

After 18 months, there are four two-day course overviews for engineers (one every six months in a two year cycle) on: satellites and earth stations; switching and signalling; OTC services; submarine cables; transmission and radio.

These are attended by all engineers, irrespective of the area they are working in, so that each engineer gradually builds up an understanding of the diverse nature of OTC.

Civil Aviation Authority

The Civil Aviation Authority, which began operations on July 1, 1988, took over from the Department of Transport and Communications, the responsibility for the provision of air traffic services and aviation regulatory and safety services for Australia's aviation industry.

The CAA operates Air Traffic Control (ATC) services, Rescue and Firefighting Services, provides maintenance of ground facilities used for ATC and aeronautical information publications for use within Australian airspace.

To support these functions the CAA operates extensive communications, radar and navigational systems. The CAA has operational staff employed throughout Australia and its territories. It has its head office in Canberra and five field offices located in New South Wales, Queensland, Victoria, South Australia and Western Australia.

Radio technical officers are involved in the installation, maintenance, operation, design and calibration of the authority's complex electronic equipment. This equipment incorporates analogue, digital and microprocessor techniques to support a variety of facilities including:

Radar – used for tracking and surveillance of aircraft;

Communications – all ground communications facilities which are required to control aircraft and provide advisory services to aircraft;

Navigational aids – used at all major airports and along air routes to provide distance and bearing information to aircraft;

Facilities – design, development and installation of consoles and supporting systems for air traffic controllers.

Training

Radio trainees undertake a four year training program. It involves two years of study at a technical college sandwiched with two years of training with the CAA.

In NSW for example, applicants must be eligible to enrol for the Advanced Certificate in Electronics and Communications or the Associate Diploma in basic manual skills, specialised systems and equipment and new technologies. The CAA operates its own training centres in Brisbane, Melbourne, Adelaide and Perth.

Salary

Salaries for radio trainees are currently paid at the following rate: Under 18 $12154, $14180, 19 $16408, 20 $18434, 21 and over $20257, $21273, $22334. Technician $23297, $23964, $24626, $25291.

Trainees who successfully complete their four year training period will be advanced to technician. After two years experienc at this level, they will then become radio technical officers grade 1.

Promotional opportunities within the radio technical officer structure are said to be excellent. Promotion to higher levels is based on merit and availability of positions.

The technical officer salaries are somewhat higher. A radio technical officer grade 1 can earn $25291-27981, while a senior radio technical officer grade 3 earns $36066-36986.

Further information can be obtained from the Recruitment Officer, Civial Aviation Authority in each State.

The Philips approach

The success of the Philips company relies largely on the skill of its technologists. The annual investment in research and development, more than 8% of sales, is responsible for its technical leadership and for such well-known products as the humble audio cassette and compact discs.

Probably best associated with its first field of expertise – lighting – and with quality TV, Philips Australia has a dozen specialist operating divisions with branches in all capital cities. There are also high tech manufacturing centres in three states.

In Sydney, Philips Defence Systems has a reputation for its manufacturing quality and deliveries to both local and export customers. Philips Traffic Systems designs and manufactures raod traffic control equipment for world markets.

In Melbourne, Philips Radio Communication Systems, Australia's largest operator in this field, is an international supply centre with 50% of its locally designed production (mobile radios and cellular-phones) being exported.

In Adelaide, Philips microelectronics facility offers locally developed customised electronic solutions for Australian industries, such as automobile and appliance makers.

Other divisions market scientific equipment and test instruments; PABX and radio communications; data and banking systems; hi-fi audio, video products and domestic appliances. All of these are backed by the company's own trained service, customer support and software staff.

All the manufacturing plants, the marketing and the support operations employ technically qualified staff. Some start at pre-apprenticeship level, others as qualified engineers.

"With Philips there are ample opportunities for career mobility," said personnel and social affairs division manager, Pat Miles, who joined the company as technical trainee.

"Technical and engineering staff frequently move into our marketing or general management in Australia or in the international scene.

"In simplistic terms we look for three things in new applicants, the "chemistry" – will they fit in; their acedemic achievements in whatever they have undertaken; and their career aspirations matched with their potential," Pat Miles explained.

Philips conduct a wide range of in-house training programs to aid and improve job satisfaction and career development. It is common practice for specialist Philips technicians and even certain production line staff to be given specific training in Europe or North America.

Philips maintains a close liaison with several Australian universities, institutions and TAFES, helping to provide a practical link between the class room syllabus and industry.

There is a formal work experience program for undergraduates. A Philips post graduate masters scholarship program in Europe, open to all applicants, has already been granted to 14 young Australian engineers.

ABC TV and Radio

Engineers from both ABC TV & Radio are hoping that funding will be approved for technical programs in 1990.

Following funding cuts, ABC management curtailed its long established traineeship program, but now technical staff levels are falling so it must address its technical training.

This is good news for students. The ABC offers perhaps the most interesting traineeship for aspiring electronics technicians: the range and quality of its audio, video and RF hardware is staggering.

While the Federal Government seems intent on cutting the ABC's funding back to the bare minimum, it's reassuring its engineers are making the effort to guarantee funding to train young Australians.

Jim Toogood, federal head of radio technical services, and Bob Sitsky from ABC TV's training and development department, describe the opportunities that hopefully will be available next year.

Radio

The ABC is hopeful that it will be able to offer ten broadcast engineering traineeships in radio in 1990. These plans for trainees are subject to funding, which in the present circumstances must be competed for against other priorities.

If funding is available, the ABC will advertise the traineeships through the daily press and make them known to educational institutions. The traineeships will be available to persons who have completed an Associate Diploma or who are in their final year.

Successful applicants will be given in-house training over a two year period and on a successful completion of this will be eligible for employment as broadcast engineering officers.

I stress that at the time of writing, budgets are still being discussed and the above plans are subject to the outcome of these discussions.

Television

The ABC has long been regarded as the premier technical training ground for the TV broadcasting industry – a tradition that goes back to the earliest days of television and continues today.

A person engaged as a broadcast engineering trainee (BET) would normally be someone who has recently completed the Higher School Certificate or preferably someone who is already or has completed an appropriate TAFE course, eg an Electronics or Electrical Associate Diploma.

The full BET course is for four years duration. However, trainees who are part way through the TAFE course are given credit for their previous study. Similarly, credit may be given to trainees who have relevant working experience in the electronics or broadcasting industries.

Trainees also complete a series of 'Unit Courses' on broadcasting technology and apply this knowledge by means of a directed field training program covering planning, installation, maintenance and operation of TV equipment.

The ABC traineeship system is designed to produce highly skilled personnel who will perform complex tasks on state of the art technical systems.

Salary paid to trainees is on an age basis until they turn 21. Adult trainee salary is currently $20,752 to $22,992.

Career prospects are good : trainees are advanced to broadcast engineering officers (BEO) Grade 1 ($26,115-$28,894) at the conclusion of their training and after that promotion is on merit to higher grades. Current salary levels range from $32,397 (max) for the BEO Grade 2 up to $39,558 (max) for the BEO Grade 6.

Many BEOs work shift hours and this means that the *take-home-pay* is considerably higher than the base levels given above.

Subject to the availability of funding the ABC hopes to take on Trainees at the beginning of 1990 in Sydney, Melbourne and other capital cities.

Careers in avionics

by *John Cramond

The term avionics has been interpreted differently by all sectors of the aviation industry.

Being a combination of the words aviation and electronics, avionics is generally taken to encompass electronic components in the instrument, autopilot, navigation and communication fields.

At Australian Airlines the wider interpretation is applied, that is, being all things electrical that fly, including generating and control equipment, pumps and motors, etc.

In 1988 Australian Airlines commissioned a new Avionic Centre into operation: which brought together three separate workshops into the one modern facility.

The three workshops: instrument; electrical and radio had been in operation since 1946. Since that time nearly 1,000 staff have come and gone and 450 apprentices have been trained within the shops.

These three trade areas are now effectively combined into one workshop environment and maintain nearly 6,000 different aircraft components that are responsible for navigation system monitoring, performance measurement, power generation and distribution, data and voice communication and a host of other functions on aircraft of the Australian Airlines Fleet.

Over the years the scope of activities has increased enormously from very simple radio, instrument and power systems of the DC3 through to the modern equipment.

On-board flight management computers, laser navigation equipment and CRT instrument equipment put the aviation industry at the cutting edge of new technology.

OTC offers a program of scholarships and student awards.

Well trained staff are obviously an essential ingredient in the operation of this industry as well as carefully designed facilities. The new avionics building will take the organisation into the 21st Century with the likely developments that will occur in this industry.

Currently there are 86 tradespersons and 36 apprentices employed in the Avionics Centre.

The airline maintains a high commitment to training through an apprenticeship system. The yearly intake of avionics apprentices averages about 15. A recent restructure of the aviation trades has resulted in a trade called "Aircraft Maintenance Engineer Avionic" which is a combination of Electrical and Instrument trades.

Training for the apprenticeship is quite extensive and includes :

- Theoretical training at RMIT:
- Practical training in the Australian Airlines off-the-job training centre;
- Practical experience in the Avionics Centre;
- Practical experience in the hangar working on the electrical and instrument systems installed in the airframe.

Post apprenticeship advancements include:

- A number of career levels within the avionic workshops. Movement to these levels require completion of TAFE training courses and some experience. The courses include digital electronics and microprocessors.
- Qualification as a Licensed Aircraft Maintenance Engineer (LAME). Training for movement into the arena is supplied internally by the company, an electrical/instrument course for one aircraft could take up to 12 weeks full time. The standards for this area are high with pass marks of 75%. The training system is supervised by the Civil Aviation Authority.
- Ex-apprentices also find their way into other challenging roles in the organisation such as planners, technicians, draftsmen, instructors and in various supervisory roles;
- According to needs, a few ex-apprentices are offered cadetships in the various disciplines. The purpose of a cadetship is to combine the practical training and experience of a tradesperson with the academic studies of a professional engineer. Professional engineers are employed in the Engineering Department in the development and certification of modification to aircraft systems.

As with most training, the costs are high, but in today's world training is absolutely essential to ensure success and in particular reliability of our air travel system.

**Mr Cramond is the engineering manager at Australian Airlines.*

Telecom restructures

Telecom Australia is in the process of restructuring all traineeships for technicians and technical officers. It is expected that the new structure will be fully formulated by October this month and an announcement will be made.

Apprenticeships, as opposed to traineeships, will continue to be determined by regional staff requirements.

The RAAF

The Royal Australian Air Force offers careers as radio technicians via three entry schemes:

- Adult technical training scheme (ATTS),
- Certificate of technology scheme (COT), and
- Trade apprenticeship scheme (TRADAPP).

The educational prerequisites for ATTS and TRADAPP are Year 10 with sound achievements in English, Maths and Science (with a physics content). COT requires Year 12 with sound achievements in English, Maths and Physics.

The type of person accepted must meet the minimum educational requirement, be medically fit, be an Australian citizen or be eligible to become one and have a good aptitude and interest in electronics.

Upon completion of training, both the ATTS and TRADAPP graduates are qualified radio technicians. The COT graduates not only qualify as radio technicians, but also are awarded an Associate Diploma in Electronics through the Footscray TAFE.

Commencement gross slaries for the three schemes are as follows:

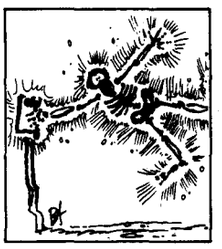
- AATS – $545.00pf (per fortnight) during basic training (10 weeks), $616.12 pf during trade training;
- COT – $410.76pf;
- TRADAPP – $331.74pf

Upon graduation, all technicians receive $1042.36pf gross.

Numbers enlisted differ from year to year but as an approximation, the following figures would be appropriate: ATTS (150); COT (20); TRADAPP (40).

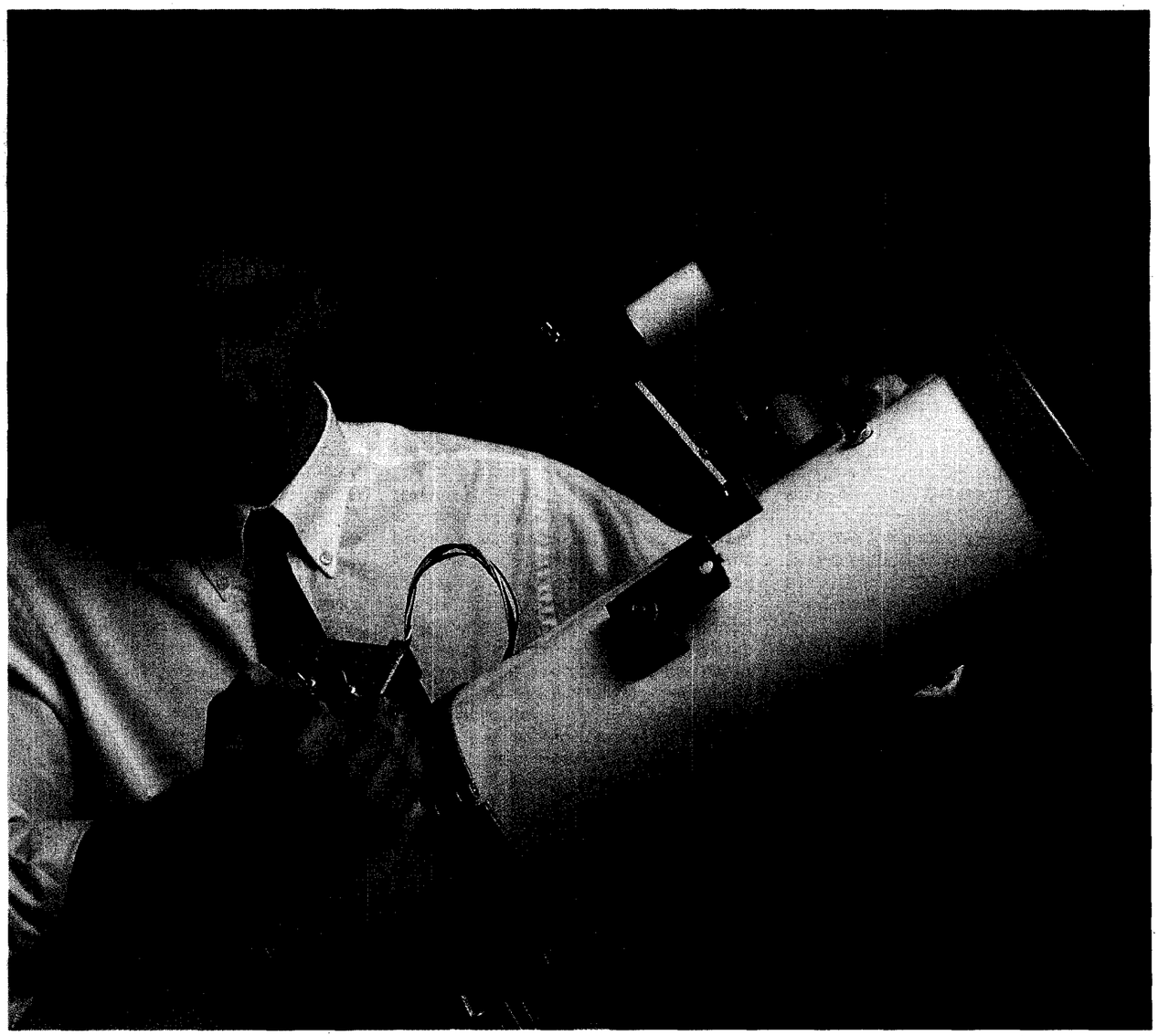
Gradutes are trained on various pieces of equipment, depending on the specific jobs they are assigned to. As the Air Force is constantly adopting the latest electronic technology, members of the radio technician trade are required to undergo courses to update their technical knowledge. eti

A TELESCOPE DRIVE CONTROLLER



ELECTRONICS
ETI-1550

To keep a star steady within the field of view of an astronomical telescope, you need to move it on its mount to compensate for the motion of the Earth. Doing it by hand is tedious, and gives poor results when trying to take photographs. A motor drive is the answer! By Morton Williams, VK2DEX.



If you have ever looked through an astronomical telescope and had trouble keeping the stars and planets in the field of view, then you will appreciate the convenience of a motor drive. In the past, these were clockwork, but today they are usually electric motors of some variety.

These may be small dc motors which are hard to control accurately, or small synchronous motors which require 240 V at 50 Hz to drive them, with the inherent dangers in the dark and the possible need to generate this (dangerous) voltage out in the field where operation from a battery source is necessary.

Another variety which may be used is the stepping motor. To the uninitiated, however, such beasts are esoteric in operation and control.

Stepping motors simplified

A stepping or stepper motor converts digital information into proportional mechanical movement. It is an electro-mechanical device whose spindle rotates in discrete steps, controlled by command pulses. The number of steps, the speed and the direction of rotation of the spindle are all determined in this way. The control of the motor and the generation of the pulses is provided by electronic circuitry. Figure 1 shows, in block diagram form, the constituent parts of a stepping motor system.

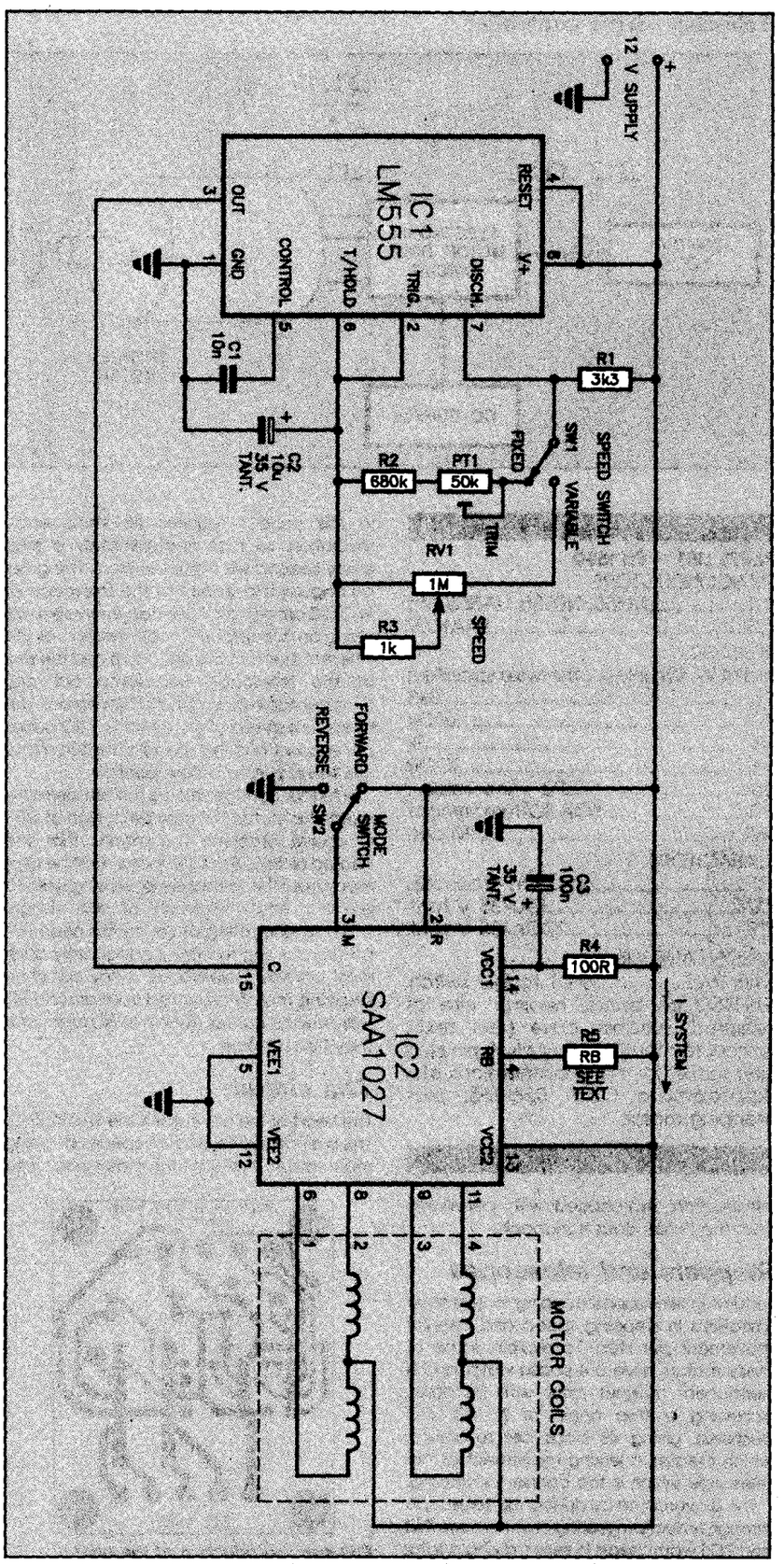
The advantages of precise and rapid positioning of objects using electronics is obvious and this has led to a great variety of applications. These include: dot matrix printers (which many readers will be familiar with); plotters; computer disk drives; camera lens control; remote positioners and indicators, etc.

All have one requirement in common-controlled motion. Wherever this is a requirement, stepping motors can be used to advantage.

Stepping motors come in two types: bipolar and unipolar. They differ only in that the unipolar motor has its coil windings centre tapped, creating in effect twice as many coils. There is no difference in their operation or control. They are low voltage devices, and there are many available that run off 12 Vdc, allowing operation from a car battery, away from mains power.

The full benefit of stepping motors can only be realised if they are correctly driven. It requires a dc supply, an electronic switch and a source of control pulses (Figure 1). The appropriate dc supply is routed to the motor via the electronic switch. In effect, the motor moves through one step for each control pulse applied to the electronic switch.

I will not go into a detailed description of their parameters and operation as this is outside the scope of this article, but recommend you read the references listed later. Further enlightenment is given in the panel here, titled Stepping Motors, An



Circuit diagram of the ETI-1550 Telescope Drive Controller. It is disarmingly simple!

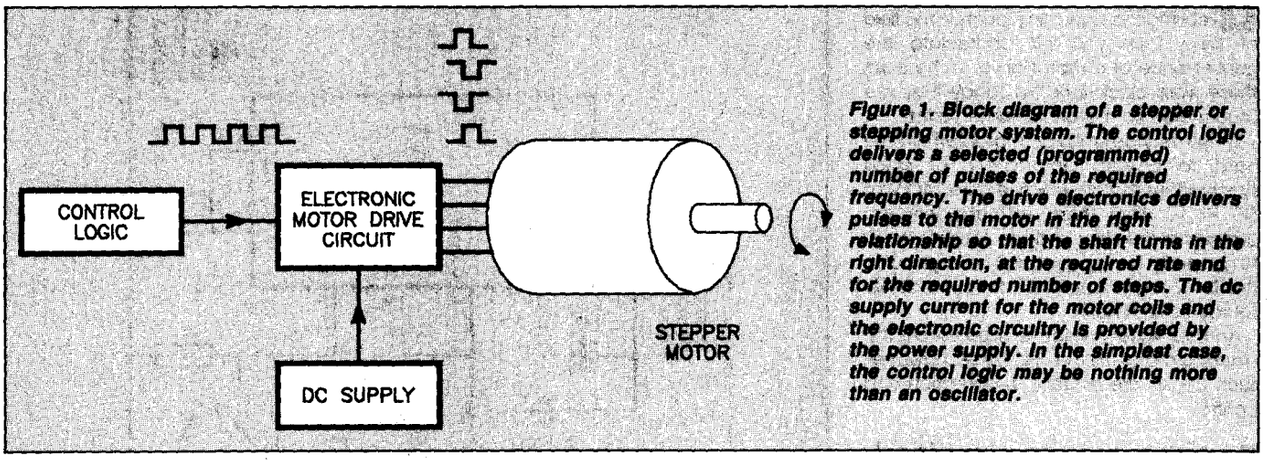


Figure 1. Block diagram of a stepper or stepping motor system. The control logic delivers a selected (programmed) number of pulses of the required frequency. The drive electronics delivers pulses to the motor in the right relationship so that the shaft turns in the right direction, at the required rate and for the required number of steps. The dc supply current for the motor coils and the electronic circuitry is provided by the power supply. In the simplest case, the control logic may be nothing more than an oscillator.

PARTS LIST – ETI-1550

SEMICONDUCTORS
IC1 ..... LM555, NE555, UA555 etc
IC2 ..... SAA1027

RESISTORS
all 1/4 W, 5% unless otherwise specified
R1 ..... 3k3
R2 ..... 680k
R3 ..... 1k
R4 ..... 100R
R5 ..... RB – see Table 1
PT1 ..... 50k, 10-turn trimpot
RV1 ..... 1M pot.

CAPACITORS
C1 ..... 10n greencap
C2 ..... 10u/35 V tant.
C3 ..... 100n/35 V tant.

MISCELLANEOUS
SW1, SW2 ..... SPDT toggle switch.
ETI-1550 pc board; hookup wire as required; suitable case (see text); connectors for 12 Vdc supply; 5-pin plug and socket for motor connections, etc. Approximate Cost: $28-$35, plus stepping motor.

Introduction, reproduced with permission from the Philips data handbook.

Steppers and telescopes

For driving telescopes, stepping motors have limitations in stepping speed and angular movement per step. To explain, some of these motors have a 4-phase stator and a permanent magnet rotor with 24 poles, achieving a step angle of 7° 30′ (7.5 degrees), giving 48 steps per revolution, which creates a jerking movement of the telescope which is too coarse for viewing.

This is overcome by driving the telescope through reduction gearing of, in my case 96:1 and 20:1 worm gears in series, giving a total of 1920:1 reduction. The stepping motor I used in this project requires 48 steps each revolution, so that approximately a step every second will track the stars. This gives an angular movement of the telescope of 14.0625 arc seconds per step every second, giving an acceptably smooth rotation, as the inherent inertia in the gear train and the size of the telescope will damp out any unacceptable pulsing in the movement. The maximum speed of my motor is 300 pulses per second, and this speed is used to move the telescope to a new position.

A further consideration is the temperature rise of the motor. This may be as high as 50° C above ambient. This means that the heated air rising from the motor must be kept away from the telescope or viewing path to prevent heat distortion of the image.

The torque rating of the motor need not be high for the motor to adequately drive most amateur telescopes; many common stepping motors are rated from around 20 milli-Newton-metres (mNm) to 50 mNm and they'll do just fine.

The circuit

The heart of the controller is the SAA1027 IC. This is a Philips chip, and is a special stepping motor driver. It will step the motor each time a control pulse is applied to pin 15, converting this pulse into the operating pulses required by unipolar stepping motors, Figure 2, which are output to pins 6, 8, 9, and 11, respectively. The motor direction is controlled by switching the mode pin, pin 3, to either the supply voltage or ground.

The value of the ballast resistor, RB is selected from Table 1, to suit the current drawn by the motor of your choice. This system current may be found in the specifications supplied with the motor.

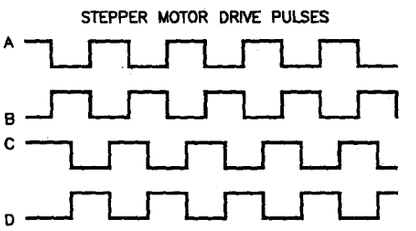
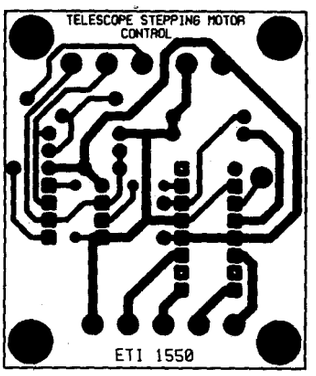


Figure 2. Showing the operating pulses required by unipolar stepping motors. The A-B-C-D pulse sequence is output from pins 6, 8, 9 and 11, respectively, of the SAA1027 in the controller circuit.

The control pulses are generated as a square wave by a 555 oscillator, switchable between fixed and variable. When set to variable, the oscillator is adjustable between 0.5 Hz and 300 Hz, to suit the stepping motor used. I chose values here to provide the maximum pulse rate for my motor (300 Hz). I switch to variable to initially position the telescope or change position, then switch to the fixed frequency of one Hertz, to counteract the spin of the Earth so as to keep the chosen object in view.



Full-size reproduction of the printed circuit artwork.

Construction

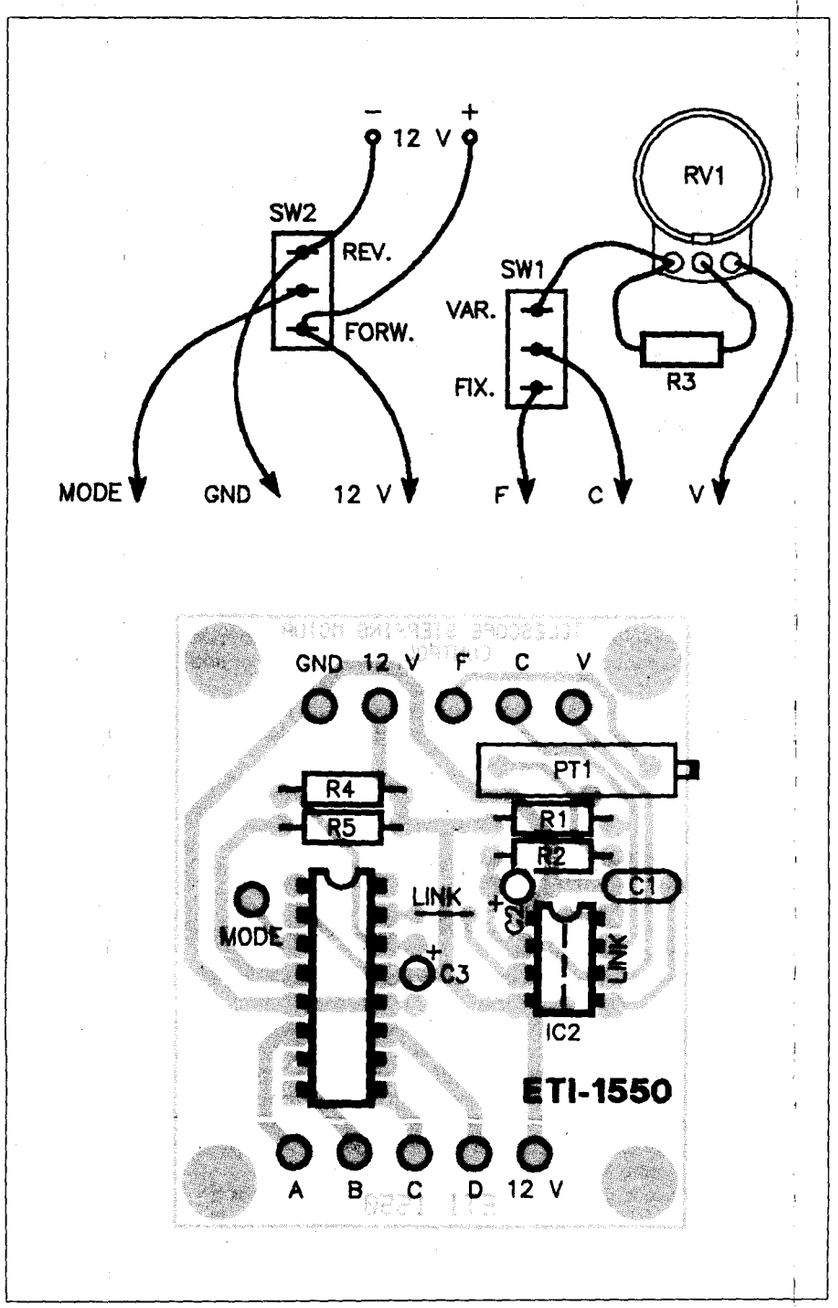
The pc board measures 45 mm by 50 mm; with only two ICs, five resistors and three capacitors, construction should not present any problems to the average enthusiast.

The only critical components are the resistors controlling the frequency of the 555 oscillator, and these may be varied to suit different motors and reduction gearing, as well as the ballast resistor which must be chosen from Table 1 to suit the system current of your motor.

Housing the unit is left to your own ingenuity, but care in planning is essential so that ease of operation is considered in respect of access to the two switches and the variable resistor, as these will be operated in the dark.

COIL RESISTANCE Ohms	CURRENT/PHASE mA	RB Ohms, W	I system mA
38.5	250	150R, 0.67	600
39	290	150R, 1.15	600
45	250	180R, 0.67	200
62	190	180R, 0.67	400
65	175	180R, 0.67	400
120	100	270R, 0.33	300

TABLE 1. A value is selected for RB depending on your particular stepper motor's characteristics. This table covers the range of motors you're likely to use in this application or be able to buy. Commonly available resistors are rated at 0.5, 1 and 5 watts. For the motor I obtained, I needed a 180 Ohm resistor.



The assembly can proceed in any order. However, the two links should be soldered in place first; one of them is beneath the 555. Make sure you place the ICs facing the right direction – in each case, pin 1 faces toward the trimpot. Capacitors C2 and C3 are polarised, so make sure you solder them in the right way round, too.

Shopping around

The majority of the parts will present no problems as they are standard components, available from the usual suppliers. Two of them, however, are a little more specialised, so I will cover them.

The trimpot, PT1, is a ten-turn type and is situated on the board so the fixed frequency of the oscillator may be adjusted through a hole in the case.

The SAA1027 is, as mentioned earlier, a Philips part. It is a stock item with Radiospares Components (no. 300-237), which has offices in Sydney, Melbourne, Brisbane, Adelaide and Perth. Melbourne, or Victorian, constructors are also advised to try All Electronic Components at 118-122 Lonsdale St in the city ☎ (03)662-1381.

Stepping motors are available from many sources, either new or as surplus stock clearance items. Just make sure that you select one that will handle the torque required, but this is not great unless you are driving a very large telescope. The two firms just mentioned – Radiospares Components and All Electronic Components – can help with your stepping motor requirements, too.

The Radiospares Components catalogue lists a couple of stepper motors ideal for this application, even giving values for RB in the circuit here. Listed on page 448 of their current catalogue, they are part numbers 332-947 and 332-953, respectively. Each features a 7.5 degree step and can be directly driven by the SAA1027. The 332-953

Component overlay for the pc board. You only need take care with the orientation of the two ICs and capacitors C2 and C3. Note the two links, which should be soldered in place first of all. If you use a 5 W wirewound resistor for RB, it should be spaced 4-5 mm above the board on its leads, to allow adequate air circulation around it.

has almost 10 times the working torque specification of the 332-947; it would seem the 332-953 would be better suited to drive many common amateur telescopes.

The case may be any suitable box that is small enough to hold in the hand, large enough to house all the parts, and robust enough to withstand your weight when you inadvertently step on it in the dark!

I made myself a Scotchcal escutcheon for the front panel, to label the controls. As individual constructors will want to use a particular case, resulting in widely varying specifications, I did not make up a front panel artwork.

Conclusion

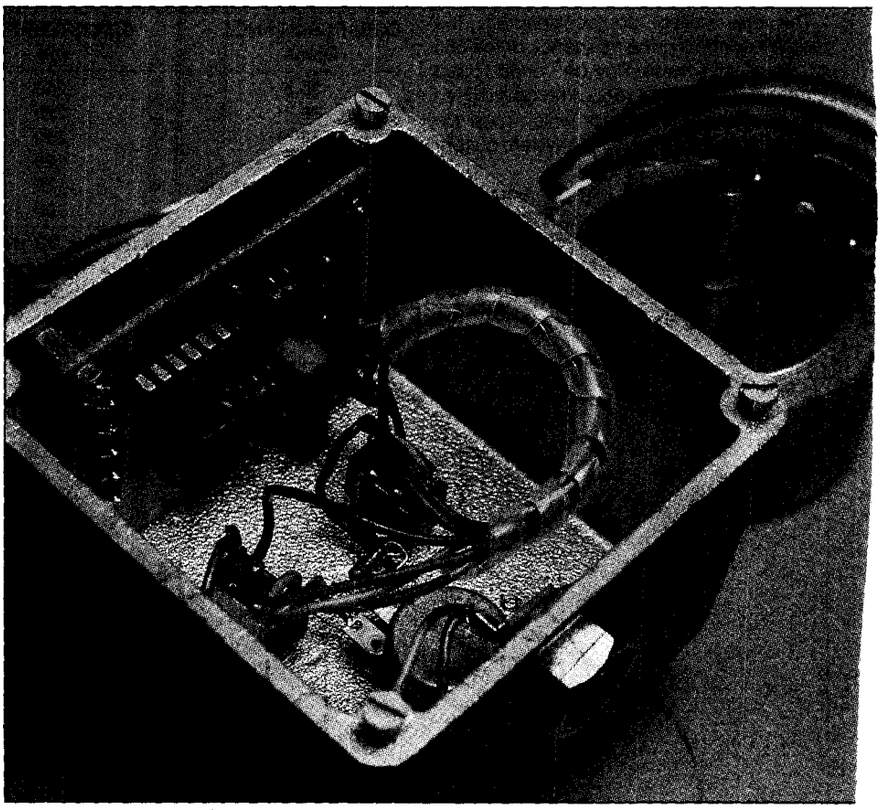
Telescopes may be driven by many different motors, but the stepping motor shows the greatest promise of flexibility, ease of use and control. This includes the ability to be interfaced to a computer, with suitable positional feedback, so that one has only to enter the star's position and the computer takes care of the rest – but that's another story!

REFERENCES

Philips data handbook, C17, 1986. *Stepping Motors and Associated Electronics.*

Philips data handbook, Signetics linear LSI, IC11N pp 7-3, to 7-7. *SAA1027 Stepping motor controller.*

National Semiconductor Linear Databook 3, 1988, pp 5-42,43 *LM555 Astable Oscillator.*



Showing the completed board mounted in a diecast box, and the stepping motor it controls.

Stepping motors — an introduction

A stepping motor converts digital information into proportional mechanical movement; it is an electro mechanical device whose spindle rotates in discrete steps, following command pulses in number and speed, when operated from a source that provides programmed current reversals.

After the appearance of the stepping motor in applications traditionally employing digital control, the advantages of precise and rapid positioning of objects using electronics became more obvious and this, in turn, led to a greater variety of applications. These now include:

- paper and magnetic tape drives;
- teletype and strip printers;
- camera iris control, film transport and colour film sorting;
- co-ordinate plotters, incremental chart recorders and variable speed chart drives;
- medical equipment, e.g. blood samplers, lung analysers and kidney pumps;
- fuel flow control, valve control and variable speed syringe pumps;
- taxi-meters, card readers, production line pulse counters, and automatic weighing and labelling systems;
- digital-to-analogue converters and remote position indicating equipment.

All have one thing in common – controlled motion. Wherever controlled movement and/or positioning is necessary, the stepping motor can be applied. And usually to advantage.

From a mechanical viewpoint, the stepping motor has simple positional control, reliability and precision – it has, however, introduced the need for electronics. Where previously, simple, mechanically operated switches often provided adequate control, the need for a better method has arisen. The advantages of stepping motor systems have been gained at some expense to the simplicity of the motor control: although still unsophisticated by modern standards, some electronic circuits are necessary.

The full benefit of a stepping motor can only be realised if it is correctly driven. It requires a dc supply, an electronic switch and a source of control pulses (digital information). The appropriate dc supply is routed to the motor via the electronic switch. In effect, the motor moves through one step for each control pulse applied to the electronic switch.

The angle of the step depends upon the type of motor and can be from as little as 18° to as much as 15°. Consequently, if 24 pulses are fed to the switch, the shaft of a motor with a 15° step-angle will complete one revolution. The time taken for this action is entirely a function of the rate at which control pulses are applied. These may be generated by an oscillator with adjustable frequency, or derived from one of a variety of sources: perforated tape, magnetic tape, etc.

The range of stepping motors comprises:
- permanent magnet versions
- hybrid versions

Permanent magnet stepping motors

The step angle of a permanent magnet stepping motor depends upon the relationship between the number of magnetic poles on its stator assembly and the number of magnetic poles on its rotor. Since the latter is a cylindrical permanent magnet, the poles are fixed, and their number is limited, due to the characteristics of the magnetic material.

Enlarging the magnet diameter to provide for a larger number of rotor poles results in a drastic increase in the rotor inertia. This reduces the starting capabilities of such a motor beyond practical use. With a permanent magnet rotor, only relatively large step angles can be obtained. However, further reduction of the step angle can be achieved by using more stators. This enables step angles down to 3.75° to be obtained.

The stator assembly comprises two or more stators, each having a coil through which current is passed to form a magnetic field. By reversing the direction of current flowing in a coil, therefore, the north and south poles can be transposed. Reversing the current flow through successive stator coils creates a rotating magnetic field which the permanent magnet rotor follows. Speed of rotation is thus governed by the rate at which the stator coils (and hence the electro-magnetic poles) are switched and the direction of rotation by the actual switching sequence.

There are two methods by which the current flow through stator coils can be reversed and this has led to two classes of stepping motor: those designed for unipolar drive and those for bipolar drive.

For ease of description, illustrations in this section which give a diagramatic representation of a permanent magnet stepping motor show only a 2-pole rotor although it could have as many as 24; the operating principles, however, are the same.

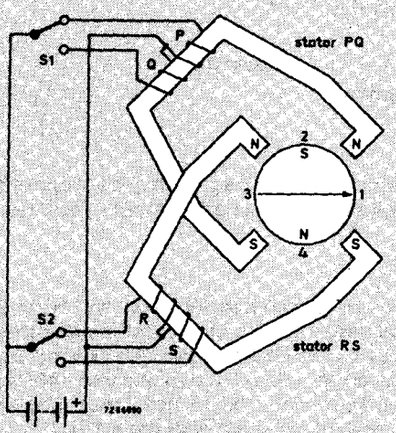


Figure 1a.

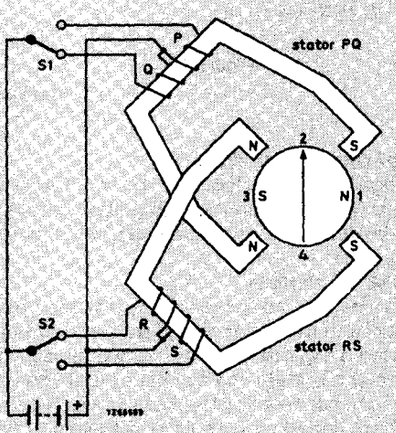


Figure 1b.

Two-stator motors (4-phase).

Motors for unipolar drive

Each stator coil of a motor designed for unipolar drive is provided with a centre tap which is connected to one side of the supply, say, the positive. The direction of current flowing through a coil is then determined by the end to which the negative supply line is connected via a switching device. Switching coil-halves results in the magnetic poles of the relevant stator being reversed.

2-Stator motors (4-Phase): Figure 1a shows a 4-phase stepping motor in which phases P and R are energised: the rotor assumes the position indicated. If switch S1 is now operated (phases Q and R energised), the conditions illustrated in Figure. 1b obtain, i.e. the rotor has moved through 90 degrees.

From this it can be seen that by operating switches S1 and S2 alternately, the rotor can be made to rotate in 90° steps. The direction of rotation can be reversed by altering the switching sequence.

Motors for bipolar drive

The stator coils of a motor designed for bipolar drive have no centre tap. Instead of using alternate coil halves to produce a reversal of current flow through the stator windings (as for unipolar drive), the current is now reversed through the entire coil by switching both supply lines. Operation of a motor with bipolar drive is identical to that of one with unipolar drive.

2-Stator motors (2-Phase): Operation of a 2-phase motor with bipolar drive is shown in Figure 2.

4-Stator motors (4-Phase): The 4-phase motor with bipolar drive is shown in Figure 3.

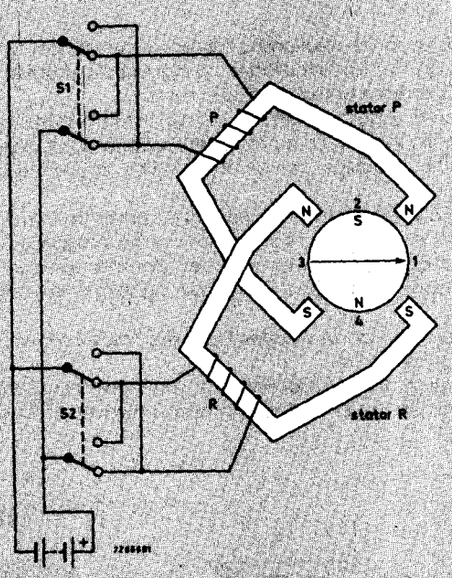


Figure 2a.

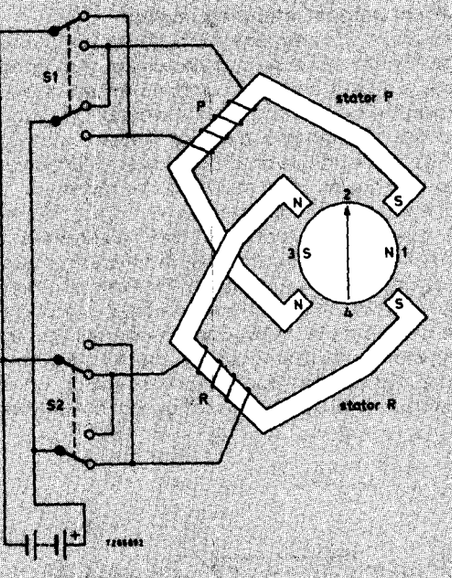


Figure 2b.

Two-stator motors (2-phase).

Features of the bipolar drive

The advantages of using motors with bipolar drive are shown in Figure 4. This compares the performance of one of the unipolar motors with its bipolar version. A considerable increase in available torque is apparent using the bipolar version: the associated electronics, however, are necessarily somewhat more complex.

Hybrid stepping motors

Philips hybrid stepping motor technology is based upon a principle which gives options in step angle and motor size beyond those possible with the common design of hybrid stepping motors. The design consists of four stator cups assembled face to face around a ring coil, thus forming two closed stator parts joined by a permanent magnet. The inner circumference of each stator cup has teeth, the number of teeth depending on the step angle required. The rotor consists of four discs, with the same number of teeth as the stator cups. The rotor discs are offset from each other by half a tooth-pitch in a pattern dictated by the necessary energising sequence of the ring coils. The teeth of the stator cups are in line.

The permanent magnet flux is distributed through each stator part and closed via the rotor. When the stator coils are energised alternately and in both directions a rotating magnetic field is produced which the rotor follows. At each step in the energising sequence, the teeth of one rotor disc line up with the teeth of the stator cups.

Possible step angles = $\frac{360}{n \times z}$ degrees,

where n = number of phases
z = number of teeth/disc

for n = 4, z = 50, step angle = 360/4 x 50 = 1.8° (200 steps/rev)

n = 4, z = 48, step angle = 360/4 x 48 = 1.875° (192 steps/rev)

n = 4, z = 24, step angle = 360/4 x 24 = 3.75° (96 steps/rev)

Figure 6 shows the position of the four rotor discs in a motor with a step angle of 22.5°.

• Information courtesy of Philips Components

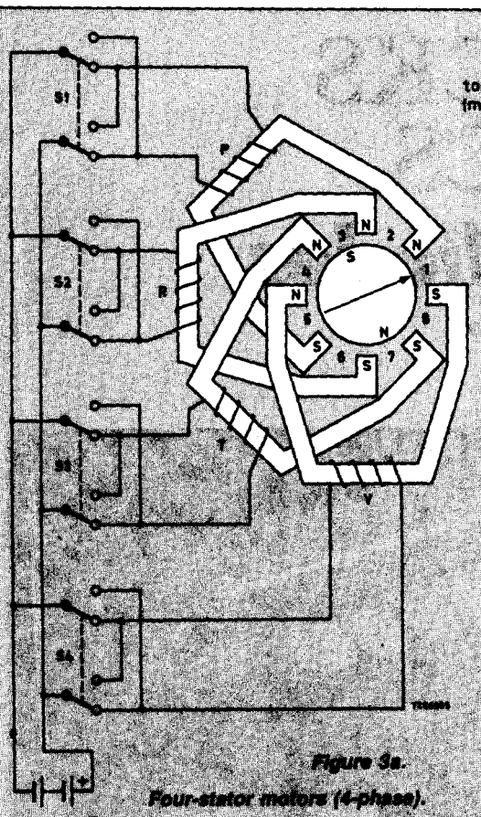


Figure 3a.
Four-stator motors (4-phase).

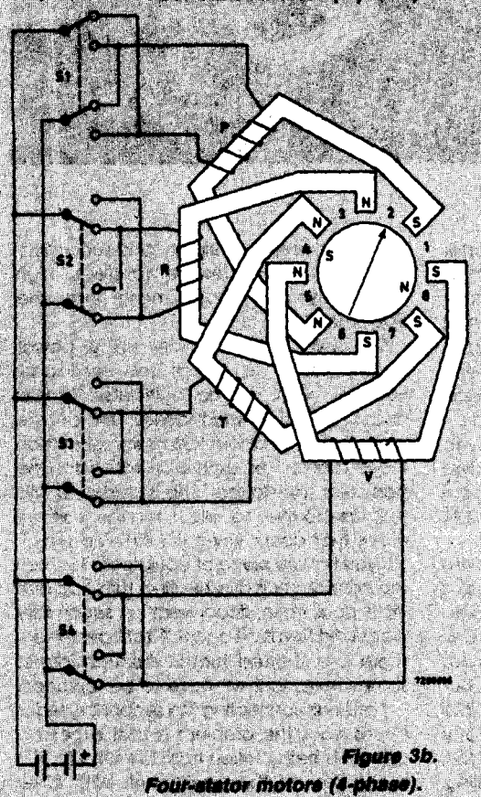


Figure 3b.
Four-stator motors (4-phase).

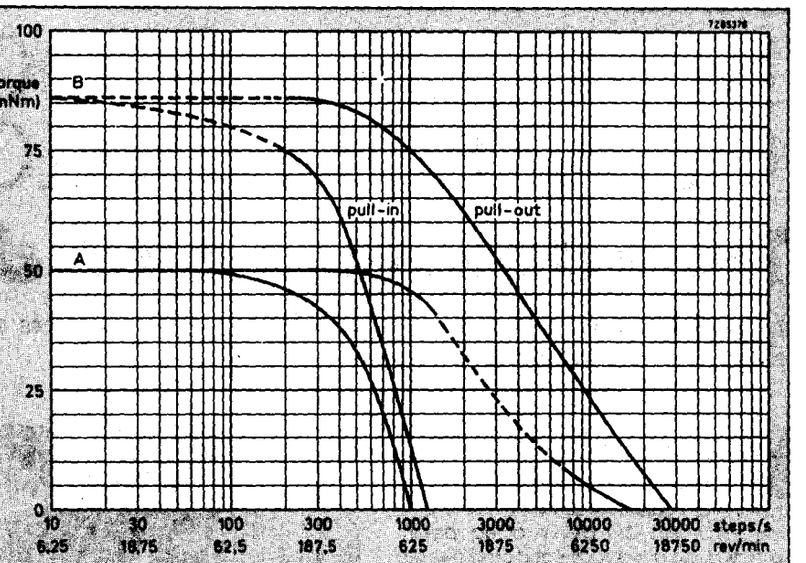


Figure 4.
A: unipolar motor.
B: bipolar motor.

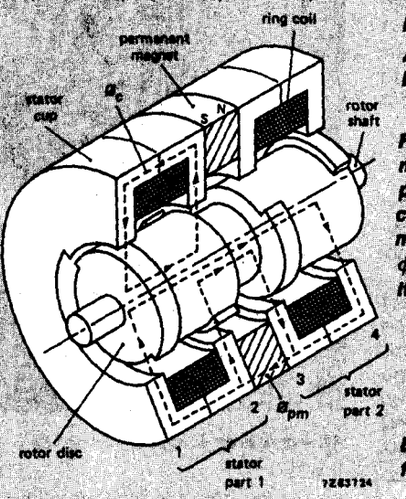


Figure 5a. Ring coil hybrid stepping motor, showing the paths of the permanent-magnet flux ϕ_{pm} and coil flux ϕ_c for one coil excitation mode. For this mode ϕ_c adds to ϕ_{pm} in disc 1 and subtracts from it in disc 2.

Below: Figure 5b. The positions of the four rotor discs of Figure 5a.

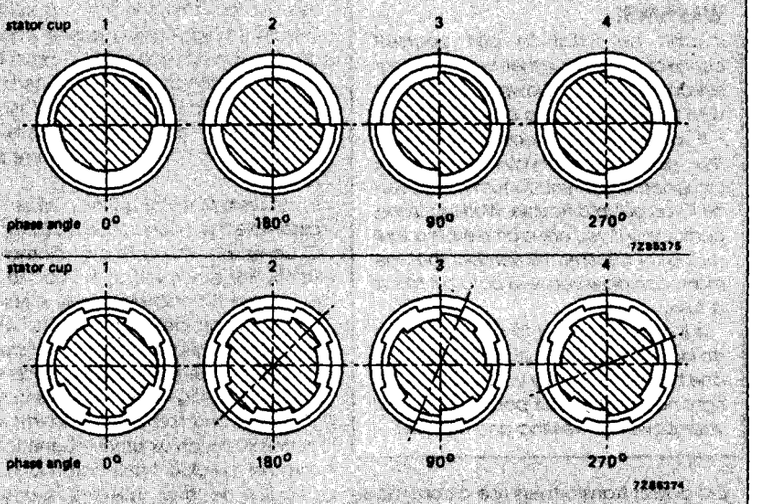


Figure 5. Positions of the rotor discs with respect to each other for a motor with four teeth on stator cups and rotor discs.

Part 3

BUILDING BLOCKS OF ELECTRONICS

Transformers and diodes

Jack Middlehurst takes us on a guided tour of transformers of all sorts and introduces the ubiquitous diode.

Transformers come in four distinct categories related to the frequency range in which they are used: power, audio, intermediate frequency (IF) and radio frequency (RF). Old pieces of equipment such as audio desks, radios and amplifiers are usually a mass of transformers. With the advent of the transistor, audio transformers are much less common than they used to be. The symbols commonly used for transformers are shown in Figure 3.1

Power transformers

The power transformer has two purposes. It provides isolation of the equipment from any direct connection to the main electrical supply – in Australia, nominally 240 Vac – and it changes the 240 Vac to the correct voltage for the power supply in the equipment. For modern audio equipment, the secondary voltage is usually in the range three to 50 V; for old radios there are often three or more secondaries, commonly including 5 V, 6.3 V, and 770 V centre tapped.

An iron-cored inductor, or choke.

WARNING!

It can be fatal to get yourself connected across either the primary or secondary of most power transformers with the power on, so be very careful.

If you are taking measurements with the power on, always make sure someone is with you to turn the power off if you get into trouble. Working alone, particularly if you are a bit tired, is a sure recipe for disaster. Remember that the mains can blow you, well before it blows a fuse.

It is good practice to stand or sit on an insulating surface and always keep one hand (preferably your left, if you're right handed) in your pocket, i.e. do all your power-on testing one-handed.

Old power transformers use a core made of 3% silicon steel laminations about 0.3 mm thick. Usually the core is made of punchings in the shape of the letters E and I. Some cores use two punchings in the form of the letter F. Modern high quality power transformers use C cores in the form of 0.1 mm thick grain-oriented silicon steel that has been wrapped into a toroid (a shape like a roll of sticky tape) and then cut across the diameter to form two letter Cs. The cut surfaces are precision ground.

This form of construction makes it easy to assemble the wound coils by slipping the two C cores into the coils and clamping them tightly together with a thin band of steel. Such transformers are highly efficient.

In true toroidal transformers, which are even more efficient, the wound steel strip is not cut but the coils are wound directly onto the toroid using a special winding machine.

C core and toroidal transformers do not generate much external magnetic field, but some of the older types can induce hum into circuits several metres away. Many transformers have either a single turn of thin copper sheet, or a single-ended winding, that connects to earth as an electrostatic shield between the primary and secondary windings. This reduces the transfer of high frequency (RF) mains hash into the equipment.

The only test necessary on a power transformer is to check the secondary voltages with an ac voltmeter. If you disconnect the secondaries, all of the voltages will be about 10% or so higher than those marked or otherwise rated for the particular transformer. This is designed into the transformer to allow for the voltage drops that occur when it is fully loaded.

If you have a piece of equipment in which the transformer is overheating, turn it off and let it cool, then disconnect all secondary leads and turn it on again. If it still overheats, there is a shorted turn in the transformer somewhere, so it will have to be replaced.

If after disconnecting the secondary leads it runs cool, the problem is that excessive current is being taken from it, so the fault is in the rest of the equipment. With older transformers, the rule was if you can't hold

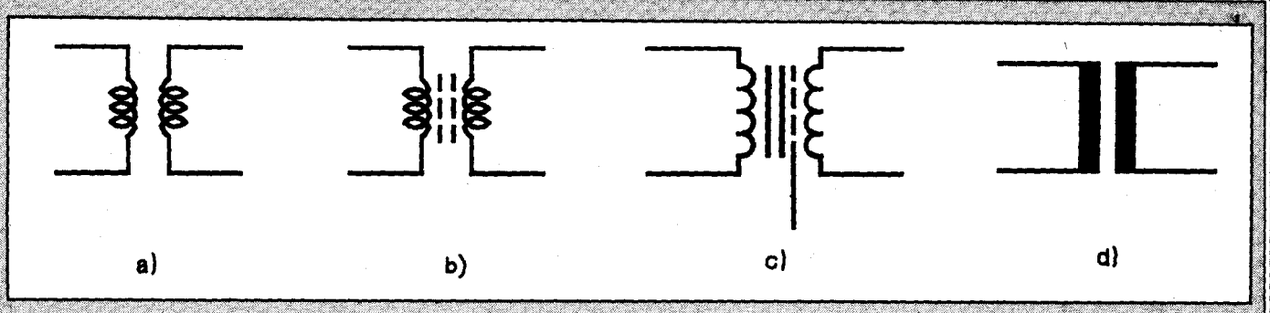


Figure 3.1 Symbols for transformers. a) untuned RF or IF transformer; a tuned version would have a capacitor connected across the secondary and/or primary; b) ferrite-cored transformer, RF, IF, or sometimes audio; c) iron-cored transformer, audio or power frequencies. The dashed line represents an electrostatic shield; d) power transformer.

your hand on it something is wrong. Some modern C cores are designed to run at 60° C above ambient, which is too hot to touch for more than a second or two, so you have to be wary in deciding what is too hot for a transformer.

Audio transformers

Audio transformers are similar in construction to power transformers except that they use more exotic materials for the core. Steel containing 13% silicon was much used in the past, but these days grain-oriented silicon steel 0.05 mm thick is used for high powered output transformers, and nickel alloys such as mu-metal and the various permalloys are used for microphone and other low-level applications.

Modern audio transformers of this type have no difficulty in achieving distortion levels below 0.1%. One also occasionally finds large potcores used in audio transformers.

Audio transformers have three critical properties: primary inductance, primary resistance and transformation ratio. The primary inductance has to be sufficiently high to prevent the transformer loading the circuit driving it. The dc resistance produces a power loss that has to be minimised and the transformation ratio is fixed by the ratio of the desired load on the transformer to the load required on the circuit block driving the transformer.

Transformers usually go open circuit or develop one or more shorted turns, so their testing is quite simple. Remember not to measure the resistance of special audio transformers. The primary inductance and resistance can be measured by disconnecting the leads and treating the primary as a simple inductor. Watch out for inductive kicks from audio output transformers since they often have primary inductances of 100 Henries or more. If the transformer has a shorted turn, its measured inductance will be much lower than expected or specified.

The voltage transformation ratio is the ratio of secondary voltage to primary voltage. This can be measured by applying a signal from the ETI-195 injector to the primary and measuring the output at the secondary.

You can't do anything about the transformation ratio other than measure it, since it is fixed by the ratio of the number of turns on the secondary to the number on the primary. Once you know the ratio, the input impedance of the transformer can be calculated as the load resistance on the secondary divided by the square of the voltage transformation ratio.

IF transformers

Frequencies from about 50 kHz to 500 kHz are used for intermediate frequencies in AM superheterodyne radio receivers. These transformers have their primary and secondary windings tuned by capacitors in parallel with the windings. Ferrites and potcores come into their own at these frequencies.

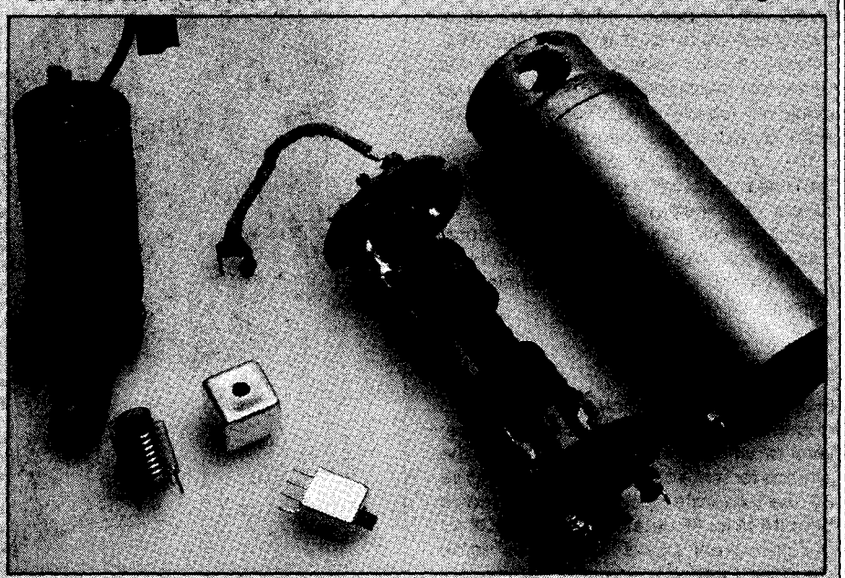
Old radios use air core transformers which can be quite large. Military radios made during WWII used powdered cores (an early form of ferrite) to try and reduce their size. Modern IF transformers are invariably ferrite cored and adjustable slug is incorporated to permit tuning.

Almost all designs use Litz wire and the coils are wavewound (the turns criss-cross one another, rather than lay side-by-side, to reduce inter-turn capacitance), so rewinding such things is almost out of the question unless you are very clever with your hands and can find some small quantities of similar Litz wire!

With IF transformers, a simple measurement of dc resistance checks for an open circuit. If the transformer can be tuned, all is well. If not, check the tuning capacitor.

RF transformers

With RF transformers, neither winding has to



RF coils and transformers. At left a 1930s valve radio (wireless) coil contrasts with a modern RF coil in front of it. In the centre are two modern RF transformers, while an earlier valve radio IF transformer is shown at right outside its shield can.

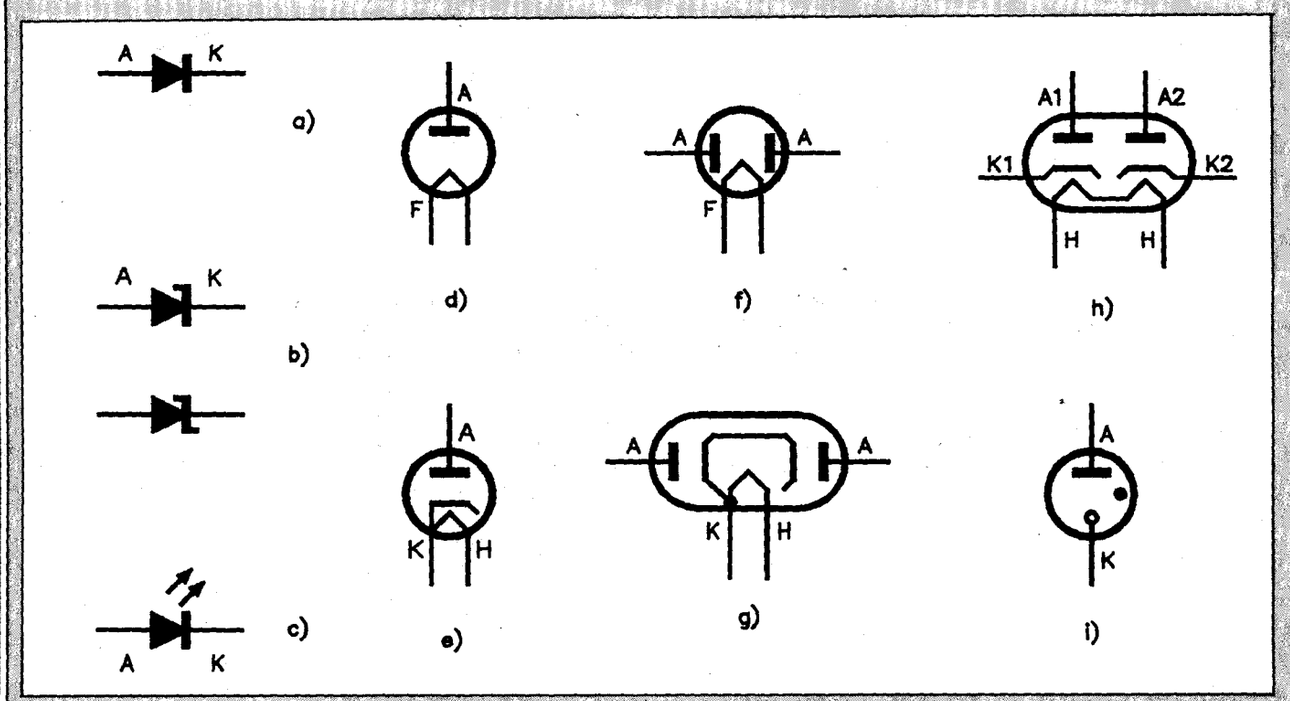


Figure 3.2 a) semiconductor diode; b) two symbols for a zener diode; c) light emitting diode; d) directly heated vacuum tube diode; e) indirectly heated vacuum tube diode; f) directly heated twin diode; g) indirectly heated twin diode; h) indirectly heated twin diode with separate cathodes. A = anode, C = cathode (some circuit diagrams use K for cathode), F = filament, H = heater.

be tuned although often one or both of them is. Old versions are air cored, and in modern versions for low powered use they are ferrite cored, often using a core in the form of a toroid. For TV, special ferrites in the form of beads can be used up to about 800 MHz.

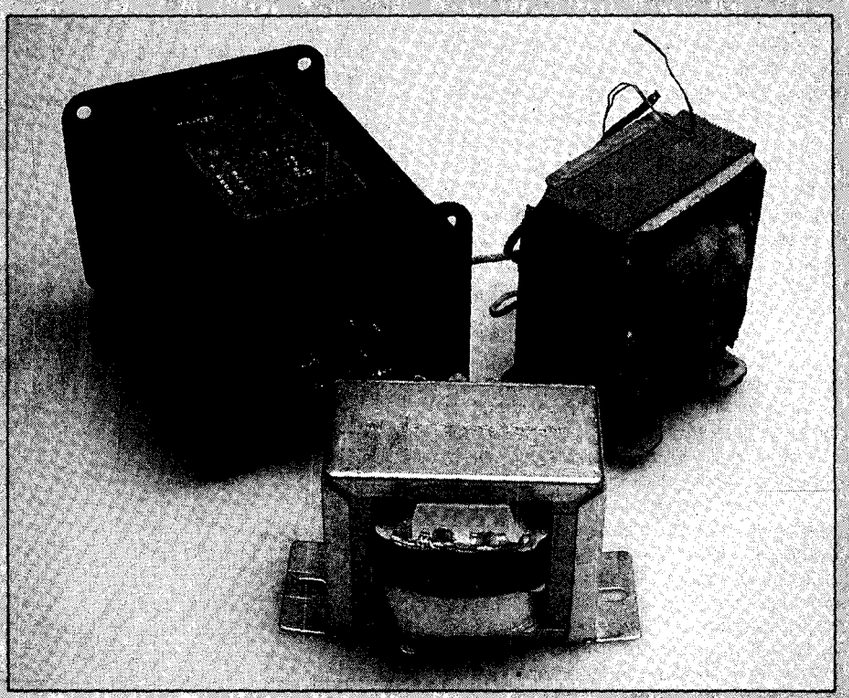
Apart from a simple test of the dc resistance, there is not much you need to do about RF transformers other than inspect them by eye for any obvious defects.

The conclusive evidence of trouble is if you can measure a signal going into the transformer and nothing comes out. It is more likely that the tuning capacitor is the trouble rather than the coil. We will discuss RF transformers later when describing RF amplifier blocks.

Diodes

Diodes come in a wide range of forms depending on the frequency and power level at which they have to operate. The symbols for some diodes are shown in Figure 3.2. The solid state diode shown at (a) could be a 1N914 for RF detection or a 1N5408 for a high current power supply. The same standard symbol is use for the massive rectifiers used in dc power stations.

The symbol at (b) represents a zener diode, and at (c) is a light emitting diode (LED). The thermionic diode (also known as a valve



A trio of transformers! At left rear is an audio output transformer (once Australian made). At right is an ancient power transformer. In front is a common multi-tap low voltage transformer.

rectifier or vacuum tube diode) at (d) is directly heated, i.e. the electrons are emitted by the filament. Such diodes are used as RF detectors in early radios, but later versions are used as HT rectifiers and EHT rectifiers in TV sets.

An indirectly heated diode is shown at (e). In this type, the filament is used as a heater that raises the temperature of a cathode that has rare earth elements in it. Such a cathode emits copious quantities of electrons at a much lower temperature than that required by a directly emitting filament.

At (f) is shown the symbol of most popular valves for power supplies – the 80, 5Y3 and related types. At (g) is the later, indirectly heated version – the 5V4 and 5R4 types. At (h) the two cathodes are independent, so this valve – the 6H6 type – could be used for full-wave RF detectors or as two independent detectors, one for the signal and one for the automatic gain control in radios.

At (i) is a voltage regulator diode, the small dark circle signifying that the valve is gas-filled. Typical would be the VR75 (OA3), VR105 (OC3), and VR150 (OD3). These diodes develop a voltage that is almost independent of the current through them. They are used to regulate screen voltages and often the anode voltage of the oscillator in an RF frequency changer. The numbers 75, 105 and 150 correspond to the regulated voltage. They do not need a filament supply and the gas in them glows when they are working.

Testing solid state signal and power diodes involves disconnecting them from the circuit and measuring their forward and reverse resistances. This can be done using an ordinary Ohmmeter. Many digital multimeters these days include a diode test function.

The forward resistance of a small solid state diode should be in the range 100 to 1000 Ohms, and its reverse resistance should be greater than 1M. Diodes intended for heavy duty power supplies have forward resistances in the range of a few Ohms to 100 Ohms and reverse resistances of over 100k. The most common faults are for the diode to be a short circuit in both directions or to be open circuit.

Zener diodes can have their forward resistance checked with an Ohmmeter but to test their zener operation requires a battery or power supply having a voltage about six volts greater than the zener voltage of the diode under test. The simple circuit of Figure 3.3 is used, the zener voltage being measured with a dc voltmeter. If the zener is working properly, connected one way round the measured voltage will be about 0.65 V, the other way round should give the correct zener voltage. LEDs can be tested using the same circuit, but in this case a 6 V battery is used and R is 1k.

Some famous double diode valves. At left is the ubiquitous 80. Lying down is a much later version, the 6AS4 — once widely used in TV receivers. At right is a 6X5 dual diode, a directly heated type with a common cathode used in detector applications. (All photos by John Lapka, valves courtesy of the Vintage Wireless Radio Company).

Gaseous voltage regulator diodes are tested by applying, say, 250 V to a resistor in series with the diode and measuring the diode voltage. The diode current is usually in the range 5 to 25 mA, depending on the type. It is safest to test them using only 10 mA, in which case the resistor will need to be 100 × (250 – Vr) Volts, where Vr is the regulator voltage. If you are going to test them for more than a few seconds, use a two watt resistor.

The first test on any vacuum tube is to make sure that its filament is intact. Either remove the valve from its socket and measure the resistance between the heater pins, or turn the power off, disconnect one filament lead, and measure the resistance between the filament pins on the socket. Then replace the valve, or reconnect the filament lead, and turn the power on.

Check that there is the correct voltage on the filament and check that the filament is glowing satisfactorily. If so, turn the power off, disconnect the anode lead, turn the power back on and measure the forward and reverse resistances with an Ohmmeter, keeping yourself well away from the power transformer and the lead you disconnected from the anode while you do so. Vacuum tube diodes have a forward resistance from a few hundred Ohms to a few thousand, but their reverse resistance is effectively infinite.

As they get older, vacuum tube power diodes lose their emission, and their forward resistance increases, so their dc voltage output decreases. In general, the life of a vacuum tube diode is about 1000 hours under full load, and 3000 or more hours if only lightly loaded.

In a typical power supply with a 385-0-385 Volt transformer, the dc voltage at the first filter capacitor should be in the range 380-525 Vdc. If it is much lower than this, either there is too much current being drawn, or the capacitor has lost its capacitance, or the diode has lost its emission. If it is much higher than this, the power supply does not have enough load on it. This usually means, for example, that the audio output stage in the radio is not drawing enough current.

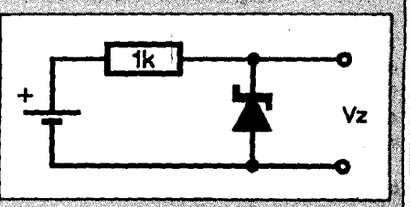


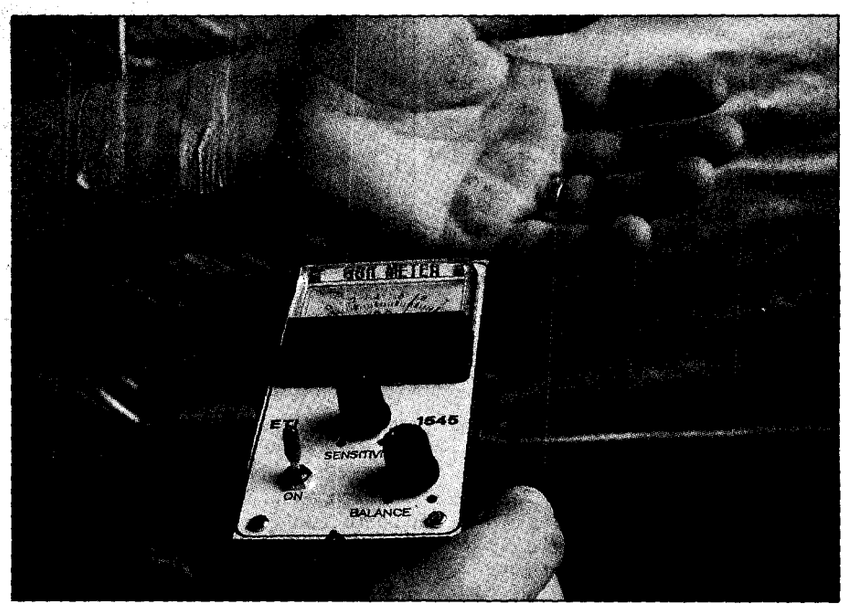
Figure 3.3. Simple circuit for testing zener diodes. The battery (or power supply) voltage should be 6 V greater than the expected zener voltage.

Get into biofeedback with this

GALVANIC SKIN RESISTANCE METER

Relax. Help is on the way! Build this Galvanic Skin Resistance (GSR) meter and explore the world of biofeedback for yourself. By Roger Harrison.

ELECTRONICS
ETI - 1545



The resistance of your skin varies according to a complex set of physiological reactions and interactions, principal among them being your state of relaxation – or lack of it! This project measures your skin resistance and indicates its state on a panel meter, which provides the feedback. By watching this and consciously relaxing, you can change the reading. Conversely, if your tension rises, it will indicate that – an instant lie detector!

The project uses all readily available, low-cost components and can be easily constructed by a newcomer to electronics. There is nothing critical about either the construction or the circuit; it is very easy to get going.

Background

The last time we published a project like this was in March 1977, the ETI-546 GSR Monitor. That is a somewhat more elaborate instrument, with both meter and audio feedback. This latest GSR meter was deliberately designed for simplicity of construction and operation.

Of all the biofeedback response instruments, the GSR meter is the most simple to learn to use. It has two electrodes which you tape to convenient points on your skin – on two fingers, or across one of your wrists.

As explained in the accompanying feature on biofeedback, the skin's response to stress and relaxation is a complex matter. Originally termed the psychogalvanic reflex, GSR is now referred to as an electrodermal or skin electric response, a transient change in electrical properties of the skin related to sweat gland activity.

The layer immediately under the skin's outer surface, the dermis, undergoes quite large and readily measurable changes in electrical resistance in reaction to changes in emotional stress. Muscular activity anywhere on the body will also influence skin resistance measured at the fingers, for example. If you measure the skin on your forearm and tense your neck muscles, a similar reaction may be gained from tensing your calf muscle.

Even when your body is otherwise relaxed, your skin will reflect emotional reactions readily and rapidly; it's instructive to watch a dramatic or favourite television show and observe your responses on a GSR meter.

The skin of a relaxed person has a low electrical conductance and therefore high resistance. When a person is stressed or otherwise agitated, their skin has high electrical conductance, that is, a low resistance.

Watch a politician who is asked a question that he'd rather not answer by a TV reporter. Nine times out of ten, he'll first lick his lips before giving an evasive answer. Why? His mouth goes dry in response to the reaction to the question. With repeated questioning, you'll see him rub or wipe his palms. Literally, he's sweating under fire. Predictably, at such times the skin resistance drops markedly.

As the actual value of skin resistance differs widely from person to person and with activity, general state of health etc, it is impossible to get a benchmark against which to measure or compare responses. The reading and magnitude of the response observed on a GSR meter is therefore never the same twice. All you are really looking for is a change, anyway.

Because skin resistance increases with

reduced stress, the feedback from a GSR meter – meter and/or tone – is arranged to decrease with increasing resistance between the electrodes.

The object is to learn how to get a decreasing indication and, with repeated use, you can train yourself so it takes less and less time to bring about a marked decrease in the GSR reading each time you use it. You can even train yourself out of using it!

The workings of our GSR meter are explained in the panel accompanying the circuit diagram.

Construction

A small, 90 x 35 mm printed circuit board holds all the small electronic components. This not only provides a convenient way to physically secure the components, but effects most of the interconnections as well, reducing the possibility of wiring mistakes. Only the balance and sensitivity potentiometers, the meter and two batteries are wired to the board.

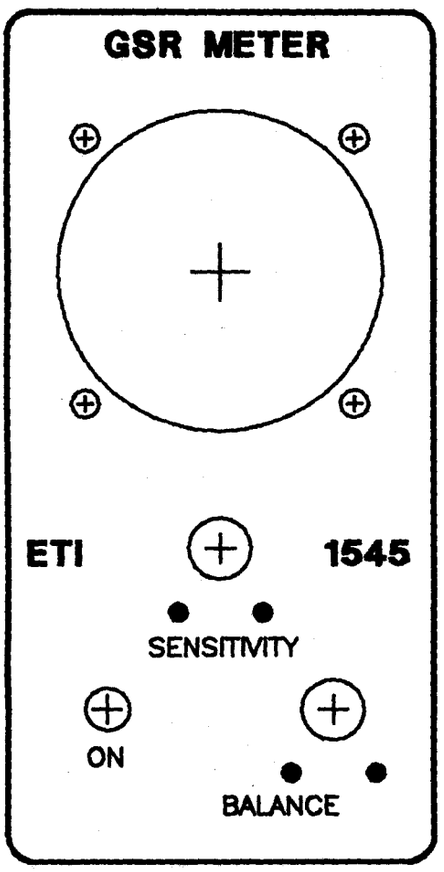
A small, plastic jiffy box was used to house the instrument. The meter and two potentiometers were mounted to the front panel, the pc board and two batteries secured inside using double-sided foam tape. The front panel is dressed up with a Scotchcal stick-on label or escutcheon.

First, examine your printed circuit board, whether you've made it yourself or bought a ready-made one. See that all the holes are drilled and of the correct diameter to fit the components. See that there are no small whiskers of copper between closely-spaced pads or tracks, particularly around the two ICs. It's better to discover and fix any problems at this stage than after you've completed the rest of the assembly.

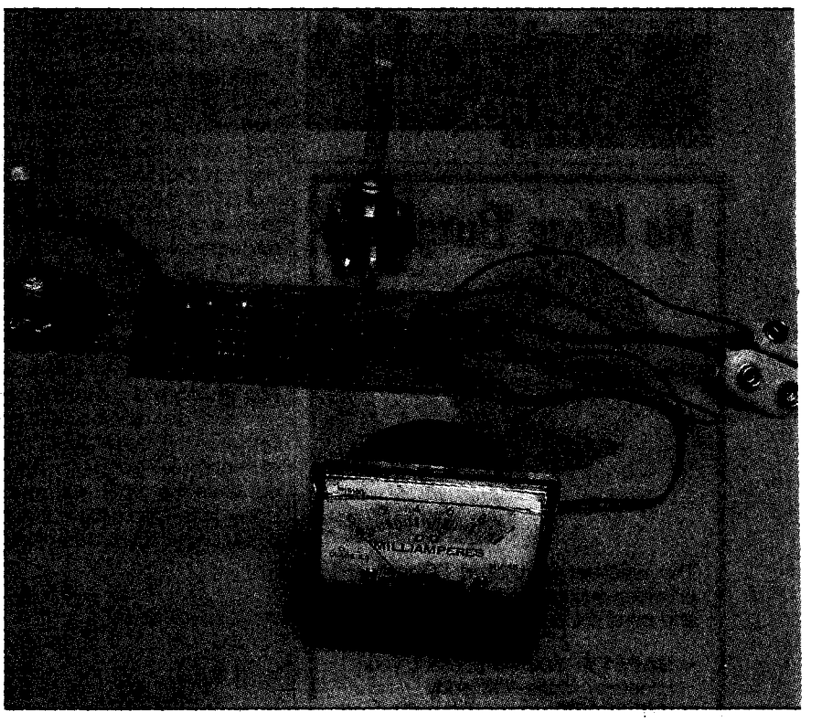
Once you're satisfied all's well with the pc board, you can proceed to solder the small components in place. The component overlay here shows their locations. You can proceed in any order, but check your work as you go. Take note of the orientation of the two integrated circuits and the diodes. This is important; get one or more wrong and it won't work, apart from the possibility of damaging an IC.

With the pc board completed, give it a final check, looking for dodgy soldered joints, solder bridges between closely-spaced pads, etc. Correct any suspicious joints or problems you discover. Saves time and heartache later!

Put the completed board aside and tackle the box next. Using the front panel artwork (or Scotchcal escutcheon, if you're using one) as a template, mark out and drill the jiffy box's front panel. It is wise to centre-punch each hole before you drill. With plastic, use a slow drill speed if you can. The holes for the potentiometers can be drilled with a small, say 6 mm diameter, drill first and then reamed-out as the plastic is quite soft. The meter cutout can be made by drilling a series

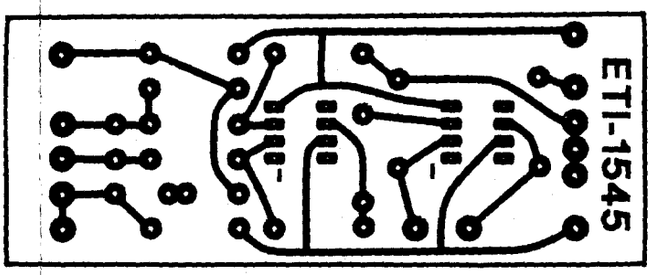


Front panel artwork, reproduced actual size.



View of the completed prototype printed circuit board readied for final testing.

GSR meter



Full-size reproduction of the printed circuit artwork.

of small holes around the inside edge of the large round hole, then carefully breaking out the centre piece. File the edge with a smooth half-round or moon file. Take care, or you may damage the panel.

If the potentiometers don't have short shafts, you'll need to cut them down to suit the knobs you're using. As a trial, mount the potentiometers, the on/off switch and the meter to the front panel to see all is well.

Tackle the Scotchcal escutcheon next. Whether you've made it yourself, or obtained a ready-made one (if you've bought this project as a kit, one will most likely be supplied), first place it over the front panel and see that it lines up and that no trimming is required. If there is, carefully trim it now. A steel rule and a sharp hobby knife are best for this.

Scotchcal has a sticky rear face, to glue it to the surface you want it applied to. Problem is, you only get one chance to get it right! Fortunately, there's a neat little trick you can use to overcome this limitation,

How it works

The circuit detects changes in skin resistance which are associated with stress or tension, and relaxation. Skin resistance rises with decreasing muscular tension and emotional stress but, as one associates a decreasing indication with decreasing activity, the feedback via the meter reading is arranged to decrease with increasing skin resistance.

The input of the GSR meter employs a special circuit known as a Wheatstone Bridge, named after the 19th century electrical pioneer and inventor. Its operation is best described by reference to Figure 1. Four resistances are connected to form the four arms of a diamond. A battery is applied between the top and bottom corners of the diamond (A-C) and a meter is connected between the other two corners (B-D).

The current from the battery splits at point A and flows down the two sides of the diamond as indicated by the arrows. Now, the unknown resistance – the skin resistance in this case – is connected between A-B. Resistor R1 is fixed in value. Now, if the ratio of R2:R3 is say 1:1, the voltage across D-C will be half the battery voltage. If the ratio of the unknown resistance to R1 is say 3:1, the voltage across B-C will be 1/4 the battery voltage. Hence, there will be a potential difference between D-B of 1/4 the battery voltage and current will flow through the meter. In this case, the bridge is said to be unbalanced.

If the value of R2 or R3 is then adjusted so that their ratio equals the ratio of unknown:R1, then there will be no potential difference between B-D and the bridge is said to be balanced. The value of the unknown

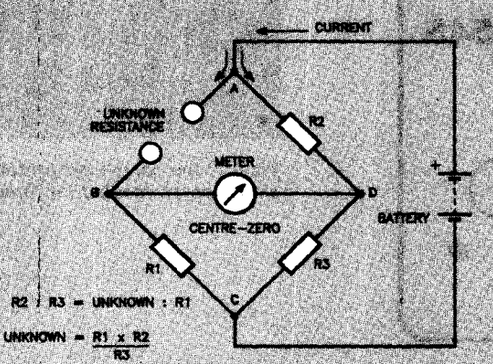


Figure 1. The Wheatstone Bridge circuit.

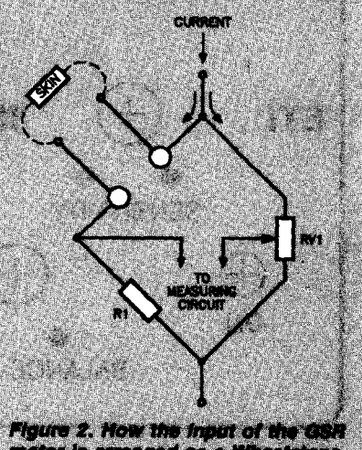


Figure 2. How the input of the GSR meter is arranged as a Wheatstone Bridge.

Parts List - ETI-1545

RESISTORS all 1/2 W, 5%
R1, 2, 3 ..... 47k
R4, 5, 8, 9 ..... 1k
R6 ..... 100k
R7 ..... 470k
R10 ..... 8k2
RV1 ..... 100k/A (linear) pot.
RV2 ..... 500k/A (linear) pot.
CAPACITORS
C1 ..... 100n greencap
SEMICONDUCTORS
D1, D2 ..... 1N914, 1N4148
IC1, IC2 ..... LM741, UA741
MISCELLANEOUS
ETI-1545 pc board; SW1 – DPDT miniature toggle switch; M1 – 1 mA meter or multimeter; plastic jiffy box – 130 x 68 x 41 mm; Scotchcal front panel; two small pointer knobs; two 9 volt transistor radio-type (No. 216) batteries and battery clips; skin contacts (see text).
Approx. cost: $27-$33.

which I learned from Peter Ihnat, one of the staff engineers who worked on ETI a few years back.

You soak the Scotchcal in water first, to soften the glue. About 10-20 minutes is ample. Leave the paper backing on it while you do this, or you're likely to get into all sorts of strife! When it's ready, wipe a wet sponge over the face of the panel, then peel off the Scotchcal's paper backing and carefully apply it to the wet panel. You can then carefully slide it into the exact position. Using the wrung-out sponge, smooth the Scotchcal in place, pushing any bubble towards the edges. When you're satisfied, put it aside to dry.

When it's thoroughly dry, cut the Scotchcal away from the holes carefully with a sharp penknife or hobby knife. Take care, lest you damage the Scotchcal. Now mount the meter, the switch and two potentiometers, taking care that you don't damage the Scotchcal when tightening the pot nuts. With the pots in place, screw the knobs on.

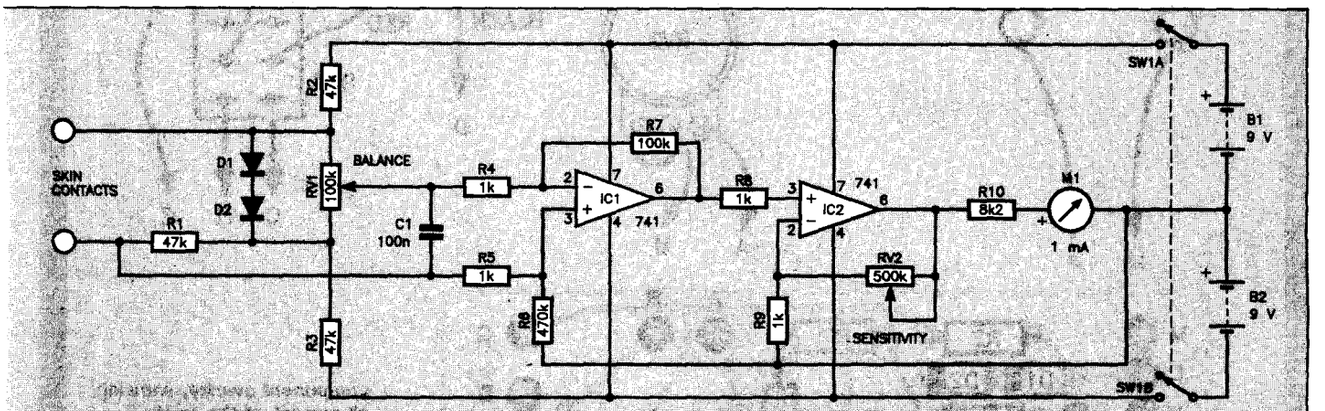
Now you can complete the wiring between the board, the two pots, the on/off switch and the meter using suitable lengths of light duty hookup wire. Make sure you wire them all in the correct way, as shown in the wiring details, or things will operate differently to what you expect.

For the leads to the electrodes, suitable lengths of hookup wire may be used. These only need to be about one metre long. Length is not critical, however. The leads may pass out of the case at the bottom of the front panel, via a small nick filed in the case so that the leads are secured when you screw the front panel in place.

The skin electrodes can be made from two round discs about the size of a ten cent coin. Chromed or passivated steel washers are ideal. Just solder the wires to one face and tape the other face of the disc to the finger with Velcro strips, which can be obtained from a haberdashery. Bandaids work well, too.

Using it

Take a little time to learn how to use your GSR meter. To use it to train yourself in the



Circuit diagram of the ETI-1545 GSR Meter. Despite the obvious simplicity, it's a sensitive and functional instrument.

resistance can be simply calculated, if you need to know it.

The actual values of R2 and R3 are unimportant, so long as their ratio is accurately known. With the value of R1 known to a given precision, the unknown resistance value is readily determined. The Wheatstone Bridge is widely used in electronics, particularly in precision measurement applications.

In our GSR meter, two electrodes are connected across part of the body to form one arm of a Wheatstone Bridge at the input. R1 and the balance control, potentiometer RV1, form the other arms – as shown in Figure 2. The output of the bridge goes to the measuring circuit, which involves two operational amplifiers here, IC1 and IC2.

The input bridge's output is connected across the two inputs of op-amp IC1. C1 shunts the bridge output to effectively short-circuit any hum and noise picked up on the electrodes.

The two diodes, D1 and D2, ensure the voltage across the bridge is limited to 1.2 V, providing regulation against supply voltage changes and limiting the maximum voltage that can be placed across parts of the body to about one volt or less. Resistors R2 and R3 in the circuit limit the current flowing through the input bridge to a low value (about 1/6th of a milliamp).

As the skin resistance can vary greatly from person to person, the balance potentiometer, RV1, must be able to balance the bridge for a very wide range of skin resistances. The balance potentiometer forms two arms of the bridge with its wiper becoming one of the output points. The other is the junction of R1 and the lower input contact.

At balance, the voltage developed across C1 is zero. If the skin resistance decreases, the bridge unbalances and a voltage appears across C1. This capacitor also provides a little smoothing of fast fluctuating changes.

IC1 amplifies the voltage from the input bridge's output by 100 times and the amplified signal appears at its output, pin 6. This is fed to the input of IC2 where the signal is amplified still further.

The gain of IC2 can be set between unity (that is, 1) and 500 by the sensitivity control, potentiometer RV2. A moving coil meter then displays the output of IC2. R10 limits the output current to a maximum of 1 mA to protect the meter from being overdriven, which slams the meter to full-scale.

The maximum gain of the circuit can be increased to about 250,000 by increasing the value of R7 to 470k. However, this was found to be too high, resulting in a very unstable reading with most electrodes.

techniques of relaxation, organise a comfortable armchair for yourself, in a room away from outside distractions with low, but not dim, lighting. Cigarettes, alcohol and other drugs – cough medicine even, can affect your responses, so they're out.

The index and middle fingers of your non-dominant hand (left, if you're right handed) are a good place to attach the electrodes. Sit down and make sure you're comfortably relaxed, as much as you normally can be. Support your arm on the chair's arm rest. Set up the GSR meter so that you can easily see the meter and reach the controls with your other hand.

Set the two controls to their mid positions. Turn on the meter and adjust the balance control to put the needle on-scale. For a minute or two, the reading may wander quite a bit. After a while, the reading on the meter should stabilise and you can set the meter reading using the balance control. The meter can either be set for a near full-scale reading or a centre-scale reading.

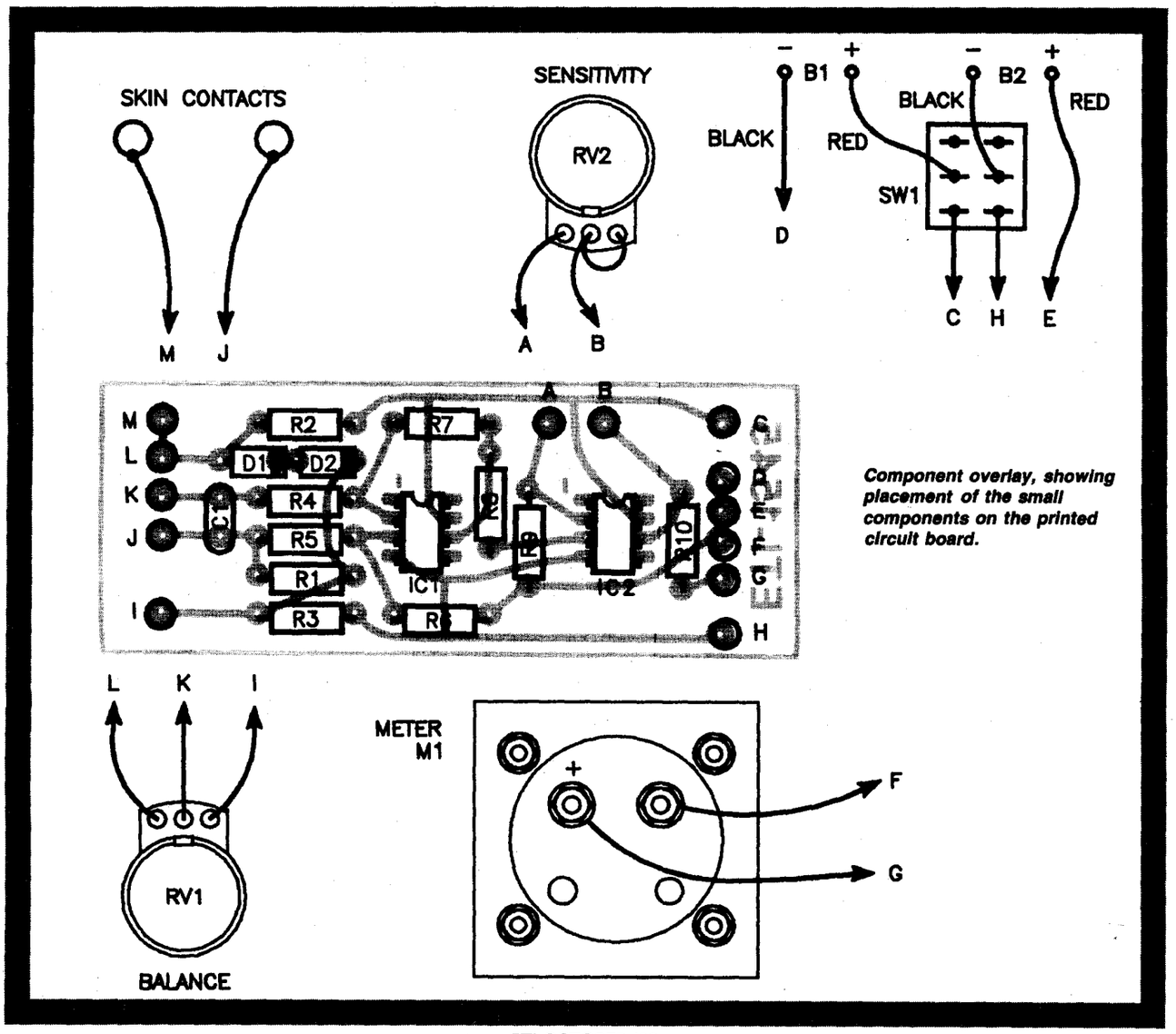
Increase the sensitivity control as far as you can while maintaining a fairly steady reading. Now relax! After watching the reading for a while you will notice it move up or down. This indicates something has happened to cause a change in your skin resistance. You might only be barely aware of it, but you are now in a position to try to reproduce the effect. With repeated use, you become more aware of how to make the reading decrease, and thus learn how to control your tension and relax. The technique that gets the result can vary from person to person.

If you get the meter to drop to zero, simply reset the balance control to bring it back up-scale again. As it drops further, you may also increase the sensitivity.

How long should a session take? Various sources give differing recommendations, but it seems something around 15-25 minutes is the go.

One advantage with visual feedback alone is that you can put a soothing music cassette on your Walkman, don the headphones, relax and watch the meter – no need to listen to a boring tone, trying to get it to drop!

You can also use the GSR meter to indicate increases in tension or stress, or other emotional reactions. You might use it as a fun lie detector in this way – amusing at parties! Stabilise the meter reading as described earlier, gauge the reaction to innocent questions and then ask a mildly embarrassing question. One other way to get a stress reaction is to burst a balloon or clap loudly behind them!



Component overlay, showing placement of the small components on the printed circuit board.

ROGER HARRISON

ANSWERS & ARGUMENTS

This column is intended as a forum for exchange between you, the readers, and the magazine. Via this column I'll answer queries on projects, general questions on electronics and related subjects that may puzzle or concern you, engage in a little argument on topics of interest, or discuss subjects you might like raised. It's up to you! Short letters will be appreciated, long ones may be edited; if asking questions, confine your letter to one or two topics please. Send your letters to: Locked Bag 888, Rozelle NSW 2039.

Remote drive for 5000 stereo amp

I have a Series 5000 pre/power amp set-up and would like to install a second pair of speakers 12 metres away in another room. At the remote speakers I need separate volume and program source control. I have a second 5000 power amp available and intend to run a shielded cable from the 5000 preamp line out into a remote preamp to control the remote power amp and speakers.

Am I looking for trouble or should that arrangement suffice? Should the signal be delivered by balanced line and if so how? The boys at Jaycar mumbled something about direct inject boxes but suggested I seek proper advice.

What preamp kits can you suggest? I only need line level inputs, volume and balance control. For this reason another 5000 preamp would be overkill.

Thanks so much for this forum; I have been saving this question for too long.

Yours sincerely,

B.F.,
Hadfield, Vic

You're unlikely to get away with running coax from your 5000 preamp's line output for 12 metres. Ignoring line capacitance loading effects, the potential for hum and noise pickup with a run that length is considerable. Hence, I suggest you run balanced, shielded cable. You will need to add on a balanced line driver at the 5000 preamp's output and a balanced input converter at your remote 5000 amp's input and run.

Figure 1 shows the circuit of a suitable balanced line driver, and Figure 2 the circuit of a suitable balanced input converter. Note that the circuits shown are for one channel only; two are needed, one for each stereo channel.

The balanced line driver employs IC1 (NE5534) as an inverter, its output driving a National Semiconductor LH0002RH unity gain precision op-amp. Resistor R2 provides overall feedback and maintains the stage gain at unity. You have to watch the grounding, note. For the LH0002RH, try Stewart Electronic Components, PO Box 281, Oakleigh Vic 3166. ☎ (03) 543-3733.

Note that 3-pin XLR connectors are shown; I'd recommend you use these.

The balanced input converter employs another NE5534, the differential input being arranged to present a 600 Ohm load to the line, allowing the use of common commercial balanced audio cable. The RC input network provides from high frequency rolloff outside the audio passband to obviate any unwanted RF pickup.

For your remote preamp, there's nothing around that I am aware of that would suit your application directly. However, I suggest you use the back end of a 5000 preamp – only the circuitry involving ICs 7, 8 and 10 on the ETI-478MB board, just adding the master level and balance controls. You can house it in any suitable-sized metal case and power it from the 30 Vac output from the 5000 amp. The balanced input converter stage

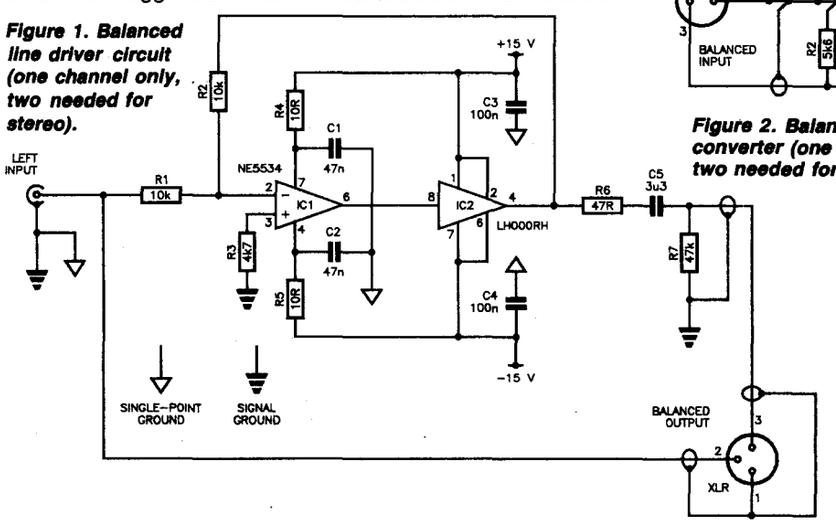


Figure 1. Balanced line driver circuit (one channel only, two needed for stereo).

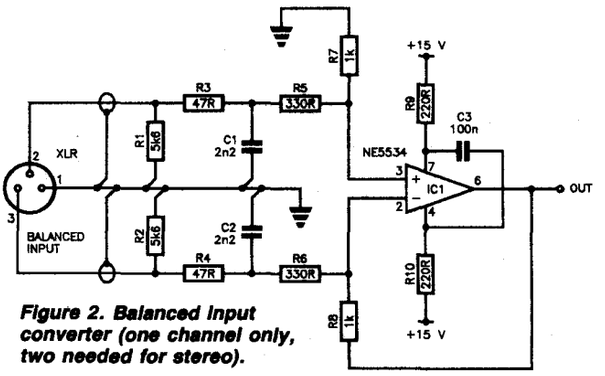


Figure 2. Balanced input converter (one channel only, two needed for stereo).

can be wired up on a small piece of matrix board and powered from the 15 supply rails off the ETI-478MB board.

Great covers!

Another great cover in July! But, just what was it?

L.D.,
Melbourne, Vic.

Sorry, we missed a caption and credit for the cover in July. The picture is a rather spectacular view of a solar prominence erupting from the Sun's surface, caught as it rounds the solar limb.

The picture came from Charles Willock of IPS Radio and Space Services, a branch of the Australian Government's Department of Administrative Services.

He explains:

"The prominence has been colour-coded to show brightness of the suspended gases, while detail of the solar disc has been suppressed to black.

"Created from an original by the CSIRO Culgoora Solar Observatory, this image was digitised at the Anglo-Australian Observatory and enhanced at the Centre for Remote Sensing at the University of New South Wales."

Decimal to 7-seg. decoder problem

First, may I thank you all at ETI for producing a high quality, well presented and informative magazine. Complimentary words could flow like water through a sieve ... But enough of this.

The Idea of the Month published in ETI May 1989, page 89, is what I would like to talk about. The concept of the decimal to seven segment EPROM Converter is excellent, as was the equally innovative Scope Soldering Station that was awarded as a prize.

I would like to bring to your attention a couple of basic errors. The drawing as published would/will not operate properly; there are also errors in data encoding.

1. The collector outputs are listed as:

DO = a (display segment)
D1 = b
D2 = c
D3 = d
D4 = e
D5 = f
D6 = g

Although they should be in this sequence, they do not correspond entirely with the DATA hexadecimal information as is presented in the table.

Some data bits are either the wrong hex number and/or incorrect binary equivalent. Also some information is 8-bit data instead of 7-bit data.

Best wishes to you all, and a cheery welcome back to Roger,

A.B.,
Smithfield, NSW

Well, thanks for the accolades and pointing out the problems with the decimal to seven segment decoder. Unfortunately, your detailed analysis and solution were too voluminous to reproduce here.

Another reader noticed the same problem and also supplied an analysis and solution. As his takes less, space, let's see what he has to say.

Solution to dec/7-seg decoder problem

I would like to take you to task on your presentation of the Idea of the Month award for May (page 89).

While you may have a busy time, it is a pity you did not take some time to ensure correctness of the article before awarding a prize. I refer to the program for the EPROM decimal to seven segment decoder.

From the data supplied and the circuit diagram, I analysed its operation and found the resultant display would be rubbish. After some investigation, I think the data should be as shown in Table 1, which gives the required display.

A.W.,
Mudgee, NSW

I believe this item was selected by Terry Kee, but was published after he left earlier this year. It seems something's been lost or gone awry in the translation between the original entry and the published item. I don't know, because the original can no longer be found. Anyway, the above should sort things out.

Thank you for your diligence and efforts, gentlemen. I'm sure other readers will appreciate it.

NUMERAL		7 6 5 4	3 2 1 0
	DATA	G F E	D C B A
0	3F	0 1 1	1 1 1 1
1	06	0 0 0	0 1 1 0
2	5B	1 0 1	1 0 1 1
3	4F	1 0 0	1 1 1 1
4	66	1 1 0	0 1 1 0
5	6D	1 1 0	1 1 0 1
6	7D	1 1 1	1 1 0 1
7	07	0 0 0	0 1 1 1
8	7F	1 1 1	1 1 1 1
9	6F	1 1 0	1 1 1 1

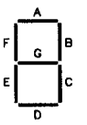


TABLE 1

Electronic gas stove igniter

I fear that my problem may lie outside the guidelines of your column. If that is so, I offer my regrets for being troublesome. But I should be very grateful for any comments you care to offer.

The subject of my query is a battery-powered spark generator used as an igniter for the domestic gas oven. I used one, bought from a shop, for years. The shop admits no knowledge of them, now.

A mishap broke the thin, brittle plastic case of the unit and disordered the electrical circuitry. The simple mechanics of my repair activities went well enough but I have not been able to locate the electrical defect which prevents the thing working now. Can you direct me to any published circuitry and data for such a device? Or a source of supply?

That original model apparently is no longer on sale. I note there are several versions of the trigger-operated piezo-electric igniters all of which have the same unsatisfactory nature:

(1) An elderly and somewhat arthritic woman must use two hands to operate the trigger device, and (2) the low energy level of the spark makes the thing slow and repetitious to a frustrating degree.

From memory of the old, now broken, device I visualise one I might make for myself. It is about the size of a common, long electric torch with a two-cell, three-volt power supply, delivering a pulsed, capacitor-discharge type of spark at an applicator tip at least twelve inches long – to reach to the back of the oven burners – from a handle housing the battery and circuitry.

I see such a construction as practical enough, but I lack information on the required circuitry and the solid-state components and similar data. I should be most grateful for your comments.

T.H.,
Claremont, WA

I understand your problem! While it's beyond the scope of this column to undertake individual designs to solve readers' problems etc, delving into my files of "possibly useful circuits that might come in handy one day or are just plain interesting", I found a circuit that might be of interest.

The simple circuit shown in Figure 3 should provide a basis from which you can begin to construct your gas stove igniter. I'll leave the mechanical details to you, as you seem to have that well in hand anyway.

It works like this: Q1, a unijunction transistor (2N2646 or DS2646), is connected as a simple pulse oscillator with a repetition frequency of a few pulses per second. The pulses appearing across R2 are capacitively coupled into the base of Q2. This transistor turns on with each pulse, providing a high current pulse to the base of Q3.

The collector current pulse of Q3 creates a voltage pulse across the primary of T1 which the secondary multiplies to thousands of volts. A flyback or EHT transformer from a VDU is specified here because they are small, designed to operate from a low voltage supply and generate a healthy level of kVs at the secondary. You'll have to hunt around computer service or spare parts organisations for this component. All the other components are readily obtainable from most electronics retailers.

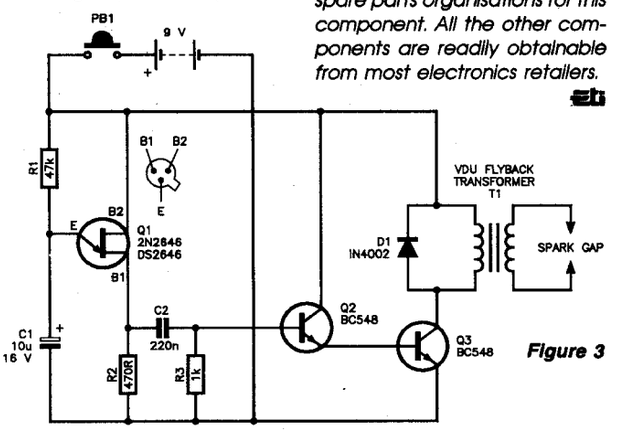


Figure 3

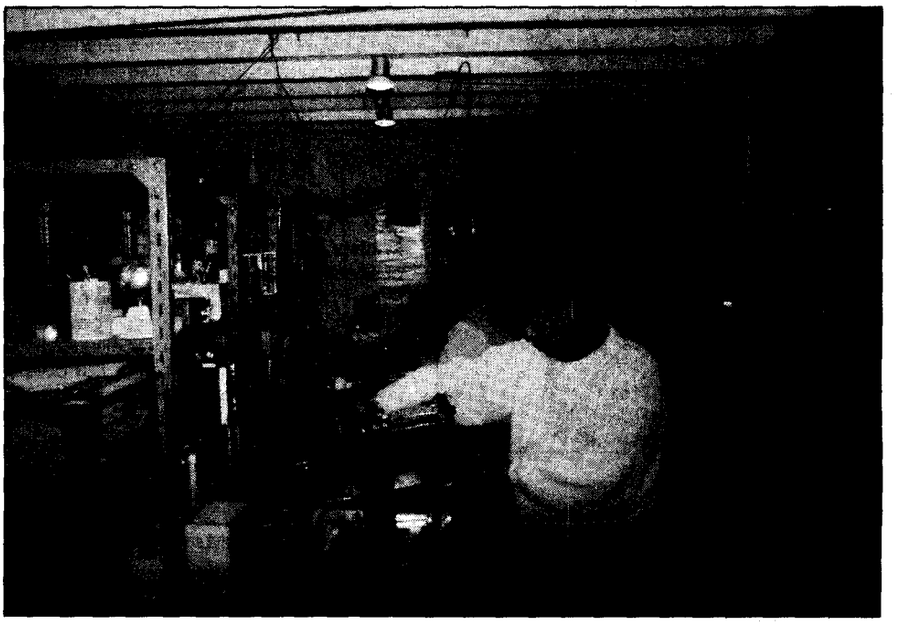
ICOM — KEEPING AN EYE ON THE FUTURE

The ICOM story starts more than 35 years ago when Inoue Denki Seisakusho, a small electrical equipment assembly company, was commenced in Kyoto, Japan, by Tokuzo Inoue.

With a change of name and a specialisation of product, ICOM Incorporated has become a world leader in the field of amateur and commercial radio products. World-wide sales are in excess of 20 billion Yen per annum (approximately AU$200m).

Japan's first transistorised amateur transceiver, the world's first MOS-LSI radio, and more recently the first general coverage receiver from 100 kHz to 2 GHz are just a few of the innovative developments to come from the ICOM factory.

New product development is entrusted to a creative development department combining the proven experience of department leaders with the fresh ideas of new staff members. Their aim is to produce products second to none in terms of technology and quality.



ICOM Australia's service department.

ICOM Australia

ICOM Australia was established in December 1982 by the current managing director, Mr Kyoshi Fukushima. Like the other ICOM subsidiaries around the world, the local office works very closely with the head office in Osaka.

From the original staff of just three people, ICOM Australia now has twelve people in Administration, Marketing & Sales, Technical Support and Store/Warehousing functions. And the company is still growing, with a steady rate in excess of 30% per annum.

Having a technical background himself, Mr Fukushima is in the ideal position, an administrator who understands the technology of his products. The fact that he can communicate directly with the factory means there are none of the communications breakdowns which often occur due to language difficulties.

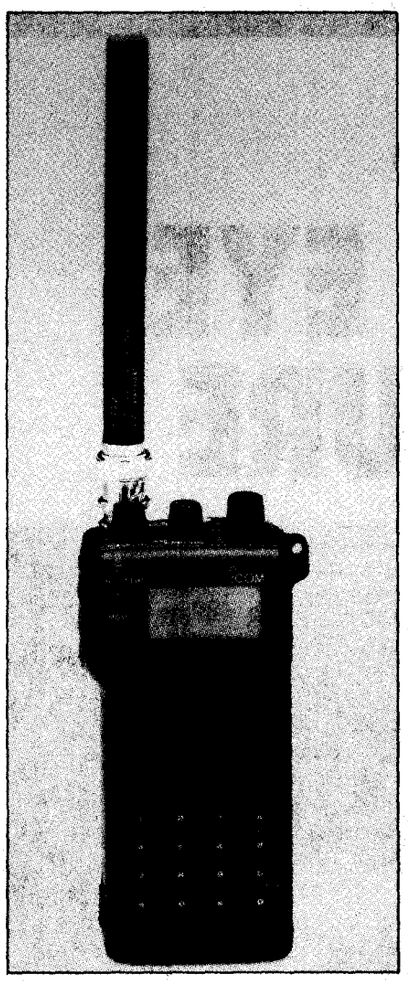
Being a subsidiary instead of a manufacturer's agent or distributor has big advantages for ICOM Australia. For a start, the exchange of information is much more direct and frank than would otherwise apply.

Instead of hearing of new models or developments after the event, ICOM Australia is involved at the planning stages, applying local input so that models can be made to accommodate our sometimes quaint laws and licensing requirements. Prototypes are available to the local office for evaluation and comment, without the attendant risks of a security breach this might otherwise have.

Feedback from ICOM Australia to head office is much more direct. Like any highly technical product, there are the occasional bugs, and both ICOM Australia and head office treat any problem with absolute priority.

The factory has set up an Internal Quality Guarantee division, specifically to investigate any problems, no matter how small. This division has been given wide powers in the factory, it can over-rule any other division (manufacturing, marketing, etc) until it is satisfied that any problems are completely solved, even if this means expensive delays in production.

Of course, ICOM Australia also enjoys a price advantage. Being a subsidiary means the company is regarded as a sales office,



The IC-2 handheld.

and is supplied at the best possible factory prices, with no middlemen, agent's margins or commissions to worry about.

Distribution

ICOM products are distributed Australia-wide through a network of authorised dealers. Before being appointed a dealer, the principals need to demonstrate not only their ability to handle the product from a financial viewpoint, but also at a technical level.

Some of these dealers are specialists in a particular type of product (for example, Marine Radio). Others supply the whole range of ICOM products. A few of the larger dealers also supply their own warranty and general service, with their technicians receiving specialist training by ICOM Australia.

ICOM Australia not only has a highly efficient service centre (including technicians trained in the ICOM factory), but has a spare parts inventory in excess of a quarter of a million pieces to back up the entire product range. This stock is also available to external service organisations.

ICOM product range

ICOM's product range is divided into four main market areas.

Amateur Radio: Best known to Australians is, of course, the amateur radio product range. From the ubiquitous IC-2 hand-held with all its variations, through to the most advanced multi-band, multi-mode transceivers.

ICOM's amateur radio range has a very loyal following amongst end users – ICOM Australia's market research has shown that over 80% of ICOM owners will almost automatically buy another ICOM transceiver.

Marine Radio: Becoming equally as popular as amateur radio, and probably helped along by it, is ICOM's Marine Transceiver range. This product group has seen a huge increase in demand, partly because of a change in regulations making radio compulsory on most vessels.

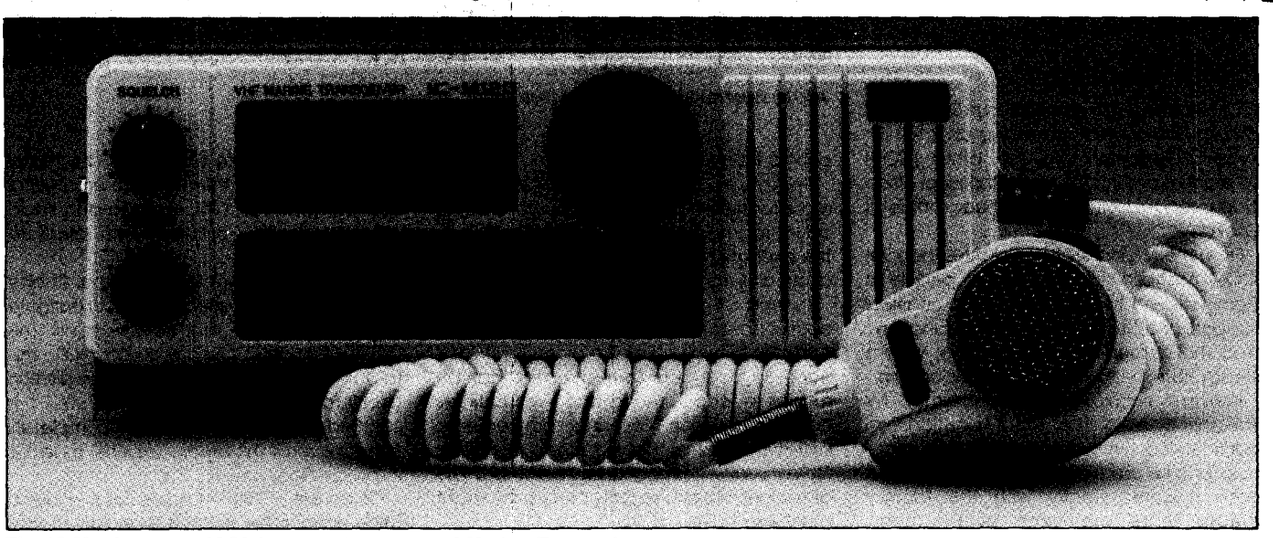
Mr Kyoshi Fukushima, managing director, ICOM Australia.

ICOM has a large range of transceivers to suit both the HF marine and VHF marine bands. Again, products are particularly innovative such as the recently announced M-800 HF marine transceiver, which is a "split system" allowing the control unit to be mounted in areas subject to spray.

The VHF marine band is equally well catered for with an excellent range from the very basic to the very extensive. VHF marine radio offers significant advantages over the more common 27 MHz.

A recent publication showing details of newly-constructed vessels (Commercial Vessel Yearbook 1988/89) showed a high proportion selecting ICOM HF and/or VHF marine transceivers. Commercial fishing vessels, in particular, use ICOM marine in large numbers.

ICOM's motto, 'Look not at today. Keep your eyes on the future', will almost certainly ensure continued success for the company. eti



The IC-M120, part of ICOM's extensive range of Marine Transceivers.

JUST WHEN ICOM WERE SATISFIED IT HAD BEEN THROUGH EVERY TEST IMAGINABLE, THE C.F.A. CAME UP WITH A NEW ONE.

The burning off of the 5 hectares paddock in North Geelong was over.

The crackle of burning grass had died down and the smoke was beginning to clear, when a familiar squelch sound could be heard nearby in the burnt grass.

One of the duty officers followed the sound to its source: it was the IC-H12 handheld transceiver that had accidentally fallen off his belt clip during the burn off operation. Although the transceiver had almost been melted beyond recognition, it still sounded as if it had a lot of life in it. Though if you were going by looks alone, you would have left it for dead.

But luckily, when it had cooled down, the duty officer tested it out by calling base.

Base responded immediately.

After 2 hours in a fire, it could still transmit and receive!

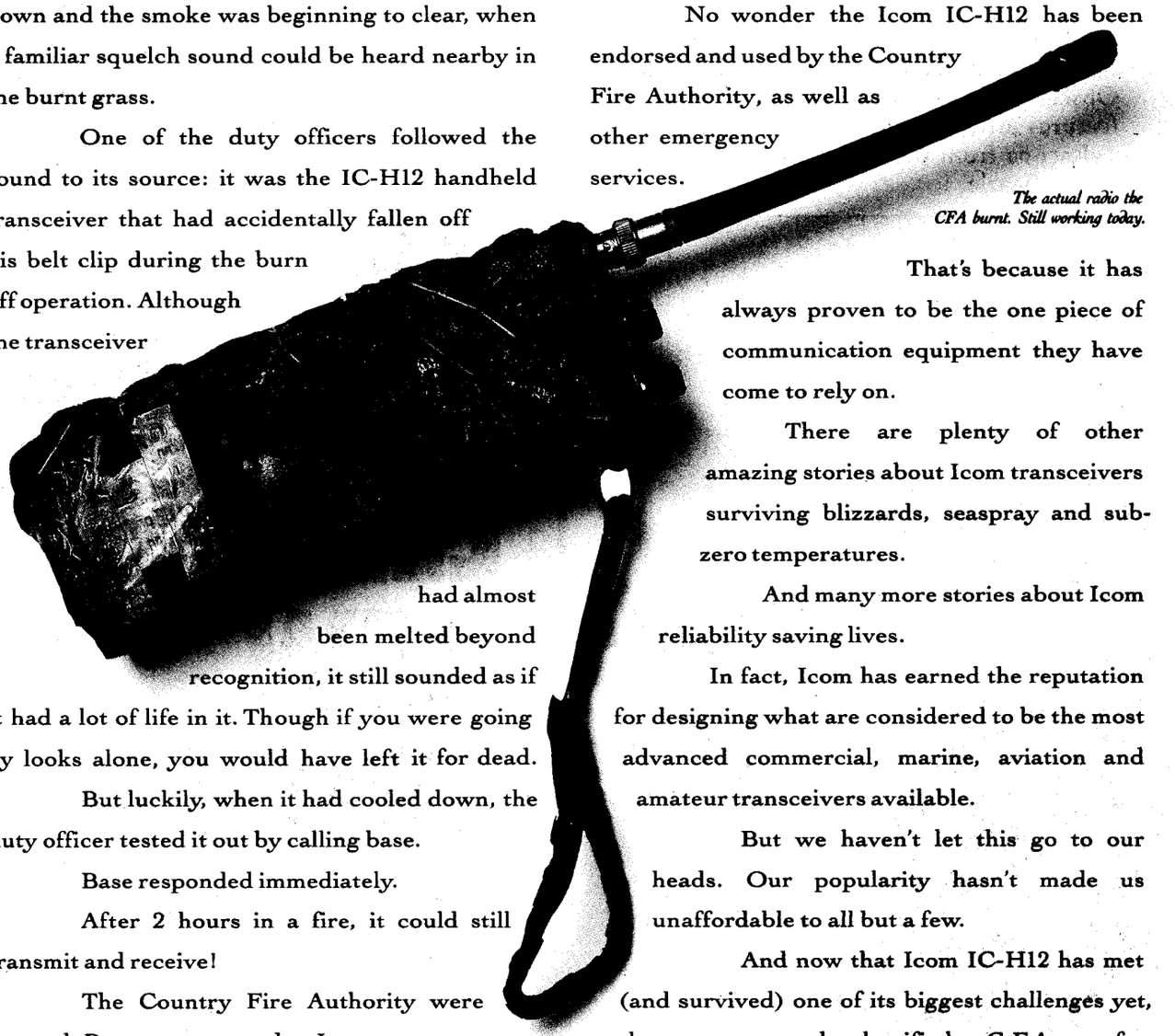
The Country Fire Authority were amazed. But not as amazed as Icom.

After all, Icom were convinced they had put the IC-H12's reliability and durability through every testing condition imaginable.

But no-one, not even Icom, imagined that it could have survived beyond melting point.

Until now.

No wonder the Icom IC-H12 has been endorsed and used by the Country Fire Authority, as well as other emergency services.



The actual radio the CFA burnt. Still working today.

That's because it has always proven to be the one piece of communication equipment they have come to rely on.

There are plenty of other amazing stories about Icom transceivers surviving blizzards, seaspray and sub-zero temperatures.

And many more stories about Icom reliability saving lives.

In fact, Icom has earned the reputation for designing what are considered to be the most advanced commercial, marine, aviation and amateur transceivers available.

But we haven't let this go to our heads. Our popularity hasn't made us unaffordable to all but a few.

And now that Icom IC-H12 has met (and survived) one of its biggest challenges yet, perhaps we can now be classified as C.F.A. proof.

For more information phone Icom on Melbourne (03) 529 7582 or elsewhere in Australia on (008) 338 915.

ICOM

Ball ICO 0035

READER INFO No. 11

TECHNOLOGY

AN OLD DOG LEARNS NEW TRICKS

On June 7, the University of New South Wales officially opened a new facility at the windy Siding Springs Observatory near Coonabarabran in northern NSW. It features an extensively refurbished Automated Patrol Telescope from the early space era. By Roger Harrison and Adam Searle.

The Automated Patrol Telescope (APT) began its career as one of an original twelve Baker-Nunn cameras set up around the world by NASA to track the first satellites in the late 1950s.

The world-renowned Smithsonian Astrophysical Observatory was given the job of designing and commissioning the APT in 1955. Its optics were designed by Dr James Baker and produced by Perkin-Elmer in the United States. Mr J. Nunn created the mechanical design of the device, and Boller and Chivens, a small company then, produced the entire telescope.

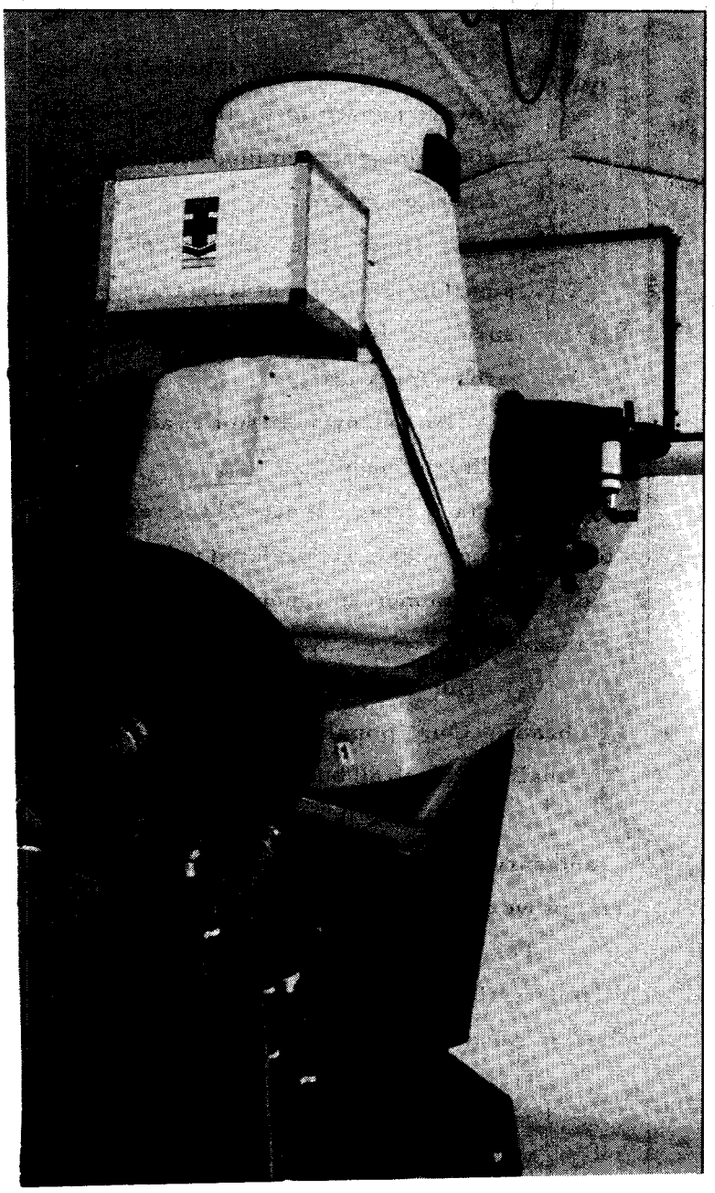
The APT was an advanced instrument for that era, being of completely new design and for a new purpose. The twelve cameras were produced without a prototype and with minimal testing, all within a space of less than two years. Those were the days of the space race!

The first test Baker-Nunn photograph was taken on October 2nd, 1957. Two days later, the USSR launched Sputnik 1. On that satellite's first pass over South Pasadena, where the APT was located, on October 17th, the camera took a successful film recording of its transit.

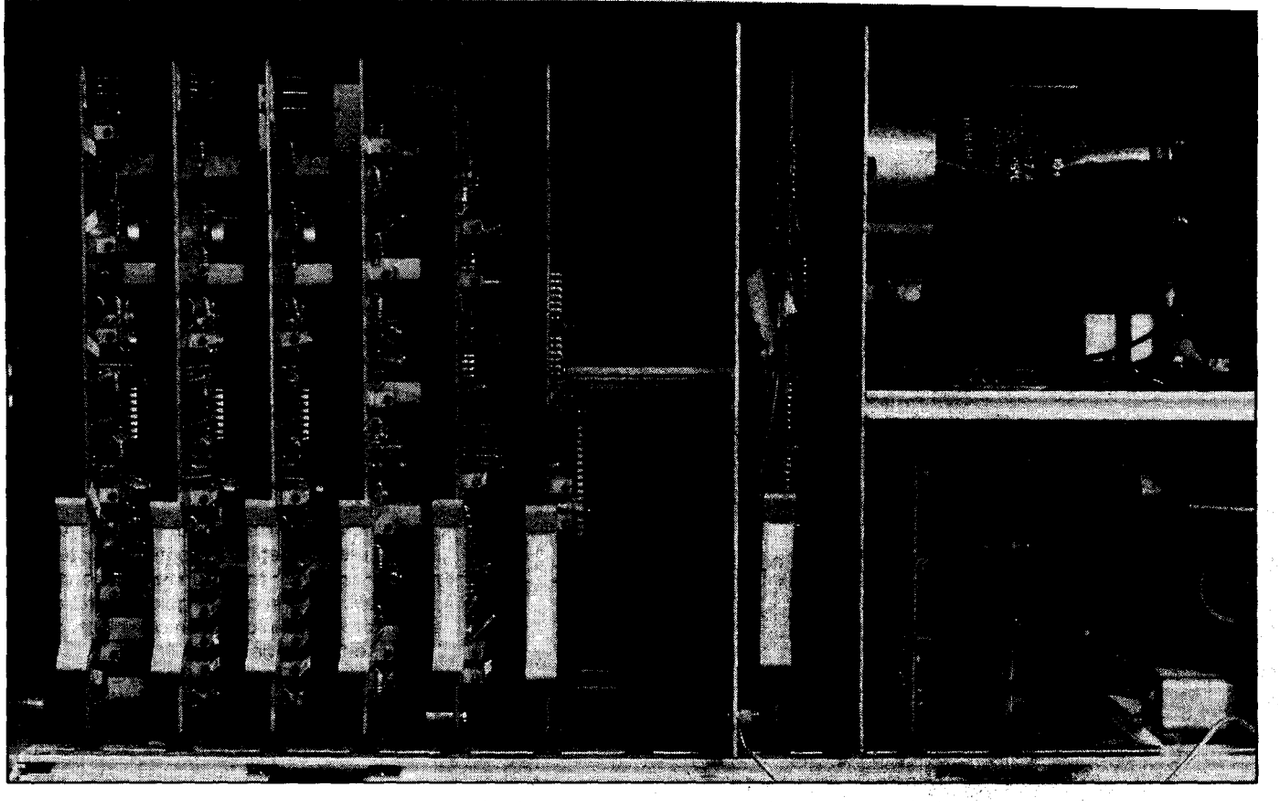
Our APT

The APT allocated to this country was located at the Australian Weapons Research Establishment at Woomera in South Australia as a contribution to the International Geophysical Year. Its first photograph was taken in March 1958, and the telescope took some of the early shots of the Sputnik flights.

After fifteen years in operation, the APT was closed down in 1973. It was then put on ice and moved to Orroral Valley outside Canberra, although it was never used there. Eventually its then-owner, the Smithsonian Institute, donated the telescope to the



The Automated Patrol Telescope, a refugee from the early space era of the late 1950s, now performs some fancy new tricks at the cutting edge of today's astronomy following an extensive refurbishment. The original az-alt-alt three-axis mount has been swapped for a brand new equatorial mount and the original photographic film transport mechanism exchanged for a modern charge-coupled device (CCD) detector (the large box at the top) constructed at the UNSW School of Physics. (Photos by B.D. Carter).



This shows the readout electronics for the CCD camera, which is mounted inside the white box atop the telescope.

School of Physics, University of NSW in late 1982.

The APT has a 780 mm diameter mirror with an aperture of 500 mm. Focal length is 500 mm (f/1).

Now, after some refurbishment, it sits on the hill at the Siding Springs Observatory with the other seven telescopes, including the enormous Anglo-Australian Telescope (AAT) and the Australian-designed and assembled Advanced Technology Telescope.

A new building was constructed at Siding Springs to house the refurbished APT. It is now the only one of its kind operating in the world. Financial support for the conversion of the APT and construction of the building was provided by The Ian Potter Foundation, the Australian Research Grants Scheme and a Major Equipment grant from the University of New South Wales.

Renovations

The original three-axis azimuth-altitude-altitude mount has been changed to an equatorial mount. This is a two-axis arrangement, commonly used with astronomical telescopes. One axis is sited north-south, parallel to the Earth's axis, enabling the telescope to be driven so as to compensate for the Earth's rotation (right ascension). The other axis sets the telescope's declination – how far it points from the celestial equator.

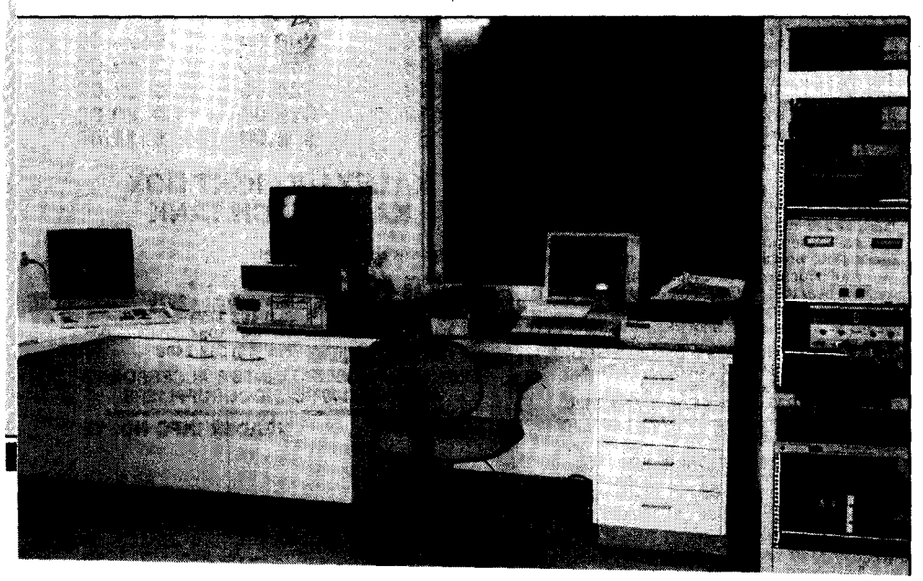
The right ascension drive employs a printed armature motor which drives a friction wheel through a harmonic drive. The declination drive also employs a printed armature motor, which drives a worm wheel through another harmonic drive. The drives were specifically, and extensively, modified for computer control. Each axis is fitted with incremental and absolute encoders which transmit the telescope's position to the computer control system. Declination limit to the south is –75 degrees.

The original photographic film transport mechanism has been replaced by a highly sensitive Charged Coupled Device (CCD) camera constructed at the NSW University School of Physics. This is based on a GEC detector with 385 by 578 pixels providing a field of view of 0.9 by 1.4 degrees, giving a pixel size of eight arc-seconds square. Two modes of operation are available:

(1) TV-rate readout, providing an analogue signal for live display, and

(2) Slow readout with 12-bit digitisation of each pixel (following a pre-determined integration time.)

Overall control of the refurbished APT is provided by an NEC APC IV personal computer connected via a GPIB bus to an Apple IIe computer, the CCD camera controller and a TV memory unit. The Apple carries out all guidance functions via



View of the APT control room, and the telescope room beyond. Note the NEC APC IV (left of the chair) and Apple IIe computers (right of the chair), used for telescope control and data handling.

View of the APT building with the roof section moved away for observing.

microprocessor-controlled servo units. Half the CCD array can be read out independently for autoguiding.

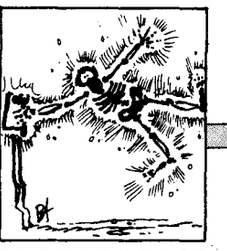
Applications

The APT is presently being used to search the stars for phenomenon such as supernovas. With an exposure of only five minutes, it can detect stars more than 100,000 times fainter than that sighted by the human eye. It can also observe, in a single exposure, a region six times the size of the moon. To cover the same area would require some 400 exposures using a conventional telescope.

With capabilities such as these, the APT can be used to identify the optical counterparts of gamma ray bursters, search for supernovae in distant galaxies and obtain photometric information on objects over a wide field of view.

As the CCD camera is taking an image, the preceding one can be analysed on-line by the telescope's computer. Normally in this kind of study, astronomers examine their data away from their telescopes over a period of months. eti

The authors would like to thank Dr Bradley Carter for his assistance in providing material and photographs for this article.



ELECTRONICS

ETI PROJECT BUYERS' GUIDE

Readers who've been with us a while will remember this column from earlier years. For those who have only recently become readers, we're resurrecting *Shoparound* to let you know which firms are stocking kits for current projects published in the magazine, those firms stocking printed circuit boards, and companies that carry components used in projects we've published, along with interesting and useful snippets of news about products and services of interest to electronics enthusiasts.

Electronics retailers and other suppliers are circulated with information on projects to be published in ETI some three months in advance of publication. This is then checked as close as possible to the date this column has to be prepared, but there is still a time lag, you will appreciate, of around six weeks before the magazine appears and many things can transpire in that time that may affect the availability of a particular component and thus the availability of a kit. This is something entirely beyond our control, and often beyond the suppliers' control. The information supplied in this column is as accurate as we can ascertain at the time of writing, so please understand if the situation is different by the time you check with suppliers.

ETI-1550 Telescope Drive Controller

Now this project, of necessity, requires a couple of specialised bits, as explained in the article – the stepper motor and motor controller IC, the SAA1027. The 50k ten-turn horizontal pc-mount trimpot (PT1) should not be difficult to obtain, although it's a comparatively expensive item.

As the article explains, the SAA1027 is a Philips part. Radiospares Components list it as a stock item (no. 300-237). They have offices in Sydney, Melbourne, Brisbane, Adelaide and Perth. We discussed this project with Andrew Frolley of All Electronic Components in Melbourne, who said he would look at stocking it. So, Melbourne, or Victorian, constructors may try All Electronic Components at 118-122 Lonsdale St in the city, ☎ (03)662-1381.

Stepping motors are another matter. Here, you will truly have to "shop around". From a little sleuthing, we determined that they are available either new or as surplus stock clearance items. Just make sure that you select one that will handle the torque required, but this is not great unless you are driving a *very large* telescope. The two firms mentioned above – Radiospares Components and All Electronic Components – can help with your stepping motor requirement, too.

From the Radiospares Components catalogue, it would seem the 332-953 stepping motor would be better suited to drive typical amateur telescopes. It features a 7.5 degree step and can be directly driven by the SAA1027.

All the other components are commonly stocked by retailers. You can suit yourself with regard to connectors, the case and switches etc.

ETI-1545 GSR Meter

All the components for this project are widely obtainable from electronics retailers. The particular 130 × 68 × 41 mm jiffy box used came from Rod Irving Electronics, as did the knobs seen on the picture of our prototype. The 741 op-amp used is THE most common op-amp currently available, and costs under a dollar from almost any supplier.

We had not received indication of which suppliers may stock kits at the time we went to press. However, why don't you enquire with stores such as Rod Irving Electronics in Melbourne and Sydney, and All Electronics Components in Melbourne.

PCBs — general

Printed circuit boards for ETI projects are generally obtainable from three suppliers:

All Electronic Components, 118-122 Lonsdale St, Melbourne VIC 3000 ☎ (03) 662-1381.

Acetronics, 112 Robertson Rd, Bass Hill, NSW 2197 ☎ (02) 645-1241.

RCS Radio 651 Forest Rd, Bexley NSW 2207 ☎ (02)587-3491.

However, these firms are not able to supply boards for projects where the pc board copyright is retained by the author or kit supplier. Check the details in the article first or, if they're not to hand, check with one of the suppliers above to see if they do stock it and that they have stocks on hand.

Don't forget that Scotchcals of front panels and meter scales, etc can also be supplied, where available, by the above firms. eti

eti AWARDS

As foreshadowed in the August and September issue editorials, ETI has decided to sponsor a series of industry awards, to recognise outstanding electronic products in a variety of categories and to encourage excellence and entrepreneurial endeavour.

For the 1989 inaugural ETI annual awards, four categories were identified for the purposes of judging:

- Test & Measurement Instruments
- Board Level Products
- Pro-sound & Broadcast Equipment
- Communications Equipment

An additional award was also mooted, to be given for an Australian designed and produced product considered worthy of recognition for its particular innovation or engineering endeavour. It was agreed that this award could be issued either for one of the products in the above categories, or for a separate product.

A category to cover consumer electronics was not included for a number of reasons, but it's an area we'll likely address a little further down the track.

Our judging panel comprised three disinterested worthies with a collective wealth of experience in many fields of electronics: ETI's Electronics Editor Roger Harrison, ex-CSIRO research physicist and computer expert from Sydney, Jack Middlehurst, and teacher/author/engineer John Day, from Stewart Electronic Components in Melbourne.

Rather than call for nominations, we chose to let the panel members search out products they adjudged worthy of consideration, based on personal experience or research or from customer recommendation or whatever, and then argue the toss at a joint meeting (or meetings; whatever it took!).

After assembling our nominations in the various categories, we gathered in Sydney recently to discuss the merits of each candidate product.

The broad criteria used were that a product should be well designed, be functional, be value for money, show innovation and be obtainable for/applicable to Australian industry, and have technical support and after-sales service available. These criteria provided the broad guidelines, and other criteria that had a bearing could be advanced (and were!).

Well, it was an interesting evening, the discussion rolling to and fro for around three hours over dinner. The judging in one category proved a "no contest". In two categories, judging came to a deadlock and had to be resolved by very carefully reasoned arguments, looking at broader issues beyond the confines of the criteria just mentioned.

And the winners are . . .

ETI has great pleasure in announcing the awards for 1989 as follows:

• Test & Measurement Instruments

The Fluke Model 45 Dual Display Multimeter.

This was a "no contest." From a distinguished field of four candidates short-listed by the panel members, the Fluke 45 stood head-and-shoulders above the others on all criteria.

Reviewed in our September issue, this is an outstanding instrument which is clearly a leader in its class. And value for money. A rare combination of features, functionality, performance and value. Hard, if not impossible, to beat in the panel's collective opinion.

Dutch-based Philips and the US-based Fluke company joined forces only last year, a marriage which brought together complementary strengths of the individual companies.

• Board Level Products

GSA Technology's SVM1400 Secure Voice Module Scrambler.

This proved a difficult decision, partly because of the wide range of product types which were considered; some six separate products being short-listed, including power supply units, single-board computer/controllers to GSA's speech scrambler. In the end, the latter product won the day for its sheer cleverness, apart from standing out well in the other criteria.

It is a speech scrambler that can be added-in to telephones and radio transceivers. It employs a sophisticated digital signal processing and encryption technique that makes it impossible for eavesdroppers to decode. Its cost is substantially lower than the nearest competitive products and it has wide application, not just in the obvious areas (diplomatic corps, military, intelligence, etc), but in government departments and

The Fluke 45 DDM.

business. Its comparatively low cost considerably broadens its areas of application and its commercial appeal. What's more, it is entirely Australian designed and manufactured, the Melbourne-based GSA Technology Pty Ltd providing all technical support. But at the end of all that, its cleverness is just stunning.

• Pro-sound & Broadcast Equipment

The AVM200 Presentation Switcher from Talia Sound & Vision.

With the coming expansion of broadcast stations, both in the commercial and public arenas, a demand is arising for well-designed, highly functional equipment to suit the stringent needs of this market.

Talia Sound and Vision is a local manufacturing company that specialises in designing and manufacturing equipment for this market. Their equipment has achieved an enviable and well-deserved reputation. Their designs are conservative, economical and reliable (three very important criteria well-appreciated in this arena) apart from being well marketed.

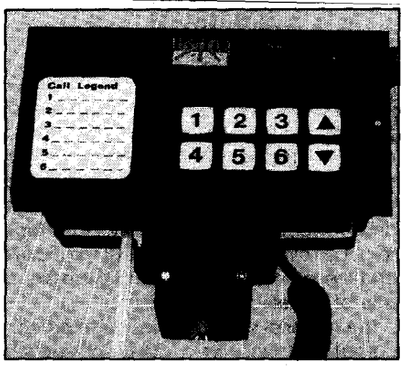
• Communications Equipment

The Sepac-ATR Wide Area Trunking Radio Communications System.

Communications is the lifeline of Australian business and government activities. Our whole commercial and social infrastructure depends on it, in many forms and varieties. One form, probable too little known outside its immediate users, is the wide area trunked radio system.

A trunked two-way radio system offers a large number of radio users a common pool of radio channels automatically allocated by a microprocessor. The radio user is no longer tied to a single base station with its inbuilt congestion and range limitations. A trunked radio system helps conserve valuable radio spectrum, reduce congestion and improve communications efficiency.

The Sepac-ATR SWAT (Sepac Wide Area Trunking) system is another Australian designed and manufactured product, specifically aimed at solving the problems unique to our local requirements and conditions. It offers features, functions and performance that were considered to place it alone in this category. Other products short-listed for award consideration, while highly regarded and worthy products in their own right and class were, in the end, rejected on other grounds, leaving the Sepac-ATR system.



The Sepac-ATR SWAT system.

• Special Award for Australian Innovation/Endeavour

Austek Microsystem's A41102 Fourier Domain Processor Chip.

In recent years, digital signal processing has become the most efficient technique for analysing and transforming information in waveforms that occur in such widely diverse areas as satellite communications, medical imaging, hi-fi sound systems, seismic exploration and radar.

The A41102 Fourier Domain Processor (FDP) tackles the three biggest concerns of digital signal processing (DSP) engineers: performance, system cost and design complexity.

It is the first processor chip of its kind to bring high performance and affordable processing power to medical, industrial and military DSP applications, and opens up DSP to many new applications which have used either older analogue technology or not used DSP because of its high cost to date.

The conception of the A41102 was due to a team of DSP scientists and engineers working at the CSIRO Division of Radiophysics, Epping, NSW. CSIRO and Austek co-operated to develop this commercial implementation.

The A41102 can do continuous fast Fourier transforms (FFTs) at input rates up to 2.5 million complex samples per second. It contains 167,000 transistors on an 8 × 9 mm chip, fabricated in a 1.5 micron CMOS process.

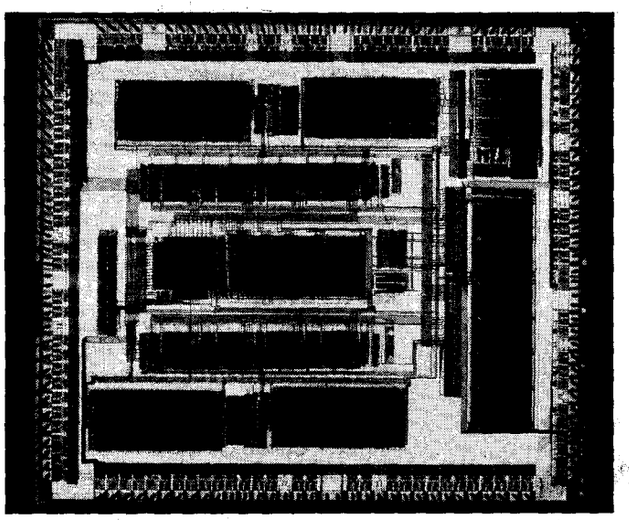
We must make special mention here of another product that was short-listed by the panel – a device known as the Viterbi chip, jointly developed by OTC and AWA Microelectronics. This device was designed for use in OTC's high speed digital data communications channels, to provide sophisticated error correction, an essential requirement in data transmission. It's a unique Australian endeavour to tackle an engineering problem that has application beyond that initially called for.

Roundup

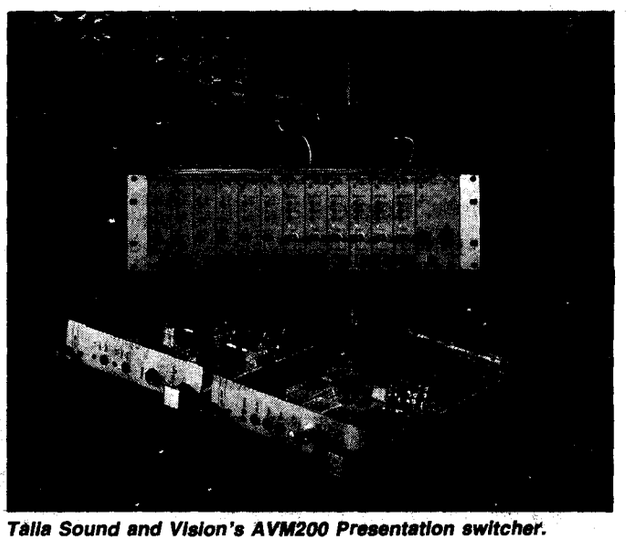
Well, congratulations to all the winners! We trust the awards, to be presented during a function at IREECON '89 in Melbourne, will take pride of place in a public display area at your premises so you can show off your success to the world at large.

As we've limited space in this issue, further details on the winning products and firms, and the background as to just why they won, will have to wait for a following issue, unfortunately.

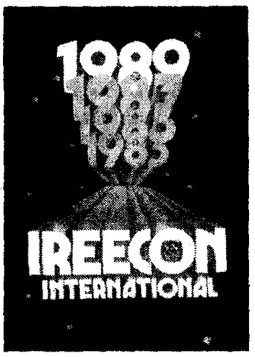
For the 1990 awards, we're considering a different product nomination procedure, among other things – all suggestions will receive critical consideration, but no correspondence will be entered into about the 1989 awards! eti



Austek Microsystem's FDP chip.



Talia Sound and Vision's AVM200 Presentation switcher.



This issue of ETI goes on sale as the 1989 IREECON Exhibition and Convention in Melbourne is in full swing. The biannual IREECON, held alternately in Sydney and Melbourne, is Australia's premier professional electronics industry show. Roger Harrison reports.

IREECON HIGHLIGHTS

To bring you this feature, we polled IREECON exhibitors for a preview of products and services they're to parade or highlight at the exhibition, which runs from September 11th to the 15th. The IREECON exhibition has gained an envied and well-deserved reputation as the place to get an overview of the state of the market and the state of the art on the professional side of the electronics industry.

The material sent to us has been broadly categorised under five headings, but readers must remember this is a very diverse market. The categories are: Sound & Vision Broadcasting; Test & Measurement; Manufacturing & Production; General Equipment; and Components, Cables & Fibre-optics.

For quite some time now, companies in the Sound & Vision Broadcasting field have dominated the exhibition. However, Test & Measurement has grown in recent years' shows, perhaps reflecting the increasing importance of this field in general. This year, high definition TV (HDTV) will be highlighted at IREECON, with a panel discussion to take place, featuring specialists from Europe, North America, Japan and Australia. Key issues in HDTV will be examined, including its impact on the existing television and related industries. This HDTV session will be chaired by well-known industry identity, Neville Thiele (see panel).

Sound & Vision Broadcasting

Abekas Australia

Abekas Australia will be proudly showing off its range of digital video production equipment. To illustrate the flexibility and multi-format capability of its A34 Solo Integrated Production System, Abekas will provide fully-working demonstrations with a mixture of videotape machines as inputs, including Betacam, MII, BVU and Super VHS.

Designed especially with component editing in mind, the Solo system combines timebase correction, audio/video switching, digital effects and comprehensive editing – all in the one compact box. The Abekas A54-D Digital 3-D Special Effects system, to be shown in both single and dual channel configurations, will be fitted with Warp and Key Channel options to produce page-turn, circle, burst, lace, drop shadow and other distinctive non-linear effects.

With their A60 and A64 single-disk and dual-disk Digital Disk Recorder models on display, Abekas will be able to demonstrate rotoscoping as well as multi-layering of effects in real time. To round things out, in what promises to be a most interesting display, Abekas will show off their A72 Digital Character Generator, which boasts a unique approach to font composition and instant character sizing. Abekas can be found at stands 54 and 57.

AR Audio Engineering

AR Audio Engineering's stand is one of the first you'll encounter on entering the exhibition. The company will display a wide and interesting range of professional audio equipment; including equipment concerned with: testing, equalising, interfacing, interconnection, amplification, balancing, racking, studio monitoring and mixing. AR Audio Engineering represents a number of brands, including: SCV Audio, Eastern Acoustic Works, Wheatstone Corp, Hill Audio and ATC Loudspeakers.

BASF

BASF has been in the broadcast and professional sound industry virtually since its outset. The same could be said of them in video and TV industry, too. At this year's exhibition, BASF will display their full range of product currently available in Australia, with a particular emphasis on the professional user. They will also showcase some new products. Included in the latter is the new studio mastering tape SM911, available in all sizes from 6.35 mm to 50.8 mm. It boasts a new dual-layer coating technology coupled with good print-through characteristics and very low modulation noise.

BASF's new loop bin mastering tape, the LM291, uses a chrome dioxide formulation, offering major benefits to high speed duplicators. The company will also release its

range of chrome dioxide VHS video pancakes. Also on display is the BASF range of Betacam cassettes – including a 30 minute one designed specially for electronic newsgathering (ENG) applications, boasting some special features which I suggest you enquire about at their stand. You might also ask about their Azimuth Precision Cassette, a reference compact cassette housing.

Robert Bosch

The Robert Bosch company has long been a name around the video/TV industry. On stands 266-269, you'll be able to peruse their range of lightweight, compact CCD cameras which boast high resolution frame transfer CCD sensors and electronic shutter which they claim totally eliminates smear. Models include the LDK90 – a Betacam SP self-contained portable for ENG use, and

three compact studio and field production cameras.

Bosch will also be displaying two video routing switchers and a master control/automation switcher, along with a video noise reducer and a synchroniser.

Consolidated Electronics

Melbourne's Consolidated Electronics, well-known for the design and manufacture of high quality broadcast audio equipment, has spent recent months preparing a product that they say will maintain their leadership as reputable suppliers of high quality, reliable equipment for the sound broadcasting industry. It's a broadcast quality CD player that is physically compatible with current cartridge machines.

It is a caddy-based system offering significant operational advantages, the company says. The caddy protects the compact disc while being used and during storage. During play time, the caddy and disc are totally enclosed within the player, so that mistracking cannot occur from the caddy being bumped by the operator. The caddy is said to significantly increase air time reliability since skipping due to dirty discs is kept to a minimum.

The player uses a linear motor for laser positioning, eliminating the wear-prone lead-screw mechanism in domestic CD players. The product is backed by Consolidated Electronics' local engineering and service support, although it is extremely easily to service in-house: four screws give complete access to the electronics; removing four more screws allows the drive unit to be exchanged.

Consolidated Electronics say their new CD player, through its innovative design, gives radio and TV broadcasters a reliable means of playing compact discs on-air. Check it out at stand 126.

Fibernet

The centrepiece of Fibernet's display on stands 14-15 will be a demonstration of multichannel video on fibre with a capacity of up to 16 simultaneous broadcast quality channels with a range up to 40 km, the company claims.

John S Innes

John S. Innes Pty Ltd should be a name familiar to many in the broadcast industry. The company – or I should say, John himself – represents many well-known and respected brands seen in stations the country over. John will be exhibiting a number of interesting new products this year and will have representatives from two companies, whose products he distributes, to answer questions on his stand. The new products include a microphone channel processor and two AM limiters from CRL, and from TFT a UHF remote pickup transmitter and a synchronous FM booster. From Delta, he'll be showing a noise generator for AM stereo and general audio testing.

In addition, John will have products and information from Altronic Research, Belar, CCA, Freeland Products, Kintronic Labs and Potomac Instruments. John S. Innes is located on stand 12.

JNS

As with many exhibitors, JNS Electronic

Panel Discussion

An IREECON '89 panel discussion on HDTV, featuring specialists from Europe, North America, Japan and Australia, will examine in detail the key issues, which include its likely impact on existing television and related industries, its appetite for additional bandwidth and, most importantly, standardisation.

The question of standardisation has sharply divided the United States and Japan, which has already begun broadcasts of HDTV programs (although receivers are prohibitively expensive for the average viewer). Australia and Europe have stressed the importance of establishing an international standard.

The HDTV debate will provide an opportunity for Australia to press its case for standardising HDTV with a common image format of 1080 lines. The existing systems have 625 information lines in Australia and Europe and 525 lines in the United States and Japan, transmitting at 50 and 60 hertz respectively. The improved quality of HDTV is achieved principally by a doubling of the information lines. While Europe favours a doubling of its present lines to 1250 and the United States proposes 1050 lines, Japan has selected 1125 lines. Australia's 1080 'active' lines offer an attractive alternative that would fit inside a greater number of lines or be adaptable for systems with fewer lines.

The session will be chaired by Neville Thiele, a former Director of Engineering Development at the Australian Broadcasting Corporation, who is now a consultant in audio, radio and television. Mr Thiele has been a member of the HDTV National Study Group since 1981 and, as an Australian delegate to the Committee Consultative International de Radio (CCIR) in Geneva, has been a member of its interim working parties on HDTV.

For further information contact Heather Harriman, IREE Executive Director, or Cherie Morris, IREE Convention Administrator, ☎ (02) 327 4822.

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IOtech

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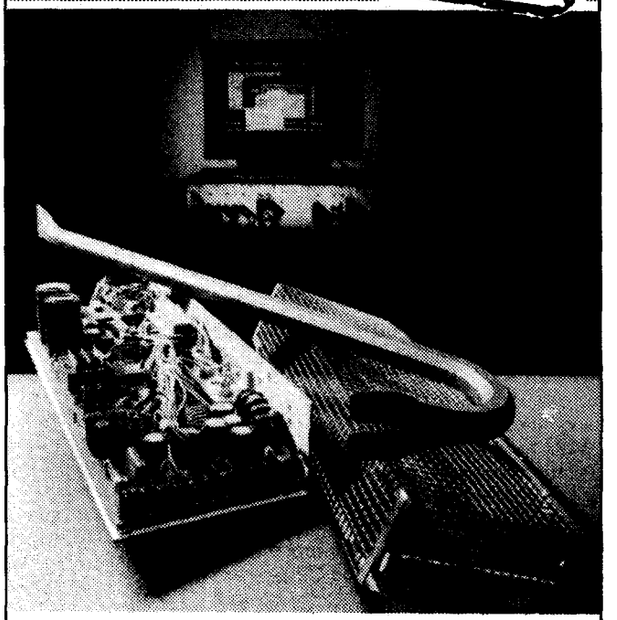
READER INFO No. 15

Power supply testing

HIGH-SPEC



The days of the simple Go/No-Go power supply tester are gone: Intepro's intensive R&D programme is releasing options which provide unprecedented levels of test capability for today's PSU manufacturers and end-users:

- **150MHz digital scope for dynamic PSU measurements in production test conditions**
- **dedicated ripple and noise instrumentation capable of testing up to 5MHz switchers**
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This powerful PC-controlled hardware is supported by a menu-driven automatic program generator with libraries of ready-to-use tests. Systems can be configured for every application: from laboratory characterisation, through production set-up and test, to repair and maintenance; call your local support centre for further details:

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READER INFO No. 16

Industries will be showing new product releases. Now moving into its 17th year, JNS is a major supplier of radio and TV broadcast gear, as well as telecommunications and allied electronic equipment.

JNS will be showing new modules for their 8000-series rackframe, including the AS 8830 audio modular switcher, AFA 8404 audio failure alarm module and the VDA 8828 HDTV video distribution amplifier. For their 9000-series audio routing switcher, they'll have a computer interface (model 9020) for addressing the 9000 via a PC. In addition, JNS will add to their AM transmitter control system a product that allows easy interfacing between valve and solid-state broadcast transmitters.

In their imported equipment range, the company will be showing a new 5 kW solid-state transmitter by Nautel, the ND-5, along with a dial-up remote control system from Gentner (model VRC 2000), and the Gentner digital telephone line program systems. And they promise more, yet. Stands 42-43 will put you in touch.

Quinto

On stands 60 and 61, you'll find Quinto. If you'll allow me a pun, Quinto will be highlighting the Paglight ML Mini-Kit, a new lighting kit from PAG, for professional video and photographic applications. It offers a continually variable focusing beam angle and the lamp head has been designed to accept long-life lamps with a wide voltage tolerance. The Paglight ML features a softpack 12 V/ 4 Ah rechargeable NiCad battery, with a dedicated mains charger and a universal mounting clamp. When fully charged this will run the Paglight ML continuously for up to 25 minutes.

RFI Industries

We can't leave this category without a passing mention of RFI Industries. Formerly known as Scalar RFI, the company is based in Bayswater, Melbourne and claims to be the major source of EMI shielding and EMI/EMC instrumentation/engineering expertise under one roof in the southern hemisphere. The company's shielding division is fully equipped to design, manufacture, install and certify all types of RF shielded enclosures, from a small benchtop model for lab use, to a large RF shielded anechoic chamber suitable for military vehicle testing! Check them out on stands 190, 193.

Test & Measurement

Alcatel-STC

Alcatel-STC Australia is the Australian representative for the well-known brand of test & measurement equipment, Anritsu. The main feature of Alcatel-STC's display will be the Anritsu EMI measuring system comprising the MS2601A spectrum analyser and companion programmable preselector, the MN1602A. The company says this system has created an enormous amount of interest from a wide variety of industries since its inception and should go down on many a visitor's must see list. Also being displayed are two new frequency counters, a new 2 GHz signal generator and a microwave power meter.

Anritsu's new digital video generator and analyser will be available for demonstration by the engineer who designed them, Shin Nagayama. Other specialist design engineers will be out here for the exhibition, and you're encouraged to bend their collective ears.

As optical fibre measuring equipment is gaining increasing importance with the greater use of optical fibre technology, Alcatel-STC will be showing a range of new Anritsu equipment in this field. On-show will be a new compact optical time domain reflectometer and a modular style stabilised

light source, along with an optical power meter featuring high accuracy measurements.

If you're sniffing around the market trying to suss-out what's happening in optical fibre T&M gear, see Alcatel-STC on stand 9. While you're at it, you might cast your optic nerve over two other companies with products to show in this area: Fibernet Pty Ltd and Kingfisher International.

Emona Instruments

The Emona Instruments display at stand 157 covers a wide range of instrumentation within the electronics and electrical industries. Products on display cover electronic test and measurement, PCB fault locators, device programmers, electrical power measurement, process control instruments and optical fibre test equipment.

A special product launch at IREECON is the Kikusui COM-3000 series of digital storage oscilloscopes. Available in two models (50 MHz and 100 MHz real time and digital storage), they offer auto set-up, on-screen cursors, DVM, frequency counter and battery pack in a package measuring only 21(W)cm x 7.5(H)cm x 34(D)cm.

Test and measurement equipment displayed include GW and Kikusui bench-top instruments covering oscilloscopes, power supplies, multimeters and generators, Escort handhelds and Polar incircuit and micro-processor fault finding instruments, EXFO and ISKRA optical fibre instruments.

Electrical power instruments on display include the Elcontrol MK3 and System 3 designed as portable power monitoring systems, Iskra table-top and panel mount

variable transformers, variable resistors and power instrumentation such as insulation testers, Kikusui DC and AC power supplies and DC loads.

Device programmers from Logical Devices of the USA range from the advanced ALLPRO software driven programmer to gang/production programmers, dedicated logic programmers, erasers and CUPL, a PAL/PLD universal logic compiler.

Process control instrumentation includes Asahki Keiki DPMS covering scaling, meter relay and μP control applications and the Time Electronics range of instruments for the calibration and maintenance of industrial control and measurement equipment.

Fibernet

Fibernet will be exhibiting, amongst a range of equipment, stabilised laser light sources and optical power meters. See stands 14 and 15.

Kingfisher International

Kingfisher International, on stand 5, will be showing optical power and pulse measurement equipment from Antel and UDT, together with fibre optic test and installation equipment of their own as well as from AMP and United Detector.

John S Innes

John S. Innes (stand 12), is also exhibiting a few T&M products: audio and RF instruments from Potomac Instruments, dummy loads from Altronic Research and a noise generator for AM stereo and general audio testing from Delta.

Nilsen

Melbourne-based Nilsen Instruments is a major specialist in test and measuring instruments as used by engineers, scientists and technicians. See them on stand 135 and check out their range of Iwatsu analogue and digital oscilloscopes, Hioki handheld and

bench DMMs, counters and waveform recorders, Thandar logic analysers, Megger-AVO multimeters, and other products. They even boast an optical time domain reflectometer in their range, by Photon Kinetics.

Scientific Devices

Scientific Devices Australia Pty Ltd is another familiar name around the electronics industry. They carry a comprehensive range of instruments from firms like Datron, Keithley, Boonton, Rockland Scientific and IOtech. However, the hot news is, they've just been appointed exclusive Australian representatives for Le Croy, a company recognised as a leader in the development of digital storage oscilloscopes and fast pulse instrumentation. Check out details of their latest range, on stands 131-133.

From Wavetek, they'll be displaying a new synthesised function generator, model 228, boasting a range from 0.002 Hz (2 mHz) to 20 MHz, with AM, FM sweep and phase modes. A new programmable power meter from Boonton will also be on display, capable of measuring levels ranging from −70 dBm to +30 dBm over a bandwidth extending from 100 kHz to 110 GHz, with a wide choice of sensors.

Wandel & Goltermann

Wandel & Goltermann will be displaying a range of test instruments for tele-communications and data communications applications, including ISDN. In addition, they will be displaying spectrum analysers and instruments for audio broadcast measurement applications. See them on stand 44.

Tech-Rentals

To wrap up the IREECON highlights in Test & Measurement, let's take a look at Tech-Rentals. They'll be presenting a cross-section of their extensive range of T&M instrumentation. Of particular interest to radio engineers will be the new Schlumberger 4013 Communications Test Set. This features full cellular radio facilities, the makers claim. You might also consider casting an eye over the Hewlett Packard 8950B 1.8 GHz spectrum analyser, or for something completely different, the Hughes TVS 7300 Infrared Thermal Imaging System (reviewed in ETI's August issue). These are all new products in Tech-Rentals inventory. Stands 155 and 158 will reveal all!

Manufacturing & Production

Binary Engineering

Binary Engineering, on stand 142, will demonstrate their Australian designed and manufactured CTS Series of automated printed circuit board test systems which they claim boosts production throughput and improvement in quality control and thus enhances product reliability.

The CTS Series, based on Binary's successful CTS-88, is PC/AT-based and ranges from the "entry level" CTS 1032AF, a 32-channel analogue functional test system, through to the 1280 Driver/sensor CTS 3128ODI Digital In-Circuit Test System.

Binary's range of digital and analogue instrument on a card modules optimise the CTS systems for test applications in either the production or service rework environment. Their TM1 Software Development System (SDS) is used to generate CTS test programs.

It features incremental compilation, multiple windowing, comprehensive analogue and digital test libraries and automatic data logging.

CIMA Electronics

CIMA Electronics provides expert design and development assistance through its engineering department which employs a team of electronic manufacturing engineers and technicians. CIMA also conducts a wide range of technology transfer and awareness programs for various industry sectors to increase awareness of the benefits of using microelectronics, to provide information on current technologies, to give practical experience and encourage product and process development.

At IREECON, CIMA will introduce the services of their two new initiatives to assist Australian industry: a surface mount technology (SMT) facility and an ASIC design laboratory, supported by the Victorian Government Department of Industry, Technology and Resources.

Their SMT facility will provide training for manufacturing, design and QC engineers and technicians through comprehensive workshop programs. CIMA's ASIC laboratory is to incorporate state of the art systems to provide training workshops in digital and analogue ASIC design, access to workstations for customers to do their own designs and provide design services for companies not having the required expertise. CIMA can oversee a design from inception through to manufacture. For a complete rundown on this unique service, check out CIMA on stand 150.

Hawker Richardson

Hawker Richardson specialises in the sale, service and support of a variety of products and equipment to automate and improve assembly production processes. Their products range across surface mount assembly equipment, through assembly robotics, pneumatic and electric assembly

IREECON highlights

tools, to manual and automatic compound dispensing equipment. They can also design, build and install special purpose machines. On stands 229, 230, 235 and 236, they will feature a number of working displays.

Vema International

Vema International is a company that specialises in the distribution and service of production equipment for electronics manufacturing and printed circuit board manufacturing. If this is your "bag", seek them out for information on equipment for component preforming, cable cutting and stripping, component insertion, SMT placement, screen printing, wave and reflow soldering, inspection systems and workstations, among other things.

General equipment

Critec

In trouble with transients? Then be sure to see Critec on stands 121 and 122. No matter whether your transient troubles arrive via the mains, data or telephone lines, Critec can supply the required protective device. Critec's power system protection units now extend from 3 to 1000 amp single and three-phase units. They also have specialist designs for 4-20 mA current loop transducers, weighbridge cell protectors and advanced electronic PABX6 telephone protectors in their range of dataline and signalling protection devices. On show will be their new Faxguard, which combines power and telephone protection in a single customer-installed module.

Emtronics

The Emtronics display at stand 152 covers a wide range of products in radio communications and associated fields. Products presented include radio direction finding systems, a debugging system for corporate security, digital communications systems, marine and land communications systems, radio communication surveillance signal decoders, monitoring and communications receivers, accessories and antennas.

Emtronics also manufactures radio communication equipment in Australia under the EMTRON label. Products include a wide band load periodic antenna, beam antennas, vertical antennas, antenna roof towers, antenna tuners, active antennas, radio frequency matching transformers, power supplies and high power dummy loads.

Other items on display at IREECON include co-axial switches, vacuum tubes, power amplifiers (RF), commercial band transceivers

from ICOM and Motorola, and marine and land mobile transceivers from Barrett and ICOM.

Jacob's Radio

Nearby, on stand 124, is Jacobs Radio Australia Pty Ltd. On display will be their newly developed range of power and environment monitors designed for application in telecommunications, computing, hospitals, etc. They say the instruments represent a major advance in collection and processing of the information on quality of ac/dc power, temperature etc that affects sensitive electronic instruments. Data can be stored and retrieved using a computer system, and transferred by modem or cable.

Jacobs Radio will also be showing a new portable data modem, the JMS-4. Powered from a 9 V battery, it operates from 75 to 2400 bps using the standard AT (Hayes) command set. Transmission quality, ease of operation, small size, lightweight construction and extensive software command capability makes this modem a leader in its class, the company says.

Fibernet

In optical fibre equipment, Fibernet Pty Ltd will be showing RS232 modems and multiplexers, fibre optic token ring and Ethernet networks, DDI networks, CATV video links, and IBM and DEC channel extenders. You are encouraged to discuss fibre optic applications with company representatives on stands 14 and 15.

Richardson Pacific

Richardson Pacific Metal Systems (formerly CIBC Australia) has specialised in the manufacture of high-tech electronics enclosures and modem cabinets since 1962. Dedicated to the production of close-tolerance sheet metalwork, the company has developed products which meet stringent telecommunications and electronics industry requirements.

The company's 19-inch racking systems and accessories allow ready configuration of units to a customer's requirements. Available in a range of heights and depths, the range includes the well-known SIRTECH, MULITRAC and STUDIRAC cabinets.

Componentry, cables & optical fibre etc

Adilam

Hiding away on stands 159 and 160, you'll find Adilam Electronics. Melbourne-based, Adilam specialises in the supply of a wide range of professional electronic components from leading overseas companies. Browse around their stand for relays from Astralux Dynamics, assorted pc-mount switches from Diptronics, motor start and lighting capacitors from Ducati, Elite stepper motors, Feller inlet sockets and connectors, Firadec tantalum capacitors, DIN and cable connectors from Harting, headers and card edge connectors from Methode, fans and precision motors rom Papst, Rectron rectifiers, Stettner capacitors and transducers, Vitrohm resistors, and Wima capacitors.

Belden Electronics

Belden Electronics has a well-established name in cables, now including fibre optic cable. On stand 99, you can peruse their range of coaxial cables, lead wire, flat cables, plenum cables, multi-conductor and multi-paired cables and the previously mentioned fibre optic cable.

Hartland Cables

Hartland Cables and their Victorian agent, Turnbull Electronics, are exhibiting an extensive range of cables, connectors and accessory products. Hartland has been manufacturing cables here for the electronics, computer and communications industry for nearly 40 years. See them for audio cables, LAN cables, multi-wire and

IREECON highlights

multi-pair cables, coaxial cables, flexible braids and pigtails. Turnbull will be exhibiting coax connectors, D-type, Centronics and LAN connectors as well as hand tools, baluns, patch panels, racks and other accessories. Check out stands 187 and 188.

RFI Industries

For RF interference and EMC control componentry, see RFI Industries. They can tell you all about their comprehensive inventory of RF filters, EMI shielding gaskets and compounds and beryllium copper contact strips, microwave absorbers, etc.

Philips

Naturally, our roundup of this category would not be complete without mention of Philips components. Go to stands 225 and 226 and ask for your Resistor and Capacitor wall charts – every lab, workshop and service centre should have one! Philips Components will be showing-off their breakthrough in 16-bit single chip micro-controllers, the newly-launched 90C100 family of 68000 code-compatible devices. This new family integrates a complete system on-chip and offers ROM and ROM-less versions, with and without EEPROM.

Check out their solid-state colour video camera module featuring 450,000 pixel resolution. And broadcasters, browse through their range of transmitting tubes, camera tubes and microwave components. While you're there, check out their data library.

We haven't been able to give you a complete, comprehensive coverage, but trust these highlights will whet your interest.

eti

NEXT MONTH

Build a Hayes-Compatible 300/1200/2400 BPS PC In-Modem

Here's an economical, easily-built high performance in-modem card for owners of PC-compatibles, featuring standard Hayes (AT) command set and 300 (V.21), 1200 (V.22) and 2400 (V.22bis) bits per second operation.

Police radar & radar detectors

Are Police Radars sufficiently accurate and discriminatory to be classed as a scientific instrument? Are they fair to the motorist? Do radar detectors make better drivers? Police radar and radar detectors — the facts, the faults and the fallacies, next month in ETI.

Review: Akai's AT-93B tuner

Akai's recently released high quality, high performance tuner comes with some worthy functions and features that warrant closer investigation. With the coming explosion in sound broadcasting, now's the time to consider adding or upgrading to a top-notch tuner in your sound system.

For the enthusiast: Reaction Timer Project

In the heyday of the wild west, the gunslinger with the fastest reaction was the last one left standing in a gun fight. In these more civilised times, we just shoot-em-up on the old video/computer game. But just how fast *are* you? This fun little low-cost project lets you actually measure the milliseconds of your reaction, displaying the result on a meter.

JIM TUCKER

A POTPOURRI

A computer stolen with an MP's secrets. A $10,000 reward to anybody who can crack an encryption program. Digital Research DOS and software wars. This month, Jim Tucker serves a potpourri of PC paraphernalia.

It was a bit of a bother. Jennifer Cashmore, a prominent Adelaide MP and spokeswoman for the Liberal Opposition on economic affairs, had had her computer stolen from her suburban electoral office.

It wasn't the fact that the computer got pinched that bothered Ms Cashmore but that there was data on the disk. There may have been secret Liberal Party plans to overthrow the South Australian Labor government on there! If the thieves were indeed Watergate style burglars, it was a real worry.

Anyway, after Ms Cashmore's computer was replaced, a noted computer journalist (me) reported the sad affair in a national newspaper one morning and, guess what – that night her second computer was nicked! Ms Cashmore was again distressed.

There is no suggestion that this was indeed political espionage but it raised a huge question: what is most important – your computer or the data on the disk?

Computers can be insured. But secrets? Well, ask your insurance brokers – I doubt whether they'll want to know.

So, let's have a little look at what we can do about it. The first rule is, don't let the thieves take your computer. Burglar alarms, yes. But if somebody in Britain can get about $10 million from the house of a Middle East sultan with full-time security guards, what hope do you or your humble member of parliament have?

In a home or office environment, personally, I'd bolt the computer to the desk. That at least makes it difficult.

The main thing, of course, is to ensure that nobody can read the data on the hard disk. And there are several ways to do that.

Passwords and logs

I've been fooling with a PC program called RUNLOG from Bart Voskulen of VKN Electronics ☎ (08) 278 4597 which does a few useful things after it's installed.

First of all, if you boot from a floppy it refuses to know about the hard disk. That stops a few smarties. And if you boot from the hard disk it wants to know your name and password. And even if you know these things (silly people keep them on a piece of paper in the top right drawer of their desk) it creates a log of who logged on, accessed what files and when.

It supports networks so a supervisor can see exactly who did what, with which, and to whom! Not useful if your computer is stolen, but giving a fair degree of security in an office.

Passwords are, of course, stored on the hard disk, but in encrypted form so even somebody reading the file (on a backup disk for example) won't be able to read it.

Cleverly, only the original floppy contains a program that removes RUNLOG and passwords. Unfortunately RUNLOG splashes its copyright on the screen so all the thief has to do is buy a copy (about $50) and un-install it.

I mentioned this to VKN who promise to fix that before you read this. Better still, the disk should boot with no prompts. As the hard disk doesn't exist if the machine is booted from Drive A, and you get a blank screen if it's booted from C, most people are likely to assume the hard disk is kaput!

Keying in the wrong password three times in a row makes the most amazing noises.

It's not ASIO secure but RUNLOG is about all your average polly needs to make sure the guys who pinch the computer are indeed professionals and don't simply stumble on super secret stuff.

If I ruled the world

Now, if you want to take over the earth and write the plan on a PC you will need something really secure. I mean something so secure that even super spies can't even read it using a Cray!

But here's some nonsense. You know that computer files can be encrypted. The highest security is allegedly the US government's Data Encryption System (DES). In fact, programs that use DES are so secret that the US State Department demands a special export licence.

A popular program, PC Tools, has file security including DES but DES is not supplied in my export version. No doubt anti-US spies have never been able to obtain a copy in the United States. Ho ho ho!

But maybe they could go shopping in Melbourne where FMS ☎ (03) 699 9899 sells a program called SecretDisk which includes DES. I won't spell it all out, but if you want to keep secrets this is the one. It encrypts on the fly so that data is never stored in readable form on disk.

In fact, FMS is so smug about the security it has offered $10,000 to anybody who can tell them how to crack a SecretDisk file. Go to it.

Roll your own

This is data protection for beginners and won't fool anybody – or maybe it will. If you want to encrypt a file here's pseudo BASIC code which you can expand to create a complicated algorithm.

It works on the simple principle of boolean logic based on the fact that when you EXCLUSIVE OR (XOR) a byte with itself all the zero bits are changed to one and all the one bits are changed to zero. When you run it again – well, it becomes normal.

Obviously, if you run some text through the program it becomes garbage, but when you run it again it becomes readable.

Before you begin, here's a simple security hint. Give your PC files obscure names – SECRET.TXT is asking for trouble. XYZ123.OVR can contain the same thing but what does it mean?

```
OPEN "FILE1" FOR INPUT
OPEN "FILE2" FOR OUPUT
WHILE NOT EOF(1)
  A = ASC$(INPUT$(1))
  A = XOR(A)
  PUT$(2),A
WEND
CLOSE
KILL "FILE1"
END
```

Don't forget to kill the source file else you will have an encrypted version but the source still on disk.

But, Ms Cashmore, are your parliamentary secrets yet safe? Alas, no. You have to remember that killing or deleting (the DOS

DEL command) really doesn't delete the file from the disk. Those who use the Norton Utilities know all about this.

Ha ha! Why not reformat the disk! Surely that will get rid of secrets. Alas, again, no. Most amateur experts know how to recover data from a formatted disk.

You can invent your own security code, then use Norton's WipeDisk to really erase the original. The whole procedure can be put in a batch file which can be run before you leave the office each night.

Digitals

Does DOS version 4.x still have bugs? Keep me posted. Meanwhile, this reporter is using Digital Research DOS version 3.4.

I've found it works exactly like MS- or PC-DOS with a few more features. For example, there is a facility to add a password to individual files or paths providing simple security in a busy office environment.

There is also online help for all external commands. Key PASSWORD /H for instance and you'll be shown the paramaters available on the screen.

And finally (sigh) say goodbye to EDLIN, the text editor supplied with PC-DOS. Has anybody EVER used this beast?

DR-DOS is supplied with a full-screen editor a la Wordstar – it's called EDITOR and in fact it uses Wordstar commands with even a help window on top of the screen (if you want it). It is for programs. There are no dot commands, no word wrap, no paging and no printing. Still, it's all you need to change batch files.

A word of warning – files created with EDITOR will not work with some programs such as my FLASHPRINT – Arrrgh! That's because when I translate the file from ASCII to binary I foolishly assumed the file would end like Wordstar with a CONTROL-Z. EDITOR doesn't bother.

But EDITOR does store the file with its absolute length in bytes – Wordstar and some other programs store text in multiples of 128 bytes. Create a one line file and then do a DIR – you'll see what I mean.

A slight bitch about DR-DOS. It is supplied with SID-86 as the debugger but there is no documentation. Not to worry, you say. Use good old DEBUG. But DEBUG promptly tells you "incorrect DOS version." Another worry!

I ended up using DEBUG itself to patch out the little bit of code which checks the DOS version.

I'm not sure where this lives on all versions of DEBUG but the technique should work for a lot of programs that report "invalid version." Look for a MOV AH,30 or MOV AX,3000 (the DOS function that returns the version) followed by INT 21 then a compare and some sort of conditional jump.

Destructing disks

Floppy disks. I doubt anybody could have invented them without a lot of lateral thinking. Here we have tiny slivers of plastic and magnetic particles wizzing around six times a second, storing our precious programs and data.

But how robust are they? Should you always buy the most expensive?

'Beer and disks don't mix'

After years of treating them with disdain – throwing them on to my desk without even putting them back in the sleeve – I have had very few failures. So I decided to put a simple 60-cent no- brand disk to the test.

First I put it on the piano and played Moon River. That's nonsense, of course, but it proves that diskettes aren't affected by Henry Mancini.

Then came the first serious test – I put the disk into a microwave oven. Two minutes at full power. That ruined it because I cooked it. The fibre liner contains moisture which is heated by microwaves. Another disk, at 15 seconds, survived.

My unscientific conclusion – floppy disks don't mind microwaves but they hate being cooked.

I then tried to tape the disk to the TV screen but found it can be held firmly in place merely by the static electricity on the screen. The disk survived 30 minutes of Derryn Hinch. Obviously, it was the unexpected.

After each test I used the DOS utility DISKCOMP to compare the abused disk to the original. But how to destroy this so-called 60-cent piece of magnetic media.

A friendly doctor, a computer wizard, taped the disk to an X-ray machine. Still it worked. X-rays can fog photographic film but not a floppy disk.

A friend in Brisbane once asked me for a copy of a floppy disk. You'll get it in a couple of minutes, I said. I put it on the photo copier and sent it by fax. He couldn't load the copy but the original was not destroyed.

So what will destroy a floppy diskette? Two things – physical abuse (like cooking it) or magnetism. If you bend a floppy it may not work. (Australia Post are experts at this sort of thing and writing Do Not Bend on the envelope seems to encourage them).

The main enemy of the floppy is a magnetic field. In fact, the simplest way to clear a disk is to hold it close to a magnet – your hi-fi loud speakers, for instance.

Finally, in the interest of science I poured a glass of Cooper's ale on the disk. Beer and disks don't usually mix socially.

I cut the diskette cover close to the edge with a sharp blade and removed the flimsy floppy. Then washed the disk under clean water and polished it with a tissue.

After replacing the plastic into a clean cover it worked!

Silly ARC wars

When is an ARC file not an ARC file? When it's a ZIP file.

Several years ago, System Enhancement Associates (SEA) developed an archival process for compressing PC data – permitting several files to be grouped and compressed together, which, to put it simply, saves disk space.

SEA's ARC shareware gained widespread usage through electronic bulletin boards and PC user groups and became the de facto standard for file compression.

In the spirit of shareware improvements, a company called PKWare developed an improved package that read and wrote compressed files much faster than the SEA software. Of course, to maintain compatibility with the horde of already-archived files, PK software read (and optionally, wrote) archive files using the same logic as SEA.

So far, so good: Competing features, compatibility, and benefits for everybody. But SEA didn't quite see it that way and took PKWare to court in California.

Even though neither of these products is sold commercially anywhere in the world, and even though it was plainly obvious that PKWare had written the software from scratch, SEA claimed copyright infringements on just about everything!

PKWare was forced to change its software so it wouldn't read or write ARC files (and of course, since it can't read ARC files, then it can't be compatible).

The backlash from the user community was overwhelming. PK's new archival software (PKZIP, complete with a new ZIP archive file extension) was a hit as soon as it was released and it's already the new standard for archival software.

SEA's ARC is gaining widespread disfavour and in certain circles the mere presence of an ARC file is a sign of social irresponsibility.

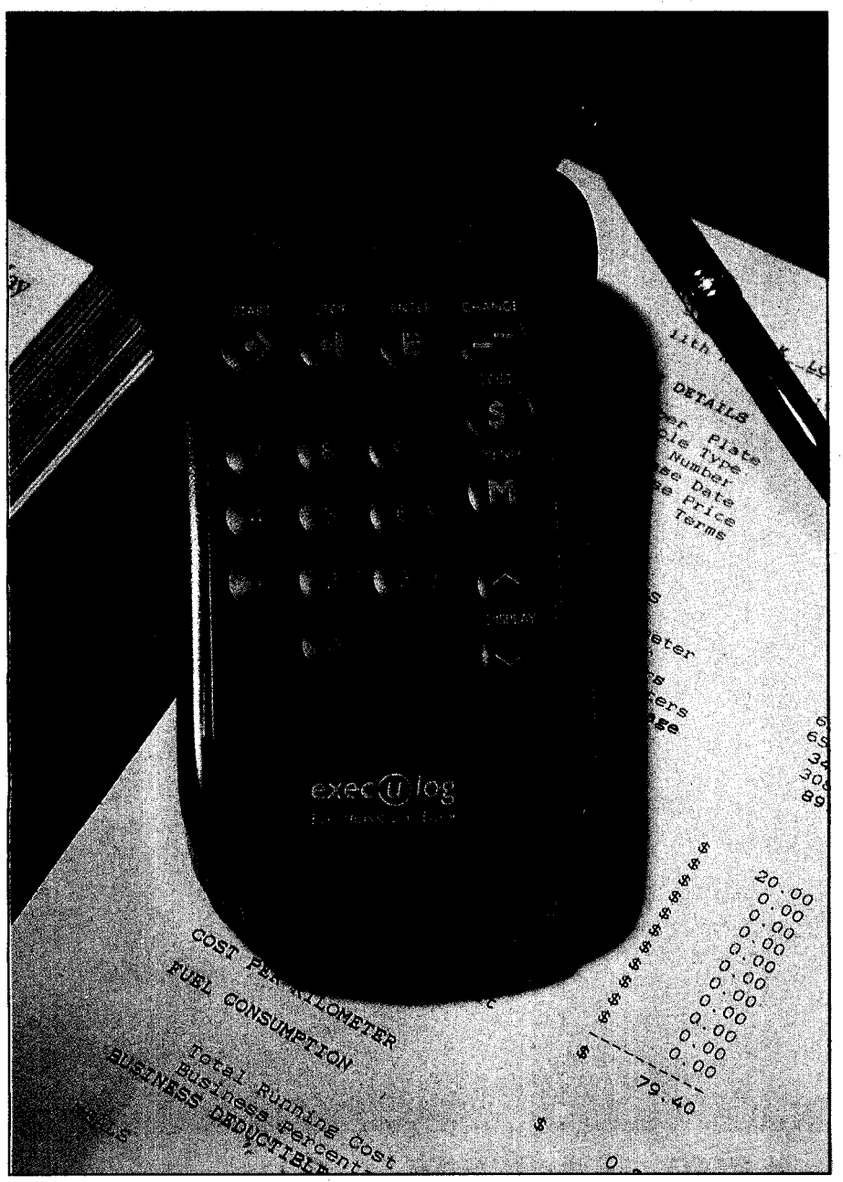
Admittedly, the world of shareware and public domain software isn't quite the top of the market (where you'll find other noted litigants: Lotus, Ashton-Tate, and Apple). But the potential for backlash against an in-court victor is real.

In this case at least, users expressed a clear preference for a vendor who fights it out in the arena of software features rather than in court. eti

EXEC-U-LOG — THE ELECTRONIC LOG BOOK

TECHNOLOGY

This computerised data logging system aims to provide better fleet management as well as saving you time and money.



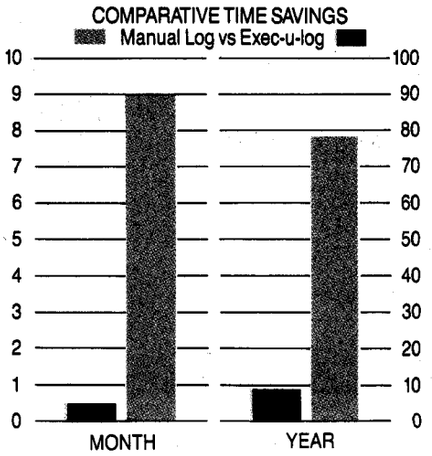
Whether you are self employed or own company cars, the cost of running your vehicle/s is a major overhead that is rarely fully appreciated or understood. Most people, probably due to poor record keeping, never claim all their running costs as tax deductions, and indeed, pay extra costs in the form of Fringe Benefits Tax.

So, how do you maximise your expenses claims, minimise your FBT costs and manage your vehicles more effectively?

Melbourne-based Automotive Electronic Specialists has, for the past three years, been developing a system to log all the data necessary for an effective fleet management system. It has released Exec-u-log, a computerised data logging system with comprehensive mounting, enabling it to be installed in all types of vehicles.

All working data is pre-entered into Exec-u-log, either when the unit is manufactured, or by the user. This covers Exec-u-log having its own odometer (running in parallel to the vehicle) a clock, calendar, up to 7 drivers' names, 31 business trip purposes and 15 cost centres, from fuel through to insurance. The system can be customised to the users' requirements.

To record a business trip, the driver need

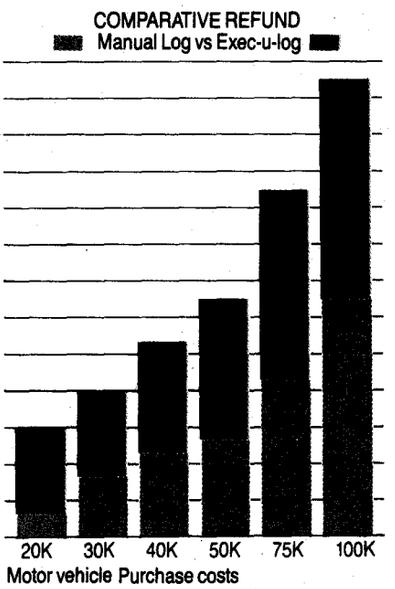


only use the 'start', 'stop', 'enter' and maybe 'change' keys. The rest is automatic. For instance, at the beginning of the trip you push the 'start' key; at the conclusion, you push the 'stop' key – the system has automatically recorded the date, time, start odo reading, stop time, date and odo reading and has calculated the distance travelled.

Exec-u-log automatically steps you into the driver's table, and, provided your name is at the top of the list, you push 'enter' to store this. The system now brings up the trip purpose table (which you have pre-entered) and, using the 'change' key, you select the appropriate purpose and use the 'enter' key to store it. If the trip is non business you do not use the 'start' key, and by default the trip is logged as being private.

Recording costs is easy. By using the 'costs' key you activate the costs table, from which you select the appropriate centre. If it is fuel, you enter the dollar value, followed by the quantity purchased. Exec-u-log buzzes and reminds you not to forget the receipt! Exec-u-log automatically dates and odometer stamps the transaction.

All of this travel data gets stored in a lithium battery-protected RAM chip. The RAM chip has 64kb of storage – or about 500 trips and 150 costs. In real terms, this would give you approximately 22 weeks of storage at, say, 30 trips per week. Exec-u-log has an automatic warning when the storage reaches 75% full, and this warning continues right up to the 100% full limit. When the warning appears, it is sensible to remove Exec-u-log from the car and retrieve the stored data. (The Taxation Office actually requires computerised data logging systems to be downloaded and signed off at a maximum period of one month).



The output

Exec-u-log has been designed to download this data either to an 80 column wide serial input printer, or straight onto a personal computer. The output is serial ASCII, with an RS232 interface and speeds from 300 to 9600 bauds are selectable. It is also straight forward to integrate this output into an existing fleet management software package.

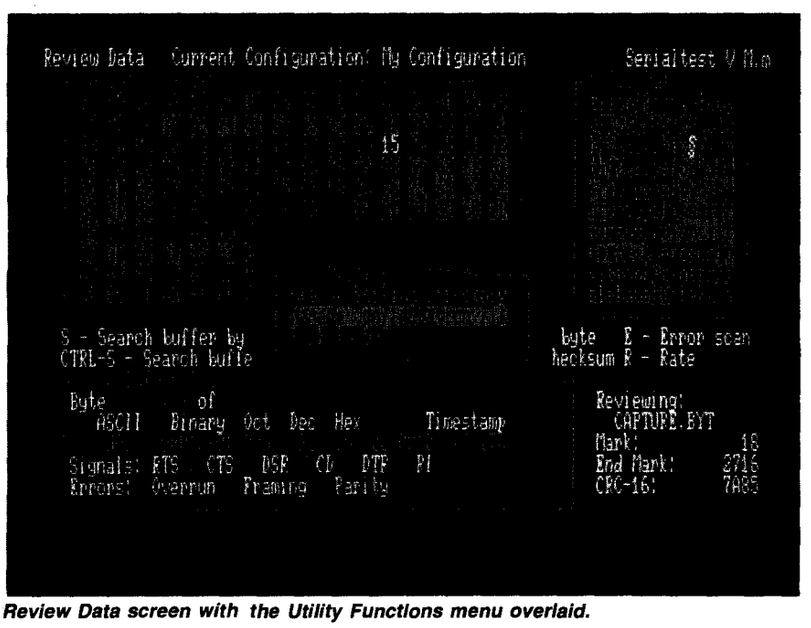
Now you have all the facts and your logbook. This output report automatically come in two forms – a detailed chronological report of trips and expenses (logbook) plus a summary of this period. Again, to make it easy, Exec-u-log automatically breaks the summary into monthly blocks, just in case you are unable to take a printout on the last day of the month.

You can clear the memory by erasing the chronological report, but the system keeps up to the last 16 summaries, so that at the end of the tax year, you can request a 12 monthly analysis of the summaries.

Apart from the cost benefits saved in FBT, the company claims a bookkeeping time saving of around five and-a-half hours per vehicle per month. eti

Information supplied by Automotive Electronic Specialists Pty Ltd, Cnr Avenue and Crescent Rds, (Private Bag 28), Camberwell, VIC 3124. ☎ (03) 882 8305.

INSTRUMENTATION



Review Data screen with the Utility Functions menu overlaid.

SERIAL TEST

Turn your computer into a test instrument with a disk of software. Jamye Harrison reviews Serialtest, which permits comprehensive checking and fault-finding in RS-232 interfaces and links.

Asynchronous serial data links (RS-232C) are commonly used for communications among computers and other specialised equipment with communications requirements. As with most,

if not all, devices and environments in the computing and electronics world, problems do arise, and need to be fixed. But first you have to find them!

RS-232C communications links are difficult to work with because of the varied implementations of the Electronic Industries Association standard. When they are not working it is terribly hard to troubleshoot because of the difficulty of monitoring the multiple control signals and the nature of the serial data stream itself.

Description

Serialtest appears to be a software alternative to dedicated serial data analysers. What usually takes expensive and specialised hardware can now be performed on almost any IBM-PC/XT/AT compatible computer.

Included in the Serialtest package is a 5 1/4 inch or 3 1/2 inch disk and two cables. One cable appears to be a standard 25-to-25 pin RS-232C connector, while the other is used as a Y-link. Also included is a comprehensive user's manual.

Hardware requirements comprise an IBM PC/XT/AT or compatible, configured with one or two serial ports, a minimum of 300 Kbytes of main memory; PC-DOS or MS-DOS version 2.0 or later; a monitor and display adapter and disk drive. A hard drive is not necessary.

With proper connection, your PC can monitor one or both ends of an asynchronous ASCII or EBCDIC (extended binary-coded decimal interchange code) serial communications link in a quiescent fashion.

The software is able to watch serial data passing through a standard serial link in a voyeuristic fashion, using the Y-link cable. In this mode Serialtest is taking continuous snap-shots of any data passing through the link and storing this data in a memory buffer, and, perhaps later, onto disk.

In a more interactive sense, the user can set Serialtest to form one end of the serial data stream, interacting in the test as the provider and/or receiver of any information. This information can be taken, say, from a disk file or from characters typed on the keyboard.

Traditionally, the best tool for this work was a dedicated piece of electronic test equipment known as a datascope. It provides a window for viewing data and associated control signals as they go by, enabling diagnosis of problems in a serial communications link.

A significant feature of most datascopes is the ability to set up a trigger, consisting of a byte, or many bytes, of data, or a specified change in any control signals. The equipment is set to act upon the occurrence of this condition in a certain way; perhaps commence or conclude testing of the link. For Serialtest, these actions can include storing the data following the trigger in a capture buffer, ignoring the data or stopping the monitoring altogether. Very helpful!

Serialtest can observe data and control signal changes live, supporting baud rates up to 115.2 Kbps.

Captured serial data can be viewed on screen, saved to disk and printed out in formatted or unformatted style. The data can be displayed in ASCII, Binary, Octal, Decimal and Hexadecimal form, giving different users versatility only dreamed of previously.

It is possible to select graphic representation of non-printable characters using the IBM-PC's extended character set. Parity, framing and overrun errors are also able to be analysed. You can also specify the size of the capture buffer, up to the amount of system RAM available.

A search function enables you to search the captured data swiftly for specific data strings. The software has program screens incorporating a message bar across the bottom and includes instructions for making menu choices or reminders for related functions.

A context sensitive help system is available on the system, which may be accessed any time.

Summary

Serialtest is a versatile, comprehensive tool and I found it easy to get into and use. As more and more test and measurement equipment comes with RS-232C or IEEE interfaces, many test laboratories and workbenches are sporting a PC. Moreover, many technicians and engineers would be called behind the times if they had not had at least some experience with a computing device, if not a working knowledge of at least one programming language!

The release of Serialtest is only testament to the fact that we are living in a world where computers are increasingly important. Perhaps ironically, the traditional electronics person seems to have successfully avoided any direct confrontation with the world of computers, up till now. At a cost of just $695 rrp, considerably less than the cost of most datascopes, excuses have just been invalidated.

Unfortunately, I was not able to use Serialtest on a portable PC. As the cost of laptop computers is continually coming down, and their convenience on the rise, Serialtest and a laptop, I am sure, would make an invaluable field tool for the service technician and for anyone else who needs to diagnose communication problems between computers and peripherals, or any equipment employing a serial link for communication. eti

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Serialtest is manufactured by Advanced Computer Consulting Inc in the USA and is available in Australia from Reptechnic Pty Ltd ☎ (02) 953 9844.

LADDER LOGIC PROGRAMMING

TECHNOLOGY

PLCs are useful devices for controlling plant. They can be programmed easily with Ladder Logic and offer efficient methods for connecting plant wiring, says Michael Nash of Current Solutions.

The personal computer running in a DOS environment is a powerful tool with plenty of third party application software. Much time can be saved by linking standard packages together. A package from Wizdom Systems, called 86-Ladder, now enables a PC to be used both as a PLC and to gather information that may be placed in packages such as spread sheets, data bases and speciality graphical control and monitoring software.

86-Ladder is a family of standalone software packages that replaces the Allen-Bradley PLC processor and I/O modules. It provides on-line programming, editing, execution, and documentation. No programming unit is required which can save a considerable amount of money. 86-Ladder looks and feels as though you are programming an AB PLC 2 system, but the results are in the PC ready to be ported into other DOS packages that allow evaluation of plant performance.

86-Ladder allows users of the industry standard OPTO-22 OPTOMUX and PAMUX products to program in Ladder Logic as opposed to Basic. Standard AC24/28 PC interface boards connect to the OPTO hardware. All the features of the Allen-Bradley PLC are available, together with on-line documentation.

Co-processors are available from Wizdom Systems for the PC/XT/AT, MULTIBUS 1, MULTIBUS 11, VME, AND STD BUS. These co-processors allow parallel processing that enables the co-processor to handle the plant I/O whilst the main processor runs a separate software package. On a PC the CNTRL.ALT.DELETE action will only do a soft reset of the PC, the co-processor remaining unaffected. This protects plant from inadvertent stoppages and brings more power to the controlling system. The co-processor passes its result to the main processor via dual ported RAM, which is transparent to the user in most operations.

The main processor can run packages such as Lotus, dBASE, Genesis, Paragon and Indelec products which enables powerful reporting and graphical representation of the plant process. By the use of such standard DOS software much information may be obtained about the plant performance which can lead to greater productivity and profits.

A further cost saving for some of the co-processors, including PC/XT/AT, is the inbuilt OPTOMUX and PAMUX interfaces that allow direct connection to the OPTO-22 equipment without the need for the AC24/28 PC plug in boards.

In addition to the OPTO-22 products, 88-Ladder will work with PC plug in boards from Burr Brown, Metrabyte, Analogue Devices, Action Instruments, Data Translation, Contec, Scientific Solutions and others. These products allow direct connection to the plant for both digital and analogue I/O from within the PC. 86-Ladder has all the inbuilt hooks to drive these boards with no speciality skills being required by the user.

Communication

Scanners available from various PLC companies allow 86-Ladder to communicate with different PLC I/O modules. These scanners plug into a PC/XT/AT and allow direct communication with I/O modules from Allen-Bradley, Modicon, GE, etc but the CPU module, I/O interface, and the report generator from the PLC suppliers are not required.

Wizdom Systems make available local controllers that allow Peer to Peer communication via Arcnet or Ethernet LANs. The LAN boards connect to local controllers, co-processors and PCs, which allow up to 255 devices to be connected together. An Arcnet LAN can cover a distance of 4.5 miles and transfer data at 2.5MBits per second.

Local controllers contain an inbuilt OPTO-22 PAMUX interface and contain the 86-Ladder program in PROM. The local controllers contain up to 128K RAM which is battery backed. Local controllers may be distributed around a factory for local control and minimisation of wiring.

86-Ladder includes on-line documentation as part of the programming and execution environment. The documentation is available in all PLC modes-PROGRAM-RUN-TEST, even with contact status and timer count updates.

The programmer can add meaningful instructions or comments at any time, turning documentation on or off with a single keystroke. To make it even easier, instructions that are repeated throughout the program can be documented by a single entry.

The documentation is stored with the ladder logic program on the 86-Ladder controller. The benefit is that the programmer or maintenance personal never needs to find a disk or listing to match the current ladder logic program.

The inbuilt documentation saves money, there being no need to purchase a separate documentation package and is ideal for trouble shooting.

86-Ladder maximises throughput and provides highest performance. The user program (8K), documentation (20K), data table (8K) are kept in separate memory spaces. The result is greater ease of use, program reliability, and faster program execution. In addition, 86-Ladder runs in extended address mode without the penalty evident in some PLCs.

Other features include:

- Automatic rung numbering and ability to search by rung number.
- Audible error indication and onscreen description of corrective actions.
- Automatic switch to PROGRAM mode when a run-time error is detected.
- Ability to configure and invert I/O in software.

Additional software packages are available that extend the functionality of the basic 86-Ladder software.

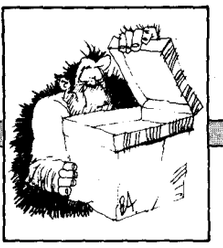
They include:

86-Message. A factory installed option that lets the programmer create operator screens, messages, and reports that allow non ladder users to see the process visually.

86-XRF. A standalone software package for the PC/XT/AT that produces a documented ladder logic listing, contact cross reference, and data table values and usage.

86-Comm. A standalone software package for the PC/XT/AT that lets the programmer upload/download programs to the 86-Ladder board.

86-Ladder is the only programmable controller that runs on multiple environments such as PCs, co-processors and Slave boards for PC/XT/AT back planes, VME, STD, MULTIBUS 1 and 11 and single board computers for distributed and local control. 86-Ladder allows the user to choose their preferred I/O, the platform to run on, the operator interface and more.



Hand driver and hex insert kit

AVAILABLE in four models, the Apex brand of Hand Driver and Hex Insert Bit Kit is designed especially for industrial users.

Kit ADK28 is supplied with a non magnetic hand driver together with 26 assorted Hex Insert Bits covering Philips; Pozidrive; Triwing; Torx; Slotted; Hex Head and Tamper Proof. Also, a non magnetic 0.25" Hex Adapter comes with it, so the Bits can be used with power and cordless drills and screwdrivers.

The ADK28M is the same as the ADK28, with the Hand Driver and Adapter supplied with a magnetic bit holder for the bits.

The other two kits are supplied with Hand Drivers with a storage facility in the handle and with 28 Bits. Two additional Hex Insert Bits come with these kits; the Hex Head 3 mm and 4 mm Bits.

Kit ADK3O is the non magnetic kit, and the ADK3OM is the one with a magnetic Bit holder and adapter. The design of the plastic case which comes with these products enables users to configure the Bits as required. The distributor, Endeavour Tools, can even quote to supply a kit for specific applications.

Contact Endeavour Tools Pty Ltd, 31 Cleeland Road, South Oakleigh Vic 3167. ☎ (O3) 562-8266.

READER INFO No. 181

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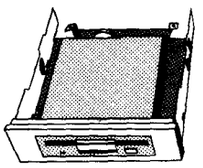

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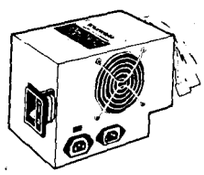

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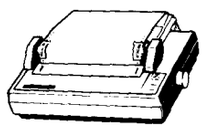

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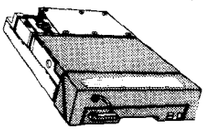

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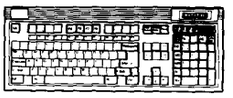

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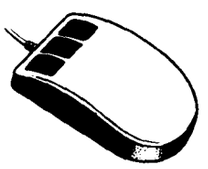

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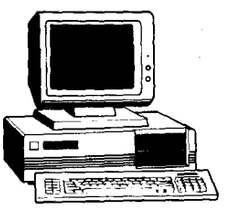

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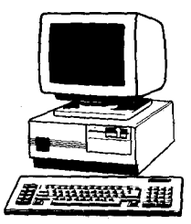

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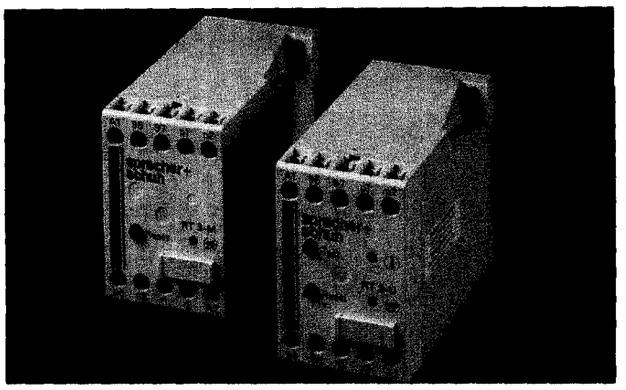


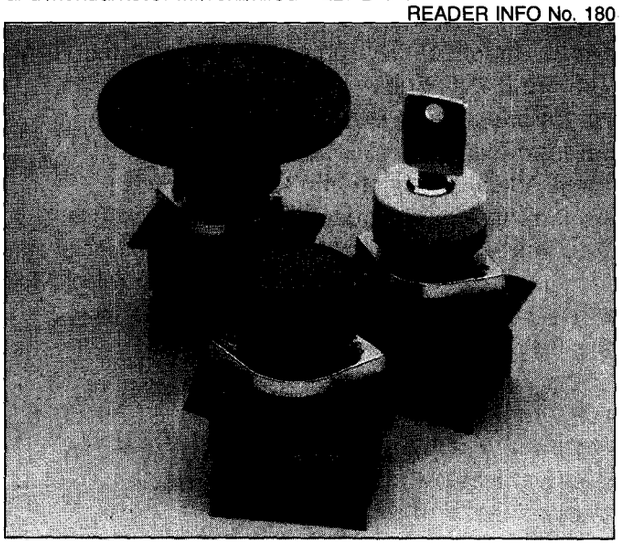
Thermistor protection relay ▲

ALL THREE models of the RT3 Thermistor Protection Relay from Sprecher and Schuh provide accurate temperature monitoring for a variety of applications. These include motor windings, transformers and bearings, etc.

The different versions are Manual Reset, Automatic Reset and Manual Reset with unlimited memory. Each model has standard thermistor protection features and can be used with any PTC thermistor sensor regardless of temperature.

Further details are available from NHP Electrical Engineering Products Pty Ltd, 51-67 River Street, Richmond Vic 3121. ☎ (03) 429-2999.

READER INFO No. 180



Pushbuttons and indicators ▲

THE DT3 range of pushbuttons and indicators from Sprecher and Schuh has been launched by NHP. The range also includes selector switches and key operated rotary switches available, like the pushbuttons and indicators, in either round or square 22 mm design.

Suitable for either panel or base mounting, the fully modular design of the range is expected to provide additional flexibility.

A comprehensive range of accessories including BA9s lamps and metal and plastic enclosures are also available.

For more information contact NHP Electrical Engineering Products Pty Ltd, 51-67 River Street, Richmond Vic 3121. ☎ (03) 429-2999.

READER INFO No. 179

Icom communications receiver

ICOM'S IC-R9000 communications receiver boasts 2 MHz to 2000 MHz coverage and can receive many different mode signals. With it you can tune into news agencies using fax, or RTTY using frequency shift keying (FSK).

For aircraft, marine and amateur stations on shortwave there is SSB (USB, LSB) and CW; and FM on VHF and UHF for businesses, emergency services, government, satellite, amateur, CB and other stations near your home or on the other side of the world.

Icom's unique multi-functional CRT display is built into the IC-R9000. It can show receive frequencies, modes and additional data for ease of use, and has a spectrum scope for visual signal confirmation.

With it users may observe the signal spectrum of nearby frequencies. The span can be selected for +/- 25, +/- 50 or +/- 100 kHz.

The CRT display also has a memory list and a terminal monitor. The memory list function enables you to see the contents of the ten memory channels at once. Memory channels may be scrolled for viewing.

The terminal monitor allows monitoring of RTTY or packet radio on the CRT, and ASCII (RS-232C level) code data from the RTTY terminal unit or terminal node controller (TNC).

Tuning steps of 10 Hz, 100 Hz, 5 kHz, 9 kHz, 10 kHz, 12.5 kHz, 20 kHz and 100 kHz steps are provided. Frequencies may be changed or received in 1 MHz steps, and there is an automatic click function for when using steps of more than 5 MHz.

Frequency stability is given as +/- 0.25 ppm in ranges over 30 MHz and +/- 25 Hz in ranges under 30 MHz. Receive frequencies and memory channels can be selected by keyboard, and a total of 1000 memory channels are grouped in 10 memory banks for storing frequencies, modes, filter widths and tuning steps.

There is a 24-hour system of dual clocks with two kinds of sleep timers and six different daily timers. Settings can be easily done on the CRT display.

The device has many scan functions for searching desired stations (13 a second) in wide frequency bands, and can also scan between two programmed edges. A total of ten groups of scan ranges can be specified.

The Selected Number Memory scan searches only memory channels containing a specified group number. Auto Memory Write scans between two programmed edges, writing the frequency, received time and date of signals sequentially in memory channels 900-999.

READER INFO No. 178

AST's i486 upgrade

AST Research has announced an i486 upgrade kit for its existing 25 MHz and 33 MHz 80386 machines. It comes in the form of a plug-in board called the FASTboard 486, and features 64 Kbytes of static RAM cache and a socket for an optional math co-processor chip.

For more information, contact Merelyn Kelly at AST Research on ☎ (02) 906-2200.

READER INFO No. 177

Sorry!

The distributor for the Seiko Optical Power Meter on page 108, *ETI* August '89, was incorrectly given as Kingfisher International of Melbourne. In fact the distributor is Fibernet of Melbourne. Apologies for any inconvenience.

Also, in September *ETI*, we forgot to mention that Jansit Computers is also a distributor of the Z88 computer. Jansit supplied the review machine and some prices are lower than quoted in the article. Further details from Jansit on (02) 891 5388.

Benchtop DMMs

TWO 6.5-digit multimeters with a 24 hour dc voltage accuracy of 4 ppm are being offered by Prema, the West German digital multimeter manufacturer. Both models also feature 0.0004% basic accuracy, a set of resident mathematical programs, 1 Gohm input resistance and user friendly display and controls.

Beyond this, the model 5001 is said to provide both dc and ac voltage and current plus resistance; 100 nV resolution; selectable integration times from 50 ms to 10 s and series/common mode rejection better than 60/140 dB.

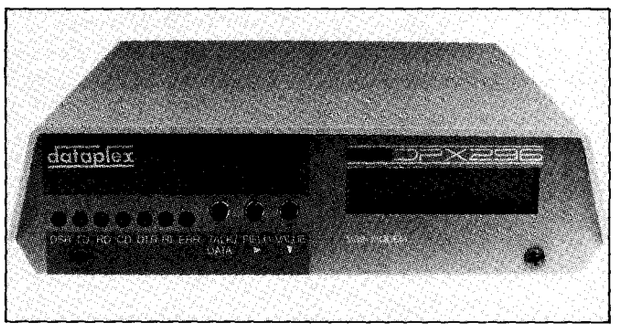
Resistance ranges are from 200 Ohms to 12M, with one milliohm resolution.

The Model 6001 has the features and specifications of the 5001, plus four-wire resistance and direct reading PT-100 temperature with 100 microohm resolution.

Further details from Emona Instruments, Division of Emona Enterprises Pty Ltd, PO Box K720, Haymarket NSW 2000. Australia. ☎ (02) 519-3933.

READER INFO No. 176

Dataplex modem ▼



THE DPX-296 full duplex modem from Dataplex combines both the CCITT V.32 and V.22bis specification in a single unit, allowing communication at 9600 and 4800 bps while retaining full compatibility with 300, 1200 and 2400 bps.

Front panel control provides a display of all modem features, enabling their easy alteration according to need, and allows the modem to be configured with or without an async terminal.

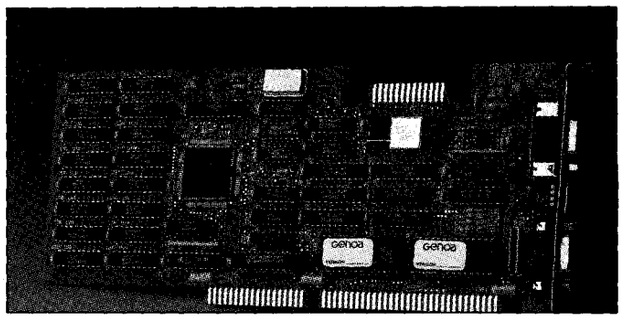
The DPX-296 is approved for connection to Telecom Australia's network. The modem's metal casing provides electrical screening and noise immunity, and for high density applications a rack mount version is available.

There is also the advanced DPX-596 multi speed dial up modem. It supports a wide range of international standards including V.21, V.22, V.23, V.26 bis, V.ASY and V.32 plus all equivalent Bell Standards covering 75 to 9600 bps.

With the latest CCITT V.42 error control procedure and MNP-5 data compression it can deliver throughput of 19,200 bps the makers claim.

For further information, contact Dataplex Pty Ltd, PO Box 541, Lilydale Vic 3140. ☎ (03) 735-3333.

READER INFO No. 175



Super VGA cards ▲

HYPEC has released two VGA cards for PCs. Both models, the 5300 and 5400, offer 16-bit functionality along with Genoa's RAMBIOS to achieve 32-bit performance on 80386-based machines, Hypec claims.

They can display 256 colours from a palette of over a quarter a million, and can switch automatically from 8-bit XT performance to 16-bit AT performance.

Features include a proprietary translation ROM that automatically maps EGA, CGA, MDA and Hercules onto analogue displays.

The Model 5300 provides 800 x 600 resolution in 16 colours and may be upgraded to a complete 512 kilobytes of memory, making it identical to the Model 5400.

The latter supports interlaced 1024 x 768 resolution for use with the IBM 8514 display and compatibles. It also supports non-interlaced 1024 x 768 resolution with displays like the NEC MultiSync XL and Nanao Flexscan 9070.

Analogue and TTL connectors, an IBM feature connector, and the advanced high resolution drivers for popular applications are also included in the 5300 and 5400.

For further information contact the Australian distributor, Hypec Electronics Pty Ltd, PO Box 438, Ryde NSW 2112. ☎ (02) 808-3666.

READER INFO No. 174

Economy EPROM programmer

THE PROM8900 stand-alone EPROM Programmer from Alfatron was designed for users employing high capacity devices who cannot afford to upgrade to more expensive existing systems, says the company.

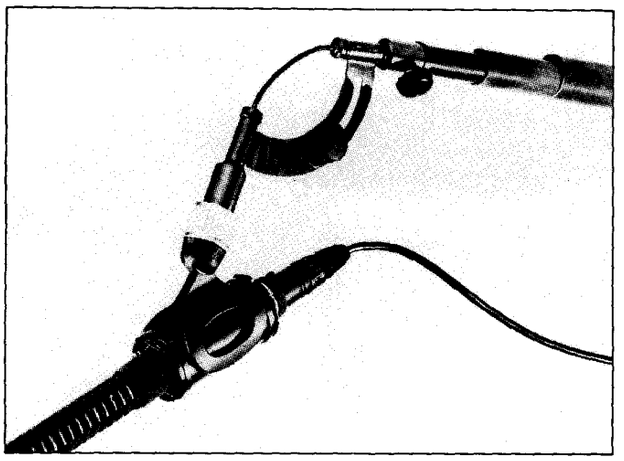
It is also for users just starting work with EPROMs. The unit programs devices from 32 Kbytes to 1 Megabit. It is also designed to upgrade to 8 Megabit devices. It is fast (employing the latest fast programming algorithms), price competitive, programming a 256 Kbit device in just 4 seconds.

The 8900 is compact, weighs 1.5 kilos and has a master and slave socket, three push buttons and an LCD alphanumeric display on its front panel.

Control of the unit comes through the menu system on the display which is used by the push buttons. An integral parallel interface is a standard feature.

Further information can be sought through Alfatron on ☎ (03) 720-5411.

READER INFO No. 173



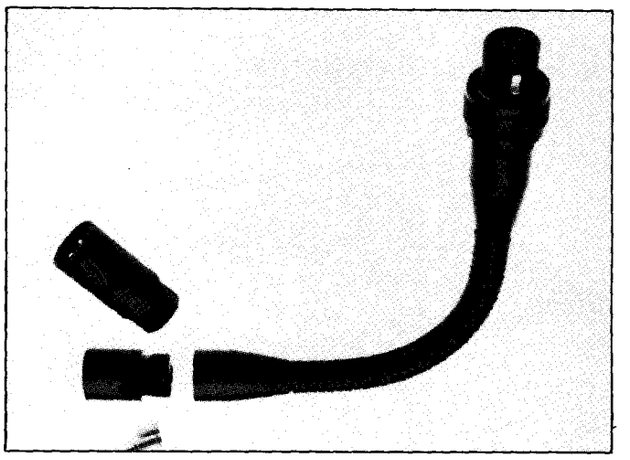
Shotgun condenser mic ▲

SAID to be one of the lightest shotgun microphones available, the MCE 86 short shotgun condenser microphone from Beyerdynamic is designed for camera mount, fishpole boom or handheld use. It weighs 92 grams and is constructed with a non-reflective Nextel finish for consistent protection.

It has a high sensitivity of 4.2 mV/Pa, over a frequency range of 50 Hz to 18 kHz, and claims excellent off-axis rejection. In-the-field flexibility is provided by the battery/phantom powered MCE 86 N (C) S model. The unit is available with two elastic shock-mounts.

Contact Hi-Phon Distributors Pty Ltd, Unit 13, Block C, Allambie Grove Business Park, Warringah Road, Frenchs Forest NSW 2086. READER INFO No. 171

Swiss goosenecks ▼



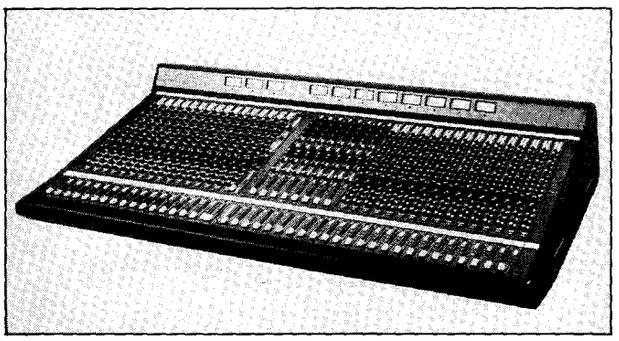
AVAILABLE in three lengths, the range of goosenecks from Swiss company Neutrik come with three adapters in a modular system which allows all possible combinations. All units are made of stainless steel and finished in a non-reflective matt black. They are also free from rust, noise and fatigue.

The goosenecks feature a female XLR module with locking ring for tight and apparently theft-proof mounting and securing of microphones.

Accessories include NC3MXI-BAG, male XLR connector and hex screw M17 x 1 with through-hole for panels larger than 7 mm.

For further information contact Karl Seglins at Neutrik's distributor, Amber Technology, PO Box 942, Brookvale NSW 2100. ☎ (02) 975-1211. READER INFO No. 172

Soundtracs console



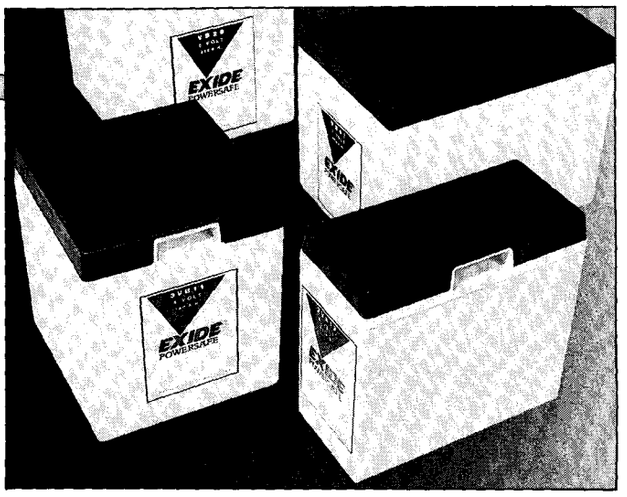
THE Soundtracs SPA console from Amber Technology is designed primarily as a front of house desk, but can be reconfigured via a single switch on each group to double as a monitor desk.

Two consoles can be linked together by access points to all audio, VCA and mute buses on rear panel connectors. All mixing buses are balanced for optimum crosstalk and noise specification.

Input channels feature a 4-band equaliser, with fully parametric mid and frequency sweepable high and low bands which are switchable between bell and shelving response. Eight auxiliary sends are fitted, all switchable pre/post fader and selectable pre/post equaliser.

For more, contact David Hudson, Amber Technology, PO Box 942, Brookvale NSW 2100. ☎ (02) 975-1211.

READER INFO No. 170



Battery guide

THE Exide Powersafe Specifiers Manual has 26 pages in full colour which are thumb-tabbed at the edge of the contents page. Section 1 deals with applications and construction, while Section 2 tabulates performance and describes calculation methods, including examples.

The rest covers battery charging, battery accommodation, product characteristics and operating guidelines. It is intended for designers and users of telecommunications, UPS, emergency lighting, engine starting, switch operating and alarm and security systems.

Further information can be obtained from Pacific Dunlop Batteries Industrial division, 55 Bryant Street, Padstow 2211. ☎ (008) 022-3785.

READER INFO No. 169

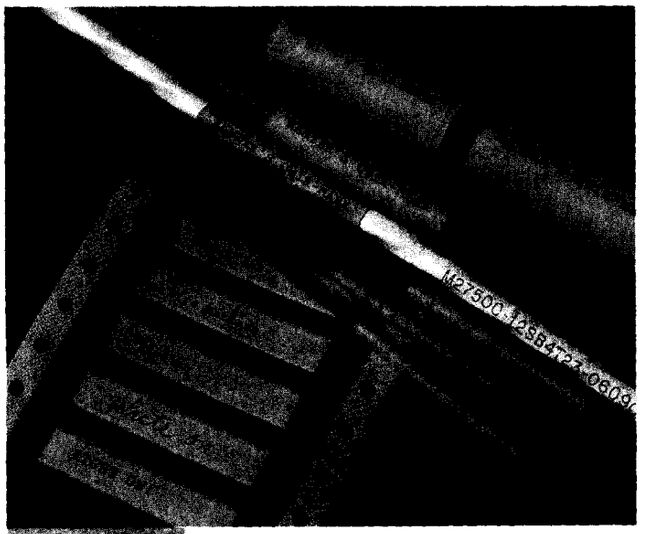
NOW AVAILABLE:

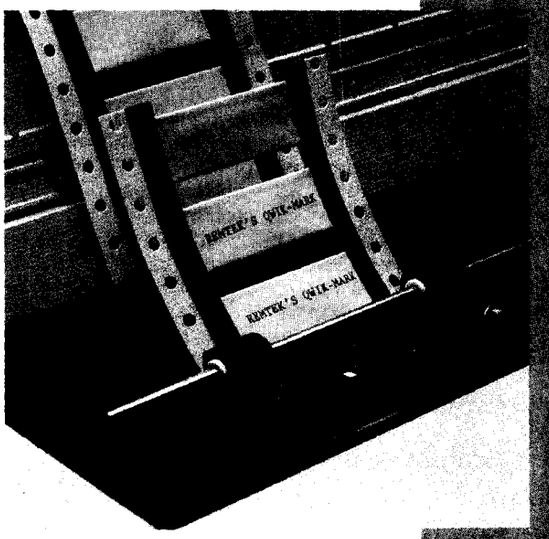
Flexible marking that's permanent and heat resistant

Remtek's Qwik-Mark is state-of-the-art in marking. Specially designed for use with standard typewriters and computer printers, the marks are smear resistant after printing. They become permatised when they are heated and shrunk.

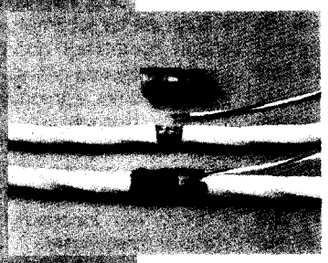
Qwik-Mark can also be marked with a pen. Used in printers and typewriters, Qwik-Mark will accommodate ball, wheel or dot matrix elements. Used this way, Qwik-Mark can be friction or tractor fed.

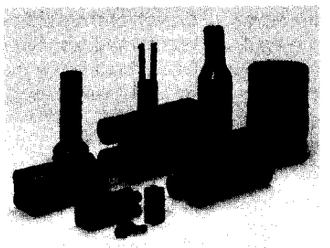
Qwik-Mark is available in 3 mm, 6 mm, 13 mm and 25 mm. Shrink ratio is 3:1. For more details on this amazing marking system, give us a call NOW.

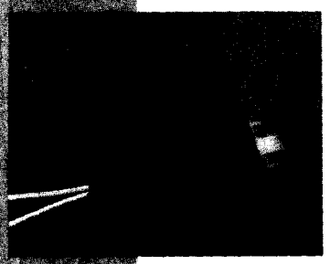


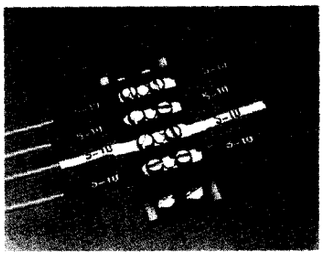


For the Complete Range of Heat Shrinkable Products: Remtek









Remtek market a wide range of heat shrinkable products, which includes U.L. and MIL spec. flame retarded materials, ultra thin wall, flexible thin walled adhesive lined tubings, semi-rigid and rigid products, medium and thick wall tubings, moulded parts and electronic devices for their application. The products are available in a wide range of polymers, including polyolefins, neoprenes, PVF, Viton, silicone elastomer, PTFE and nylon.

These products are used in electronic, communications, computers, defence electronics and avionics, as well as power supply utilities and heavy industry.

Call NOW for details.

We will be exhibiting the amazing NEW Qwik-Mark, as well as our standard products at the Elenex Exhibition. We will be at Stand 538. **SEE YOU THERE!**

REMTEK

JGMarketing/RHS102

Remtek Heat Shrinkable Products Pty. Ltd.
Head Office: 128 Platform Street,
Lidcombe, N.S.W. 2141
Phone: (02) 648 4433 Fax: (02) 648 1760
Distributors in all states.

READER INFO No. 35

BUFFOONERY

OF NUMBERS, TIME AND PLACE

We heard tell of some plans allegedly made by the peripatetic man of adventure and letters, Dick Smith. He thought the old TV show Towards 2000 was just great, but that its commercial successor Beyond 2000 was... a little over the top, beyond the fringe (beyond his ken?). Not just high technology, but over-the-top technology. He thought he'd put together something a little more middle-of-the-road. A title was the problem, though not the only problem.

Getting staff was the biggest hurdle. Couldn't afford the xxx 2000-type staff. Didn't believe in getting technically educated and articulate, but non-journalistic, people to do it – they might make it too technical..., and besides, they'd want too much money.

So he rounded up a few ordinary journalists on the grounds that, if THEY didn't understand what they were to be presenting, then how could the audience, and so therefore, the item to be considered would not be run – sort of a too technical filter.

So it came back to the name. There was only one thing for it – Around 2000 (shrug your shoulders while you say it!)

Wordsmiths' lament

The advent of the microprocessor led to the development of the personal computer. The development of the personal computer led to some programmer writing a word processor. Because programmers have to program with cryptic commands, this led to the proliferation of acronyms. Thus, the first programmer to write a word processor dubbed it, for short, a WP.

Little did that unfortunate programmer realise that the majority of the output of most WPs ends up in the WPB!

Time, gentlemen

Did you know that, on the 6th of July, at 1.23 pm and 45 seconds, the date/time was 1:23:45 6/7?

Number please

Several years ago, when IBM moved into a swank new office tower at Millers Point in Sydney, just next to the southern approaches to the Harbour Bridge, it was allocated a new, 7-digit phone number. Now, such lengthy phone numbers were new to Sydney's central business district then.

They got – 234 5678.

No matter how much IBM's press officer protested it wasn't a "fix", that it was all a coincidence of allocation and timing, Sydney's press corps refused to believe it!

Know your place

Some years back, when your dregs hack was employed in a branch of the public service (no names, no pack drill!), a PS memo was circulated by the secretary to all new departmental inductees, conscripts, new arrivals. It set out the roles, functions and responsibilities of those in the hierarchy in the following way, just so that it was clear about our place in the scheme of things:

ENGINEER-IN-CHIEF
- Leaps tall buildings in a single bound.
- More powerful than a locomotive.
- Faster than a speeding bullet.
- Walks on water.
- Gives policy to God.

CHIEF ENGINEER
- Leaps short buildings in a single bound.
- More powerful than a shunting engine.
- Just faster than a speeding bullet.
- Walks on water if there's no wind.
- Talks occasionally with God.

SENIOR ENGINEER
- Bound to leap short buildings with a running start and following wind.
- Almost as powerful as a shunting engine.
- Speeding bullets whiz past.
- Walks on water at the indoor pool.
- Talks with God if special request approved.

ENGINEER
- Can barely clear a garden shed.
- Loses tug-of-war with locomotive.
- Able to fire speeding bullets.
- Swims vigorously.
- Is occasionally addressed by God.

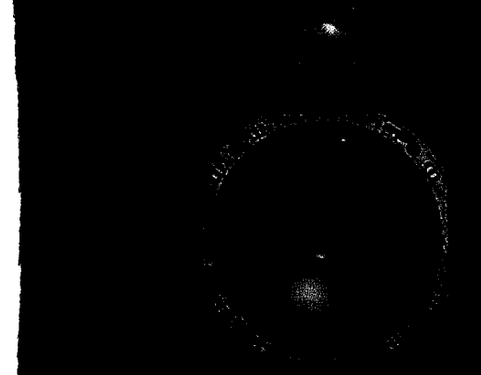
JUNIOR ENGINEER
- Leaves marks on wall when trying to clear tall building.
- Run over by locomotives.
- Can sometimes handle gun without injuring himself.
- Dog paddles vigorously.
- Talks to animals.

SENIOR TECHNICAL OFFICER
- Runs into buildings while out walking.
- Recognises locomotives two out of three times.
- Never issued with ammunition.
- Can stay afloat – with aid of life-jacket.
- Talks to walls.

TECHNICAL OFFICER
- Trips over steps at building entrance.
- Says: "look, a choo-chool"
- Wets pants with water pistol.
- Plays in puddles.
- Mumbles to himself.

ENGINEERING GROUP SECRETARY
- Lifts buildings and walks under them.
- Kicks locomotives off tracks.
- Catches speeding bullets between front teeth.
- Freezes water with one glance.
- *She* is God!

Sound Insights



MONITOR AUDIO 1200/GOLD SPEAKERS

THORENS TURNTABLES

WATTS THE THING

Are the marketers usurping the engineers when it comes to specifying output power? From what's being quoted in specifications and sales literature in certain areas of the industry these days, it would certainly seem so. Roger Harrison reports.

I sensed a certain *frisson* in the air listening to a presentation from a Technics spokesman at a press launch last year. He made quite pointed remarks that, in an industry where amplifier power ratings are used as an important marketing tool, a basic specification used to set one product apart from another, Technics had made it a policy that they would only be using the honest power rating recognised the world over – RMS watts.

It seems a ratings war, or maybe it's just guerrilla skirmishes, has been developing in the marketplace over the last year or so.

The villain in the piece is known as PMPO – peak music power output. It's a measure often used on down-market sound equipment it seems, and it's causing confusion among customers, and probably sales staff too, eager for a selling point with unwary or unknowledgeable customers.

The long-used and accepted measure of amplifier power output has been RMS watts – that's root-mean-square watts. It's a mathematically derived measure of electrical power that represents work done, that can be directly related to other measures of energy and power. It can be used directly to compare like with like.

The RMS power output rating of an amplifier tells of its ability to deliver power into a (resistive) load over a long period. Sometimes a manufacturer will drop the RMS and simply refer to it as so many watts continuous. For all intents and purposes, they mean the same thing.

That RMS rating is derived according to a standard test procedure recognised the world over and in use for many, many years. You might liken it to the horsepower rating of a car. It's meant to be a figure you can trust because it means the same thing, without regard to product or manufacturer.

It can be independently checked and verified. Which is probably one reason why many manufacturers under-quote the power output ratings of their amplifiers. You may notice from Louis Challis's reviews that many amplifiers will deliver a little more than their specified ratings, and that can't be a bad thing, can it?

You may notice that some European manufacturers quote "X watts, DIN". This is a European standards organisation (not unlike the Australian Standards Association). Remember DIN plugs? – same organisation; they've got their fingers in quite a few pies.

The manner of measuring an audio amplifier's power output according to the DIN standard is slightly different – I won't go into the technicalities here – but suffice to say that it generally results in a figure slightly higher than RMS. For all intents and purposes, you won't notice the difference in your listening room.

PMPO is another matter! There is a *huge* difference between the PMPO rating of an amplifier and its RMS output power, like ten to one. But that in itself is not really the problem, PMPO ratings can be compared too.

The problem arises when an amplifier's power output rating is quoted *without* it being qualified as to whether it's an RMS or PMPO rating, or whatever. PMPO figures sound that much more impressive than RMS, and many people equate power with performance. It's unfortunate that that happens, and it's fed by either uninformed (which I find hard to believe) or unscrupulous marketers.

Now, I'm aware – as, no doubt, you are – that a hi-fi amplifier is rarely, if ever, called on to deliver continuous output for long periods of time. Music, by its very nature, is composed of loud and soft passages with some transient peaks and the occasional sustained crescendo.

A hi-fi amplifier, for most of the time, just idles along. Its capability lies largely unused. You can liken it to a car. The engine's full capacity is only called on at intervals, during peaks of acceleration, not continuously.

Some manufacturers, recognising this, have developed amplifiers which respond to the peaks in music by bumping up their output for the period the peak lasts. This allows for reduced power transformer and heatsink ratings, reducing size, weight and cost. NAD has some well-known products that boast this capability.

Now, any hi-fi amplifier will deliver somewhat more than its RMS or continuous rating for short bursts. The difference between its peak output for a short burst and the continuous output is called the headroom. This may be as low as 2 dB (a barely audible difference), or as much as 10 dB (sounds twice as loud).

But how long is a short burst? How long is a piece of string? It might be twenty milliseconds, or it might be half a second. An amplifier's headroom figure is largely a reflection of its power supply's load regulation performance.

When driven with a continuous signal, the power supply will load down somewhat, but the supply's reservoir or filter capacitors will sustain a high voltage and current output for a short burst. Hence, the amplifier's ability to deliver somewhat higher output during short musical peaks. This is what the PMPO rating is all about.

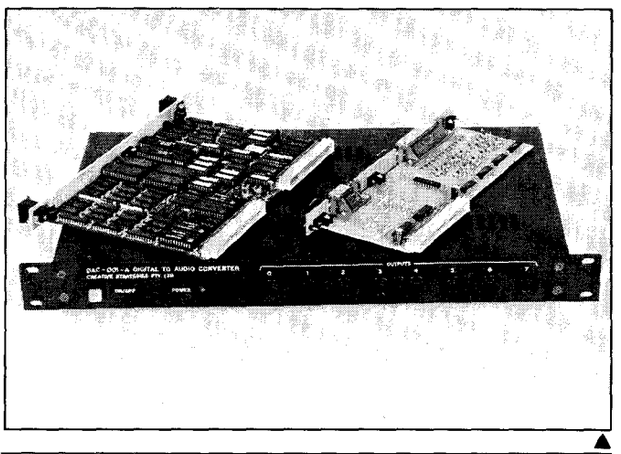
A problem that seems to have developed in the use of PMPO ratings – which have been widely exploited in the marketing of ghetto-blasters and similar portable sound products as well as music centres – is that the use of PMPO ratings has crept into the promotion and marketing of lower cost component hi-fi and midi systems.

Are we returning to the bad old days of the '70s when the term music power was in vogue? It caused a lot of confusion, and a concerted public and industry education campaign successfully buried it in the early '80s. Do we have to go through it again with PMPO?

It's encouraging to see major manufacturers in this industry plumping for RMS amplifier output ratings, a move calculated to keep the bastards honest, as ex-senator Don Chipp was fond of saying.

Perhaps what is needed is another education campaign to explain what I have dubbed "the separation of powers". There are particular power ratings for some purposes and other ratings for different purposes.

Watch this space.



VMEbus digital audio converter

THE DAC-001, from Sydney-based Creative Strategies, is a high performance, phase-coherent, VMEbus 8 channel audio digital to analogue converter and digital to digital audio converter, providing 8 channels of 4 times oversampled CD quality (16 bit) audio signals and comprising three hardware parts: a VME card; transition module and an analogue card which is housed in a separate box.

Residing on a standard 6U high by 160 mm standard card, the VME card accepts data from the VMEbus and stores it in one of eight, 8k sample FIFOs. If a channel is enabled, its data is available as a differentially driven, transformer-coupled digital audio output in the Sony/Philips Digital Audio format, or alternatively as oversampled, digitally filtered, 12S stereo signal groups. The transition module transformer couples and differentially drives the I2S signals through a 50 way shielded connector to the analogue board. The transition module also connects the Sony/Philips digital audio signals to a 14-way shielded connector or four stereo XLR connectors.

Housed in a separate, rack-mountable box, the analogue board has its own power supply to ensure complete isolation from any electrical noise generated in the computer. To achieve the best possible signal-to-noise ratio, considerable design work has been put into the grounding, and the analogue circuit board is isolated from the mains earth and chassis. In addition, digital and analogue grounds are separated and each channel has its own ground plane to maximise channel separation.

The system will be of particular interest to anyone concerned with the production of high fidelity sound from computers, eg. Schools of Music, radio and TV stations and manufacturers of synthesisers and broadcast quality audio equipment. As all 8 channels of the digital audio system can be operated in complete phase conference, this product should also be of interest to experimenters in spatial manipulation of sound in the entertainment and cinema industries.

For more information contact Creative Strategies Pty Ltd, 15 Centennial Avenue, Lane Cove, NSW 2066. ☎ (612) 427 5526. Fax: (612) 427 4450.

READER INFO No. 195

New Canon camcorders

BOTH of Canon's recently released camcorders feature the new 180 degrees Flexigrip, a combination grip and electronic 7" viewfinder which rotates 180 degrees to make high and low angle shooting easier and more comfortable than it once was.

Crawling baby shots no longer require getting down on bended knee, or lying on the ground.

The models are the Canovision8 E80 and E808. Identical except for their lenses, each weighs 1.2 kg without the battery pack and is equipped with a 320,000 pixel CCD half-inch image sensor, a high speed shutter (modes of 1/1000 and 1/1500), and a character generator for superimposing two-line titles and other data of up to 16 characters each.

An interval timer for time lapse recording is also included, for capturing such moments as sunrise, or a flower in bloom. Active infrared automatic focus, backlight compensation, fully automatic white balance, self timer, audio/video fade and date and/or time super-imposition are additional features.

The E80 has a Canon 9-54 mm f1.4 6X power zoom lens and a standard eyepiece. A Sports Finder eyepiece is optional for this model, and standard on the E808, which has an 8.5-68 mm f1.4 8X power zoom lens.

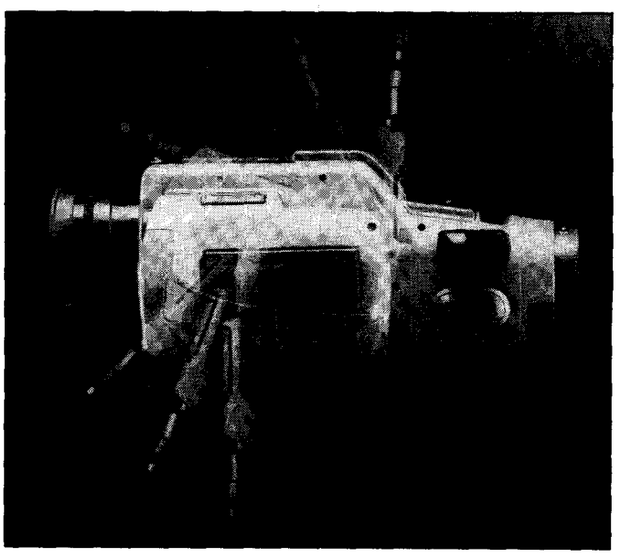
A cordless remote controller provides hands-off operation of the recording and playback functions, including zoom and fade. It stops recording automatically once a zoom or fade is completed.

Canon's unique centre-weighted average exposure system employed in both models is similar to that used in many Canon 35 mm still film cameras. Each camcorder also has a low light capacity of 7 lux.

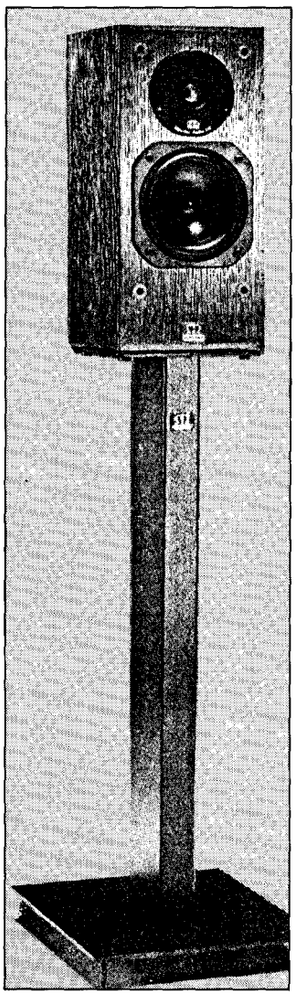
Included with both models is everything required for recording and playback.

For further information contact Canon Australia Pty Ltd, Unit 1, 37 Waterloo Road, PO Box 313, North Ryde NSW 2113. Telephone: ☎ (02) 887-0166.

READER INFO No. 194



Budget magic from Monitor Audio ▼



MUSIC lovers on a budget can now afford quality Monitor Audio loudspeakers with the release of the new Monitor 7. Selling at around $500 per matched pair, the Monitor 7s feature a metal dome tweeter for natural and extended high frequency performance and a quality long throw mid/bass driver giving excellent high power performance.

The cabinet construction is of dense medite, an acoustically dead material, and is finished with Monitor Audio's usual high standard of craftsmanship. Available only in black, the Monitor 7 is a bookshelf or stand-mounted design and is covered by a five year warranty. The Monitor 7 will complement a quality hi-fi system, including Midi systems, quality surround sound audio/visual system or is for people requiring a high performance bookshelf speaker that won't break the bank.

Critically acclaimed worldwide, Monitor Audio produces a complete range of high quality loudspeakers, including the new Reference Gold series, to suit most budgets and applications. For further information or the name of your nearest Monitor Audio specialist dealer, please contact Audio 2000, PO Box 94, Drummoyne, NSW, 2047, (02) 819 6533, Fax (02) 819 6312.

READER INFO No. 193

Gold in them thar tweeters

THE new flagship model loudspeaker from British company Monitor Audio, the Reference 1800 Gold, was recently launched at the Chicago CES. In this model, Monitor Audio's internationally acclaimed gold tweeter is placed at the acoustic centre of two precision bass/mid drivers.

The point source design allows the perceived source of the sound to be the centre tweeter area between the two identical bass/mid drivers. The result is said to be precise imagery, uniform vertical dispersion and high mid-range accuracy.

For increased stability and bass definition, a separate chamber may be filled with sand or lead shot. The Reference 1800 Gold is, like the Reference 1200 Gold, bi-wirable.

Further information is available from David Small, Audio 2000, Rear 137 Victoria Road, PO Box 94, Drummoyne NSW 2047. ☎ (02) 819-6533.

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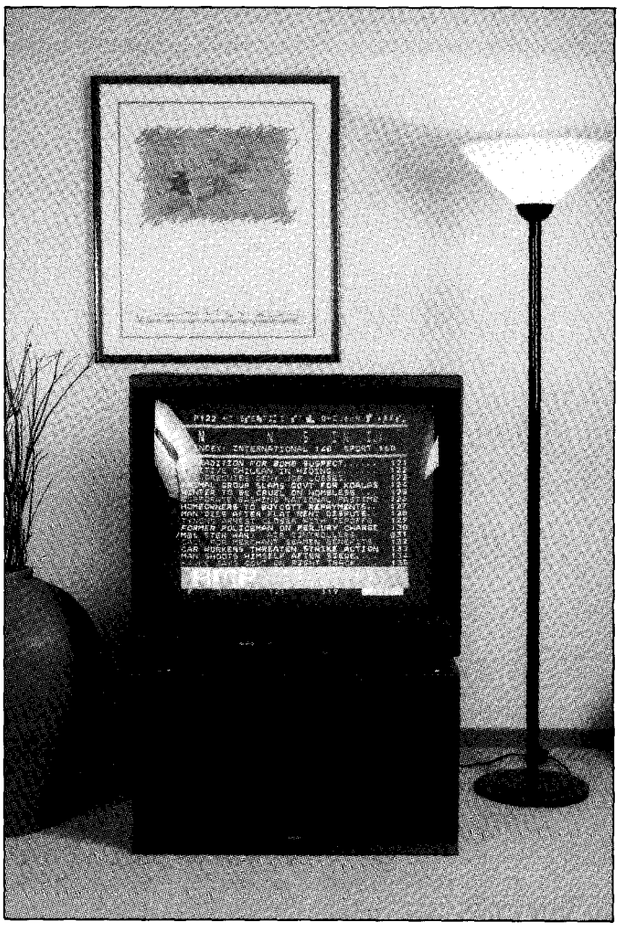


New TV boasts VCR ▲

SANYO has launched a Super VHS Video Recorder and Large Screen Digital Super VHS Television System. The Stereo VHRD4890 Super VHS Video Recorder includes Picture in Picture (PIP) so you can watch both a television broadcast and a taped program.

Incorporated into this recorder is an Instant Start Loading System, which takes about 1.5 seconds from start to playback; Four Screen Multi Program Scan so you can scan through the TV stations able to be received by your set, displaying still pictures from up to four stations simultaneously; and a Digital Auto Tracking system.

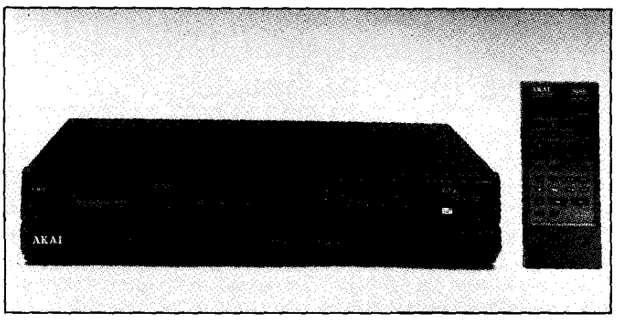
This is said to automatically adopt the optimum tracking position to ensure maximum clarity and minimum noise.

The CCP 3359 TX Television System has an 80 cm, tinted flat-square screen as well as the PIP facility. It has a two-way, four speaker sound system which delivers a full 15 watts per channel. Users can access 99 channels with 30 pre-set memory channels.

It has a four page memory for teletext, and tuning is made easier by a frequency synthesiser tuner which provides a full range of UHF and VHF channels. Together, both the VCR and television system are said to deliver up to 50% better picture quality from tape.

For more information contact Mr Mark Tyler, product manager, Sanyo Australia Pty Ltd, 7 Figtree Drive, Homebush NSW 2140.☎ (02) 763-3822.

READER INFO No. 191



Digital tracking VCR ▲

AKAI intends to increase its VCR market share with the introduction of the VS-53 digital tracking HQ VCR. An in-built digital tracking control continually monitors head alignment. This adjusts it to each tape. Manual adjustments are not needed.

Features include slow motion; still picture; frame advance; double speed playback; Quick Finder, which allows scanning up to five times faster than normal speed for SP mode; and Quick Start (play and record) which is nine times faster than some of the competition at 1.5 seconds.

Up to 100 channels can be selected by pre-set tuning, and the device also has an eight program, one month timer. Other features include Auto Off, which automatically rewinds and ejects the tape and turns the power off when playback is complete; and Auto Voltage which selects the correct line voltage.

Program prompts can also be displayed on a fluorescent display or the TV screen.

READER INFO No. 190

Classical headphones ▼

THE Model HD 530 headphone from West German manufacturer Sennheiser has been specially optimised for classical music. It incorporates a lightweight aluminium diaphragm, which ensures good transient response while providing an airy, tonal quality said to be akin to electrostatic speakers.

The frequency response is claimed to be 20 Hz to 25 kHz. Quoted distortion is less than 0.3%.

Models 480 and 520 are also available. The HD 480 Classic has a frequency response of 16 Hz to 23 kHz and can be located up to three metres from the music source. Quoted impedance is 70 ohms.

The Model HD 520 features a neodymium-ferrous magnetic driver system, combined with diffuse field loudness equalisation for impressive high volume reproduction. Frequency response is quoted as 18 Hz to 22 kHz, with distortion of under 0.3%.

For further information contact Syntec International, 60 Gibbes Street, Chatswood NSW 2067. ☎ (02) 406-4700.

READER INFO No. 189

Joint venture partner search

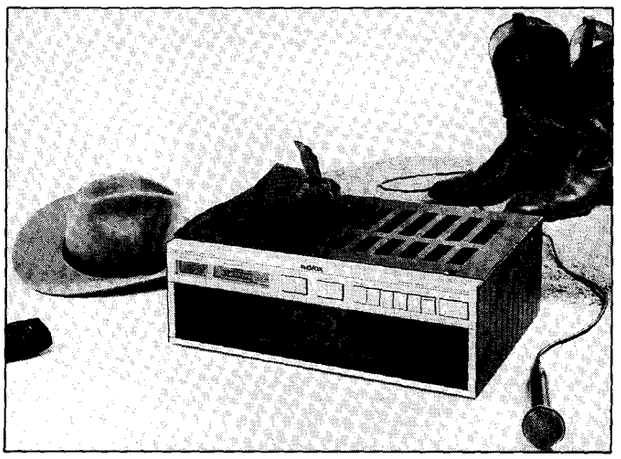
A medium-sized overseas manufacturer of high end audio equipment is looking for an Australian partner to import and market current equipment and to study possibilities for local manufacture in a joint venture in Australia.

The overseas partner is offering up to 70% of the investment capital, manufacturing technology and knowledge of the component market for competitive buying.

The Australian partner should have a successful marketing record of professional audio equipment or musical instruments on a national basis and be interested in joint manufacture and export possibilities.

Interested parties should contact Adrian de Lange Associates, 10 Grafton Avenue, Naremburn NSW 2065. ☎ (02) 439-1385.

READER INFO No. 188



New Revox Series 100 ▲

THE new generation of Revox Hi-Fi, the Series 100, comprises an amplifier, tuner and tape recorder. These are available separately, or as an integrated system.

The remote controllable B150 integrated amplifier has inputs for a full range of components including tuner, tape 1 and 2, CD, phono (MM) and auxiliary. An additional Record output supplies the input signal for a third tape recorder.

Two separate circuits in the preamplifier section allows for the simultaneous listening and recording of two different sources. The unit is rated at 130 W/ch and boasts gold-plated speaker connectors which will take cables up to 10 mm.

The Revox B160 tuner has 30 station memories, and all stations and program types can be controlled by the B208 remote control unit. Programming variations are monitored and steered by microprocessors.

Using Sendust-Ferrite heads, the B215 cassette tape recorder has a solid die-cast aluminium tape drive transport with four dc motors. It automatically and accurately aligns the heads to any type or make of tape.

Six memories are provided for programming individual cassette data.

Programmability of the B215 extends to preprogrammed locator positions which can be chosen in any operating position to permit endless play loops between any two points on a tape.

For further information contact the Australian distributor, Syntec International, 60 Gibbes Street, Chatswood NSW 2067. ☎ (02) 406-4700.

READER INFO No. 187

For the hard of hearing . . .

TWO models of wireless TV headphone sets for those with impaired hearing are available from Sennheiser. They consist of an infrared transmitter connected to the TV set and any number of stethoscope-type receivers for supplying sound at the requisite volume for viewers with deficient hearing.

The transmitter plugs into a mains socket for powering and is connected to an audio lead on the TV set. It automatically turns on and off with the television where it is plugged in. Nothing else is required.

There is the HDI/SI 405 S Mono unit, which provides standard mono TV sound, and the HDI/SI 2 S Stereo which is switchable between stereo, mono, and simulcast audio signals. It can also be plugged into the Hi-Fi.

The receiving units can be modified to compensate for different levels of hearing deficiency in each ear.

More details can be obtained from Syntec International, 60 Gibbes Street, Chatswood NSW 2067. ☎ (02) 406-4700.

READER INFO No. 186

CD Video

WHILE video compact discs will not be available in Australia until the year's end, a few companies have begun selling CD video (CDV) players in order to build a place in the local market, for if and when CDVs take off here.

Marantz, Pioneer and Sony have launched CDV players which can play both audio and video CDs of any size. While CDV players can do this, existing audio-only CD players cannot.

CDVs contain information in the same manner as other CDs, which is also read by a laser beam. The pictures can be seen by hooking a CDV player up to a television as you do with a VCR.

Despite the greatly improved quality in both sound and image provided by this new technology, CDVs are not expected to take Australia by storm, partly because of software shortages, and partly because of the extensive use of VCRs throughout Australia.

Although only a handful of CDV discs are available so far, a 12 cm 'single' for the pop market, a 20 cm EP disc lasting up to 40 minutes, and a two-hour 30 cm disc containing movies, operas and concerts are planned for release as soon as possible.

The problem here is that since their release in the Northern Hemisphere, the demand for CDV discs has been such that the one factory which produces almost all of them has been singularly hard-pressed.

READER INFO No. 185

New speaker from Apogee

THE new AE-4 system from Apogee Sound is a full-range, high level, low distortion system requiring only a single 300 watt amplifier.

The AE-4/A-4 processed system is made up of the A-4 processor and the AE-4 enclosure with its 300 mm (12") high-powered cone driver and the 25 mm (1") throat compression driver. Fluid cooling in the HF driver is used for power handling.

The A-4 stereo processor provides Time Domain Alignment, fixed equalisation points and the Positive Amplifier Feedback driver protection system exclusive to Apogee which protects the drivers from damage when safe operating speeds are exceeded.

It is available in both PV (Permanent) and RV (Road) versions, with the AE-4 cabinet coming in AV (Audio Visual) and CV (Contractor) versions.

For further information contact Graeme McGeorge on ☎ (03) 547-7578.

READER INFO No. 184

New VHS tape line up

THE Super Avilyn Technology Plus range of VHS video tapes from TDK comes in four grades. There is the HS (High Standard) PQI 128 available in E-120, E-180 and E-240 playing times; the E-HG (Extra-High Grade) TPQI 260 available in the same playing times; the Hi-Fi TPQI 263 designed specifically for stereo applications, also available in the same times and the HD-XPRO (High Definition-Excellent Grade) TPQI 286, for camera recording, original or editing master, or any AV application.

Coinciding with the introduction of this range of tapes are two new grades of VHS-C camcorder tape: the E-HG and HD-XPRO, both available in 30 minute playing times.

For video tape recording, uniform, high density ultra fine magnetic particles are required. The particle size on the Super Avilyn formulation is even more minute.

To ensure uniform dispersion of the particles and avoid agglomeration, Akai developed a new particle surface control technology called Interface Control Technology. This is used on the new Hi-Fi and HD-XPRO grades.

To bind the magnetic particles and offer greater tape durability, a new three dimensional compound binder system was customised for each grade.

READER INFO No. 183

Portable DAT player

A portable headphone digital audio tape (DAT) recorder has been put on the market by the Sony subsidiary, Aiwa. The device can also be used as a digital headphone stereo with an analogue recording function by means of an adapter.

The adapter also adds a facility enabling 1800 still pictures to be taken from a video camera and put onto a two-hour DAT tape. Aiwa expects the DAT will be useful in the automated office as a picture filing system.

READER INFO No. 182

LONG LIVE THE TURNTABLE!

Will the analogue record survive? What future is there for the turntable? Roger Harrison looks at new offerings from Thorens.

The top-of-the-range Thorens Prestige turntable.

It is just over 100 years since Emile Berliner introduced the flat-disc record with lateral modulation of the spiral groove. The sound-on-disc record has been with us ever since, albeit with some considerable development along the way. Despite dire predictions to the contrary throughout its history, no subsequent sound recording media has displaced the record – yet. The advent of the compact disc as a consumer product was predicted to kill the record within five years, but that was seven years ago. And while the CD has certainly had an impact on record sales and production, it is a long way from dead.

The 78 rpm record became established as a popular consumer product sixty years ago. Its demise was predicted when the micro-groove record was introduced, and again when stereo records arrived. In reality, it took thirty years for production of 78 rpm records to cease!

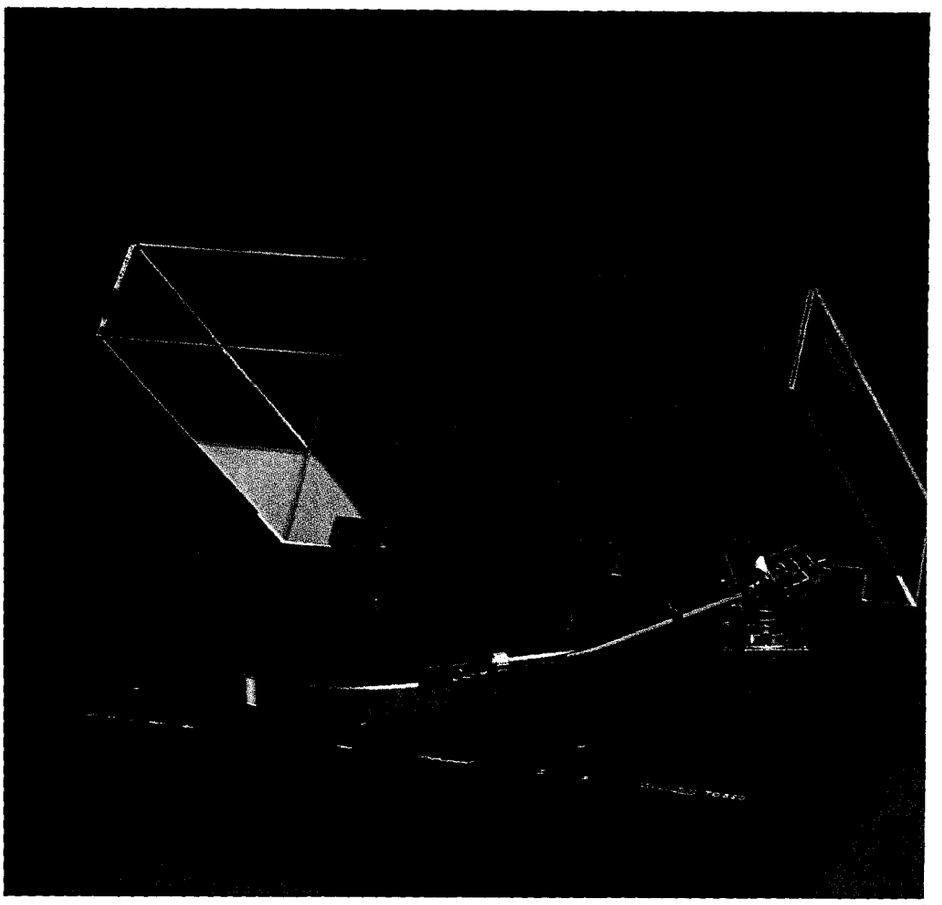
When the Philips-developed compact audio cassette was introduced as a consumer product, it was predicted that it would be the death knell of the disc. After all, here was a convenient product that allowed both playback *and* recording, and required no special handling as discs did. The reality was that the audio cassette simply provided another medium. The disc did not die. The disc, in fact, offered – and still does – advantages in quality, performance and longevity that cannot be claimed for the audio cassette. With subsequent development and considerable refinement – more a story of the triumph of craftsmanship over engineering – the cassette has come pretty close. But still the record lives on.

The rapidly growing popularity of compact discs, and the influence of Walkman-type cassette players, has seen a decline in sales

and production of analogue discs over the past five years. One major US record, cassette and CD manufacturer last year reported that unit sales of cassettes had, for the first time, outstripped record sales and that the fastest-growing product in its inventory was compact discs, although unit sales were well behind the others. What was the name of that horse that won the Melbourne Cup a few years back, Rising Fast? It's descriptive of CD sales, make no mistake.

Many music lovers and hi-fi enthusiasts have made substantial collections of discs over the years, and few are willing to forsake their investment for the sake of adopting a new technology. For such people, and their number in the world of hi-fi enthusiasts is legion, it is necessary to look at how they're going to take advantage of that investment in the years to come, as compact discs and CD players supplant the record and turntable. The answer is to invest, now, in a turntable of adequate quality and performance that is going to last for some time to come, to deliver the pleasure demanded of their collections in the uncertain future.

The idea is certainly abroad, as many distributors and retailers report a resurgence in turntable sales – at the quality end of the market. Among the names that have an established reputation for producing quality, high performance turntables is Thorens, a company that is as old as and has grown along with the sound-on-disc record. They have recently released a new turntable and an upgrade kit for one of their earlier models – considered a brave thing by some in the business, but probably a shrewd and well-considered move by this conservative, successful Swiss company, when you consider the discussion above. The new turntable is the TD320 Mk II and the upgrade kit is for the TD321 and is known as the Super Kit.



If your record collection spans back to the 78 rpm disc era, then this turntable from Thorens, the TD520, is worth checking out.

SPINDLES

The centre spindle is a component of major importance in a turntable, affecting such performance parameters as rumble and wow & flutter. Measurements of eccentricity and unevenness characterise the goodness of a turntable spindle.

In a series of measurements of turntable spindles from three major manufacturers, carried out earlier this year in Europe by an independent company, Thorens' spindles came up trumps.

Spindles from Linn, Rega and Thorens were compared for unevenness and eccentricity. In unevenness, the three were ranked as follows:

Thorens.....0.000354 mm
Rega.....0.000863 mm
Linn.....0.00155 mm

The result for Thorens was some two-and-a-half times better than the Rega, and 4.4 times better than the Linn.

In eccentricity, the three were ranked as follows:

Thorens.....0.00023 mm
Linn.....0.00098 mm
Rega.....0.00108 mm

The Thorens is more than four times better than the Linn here, and just less than five times better than the Rega.

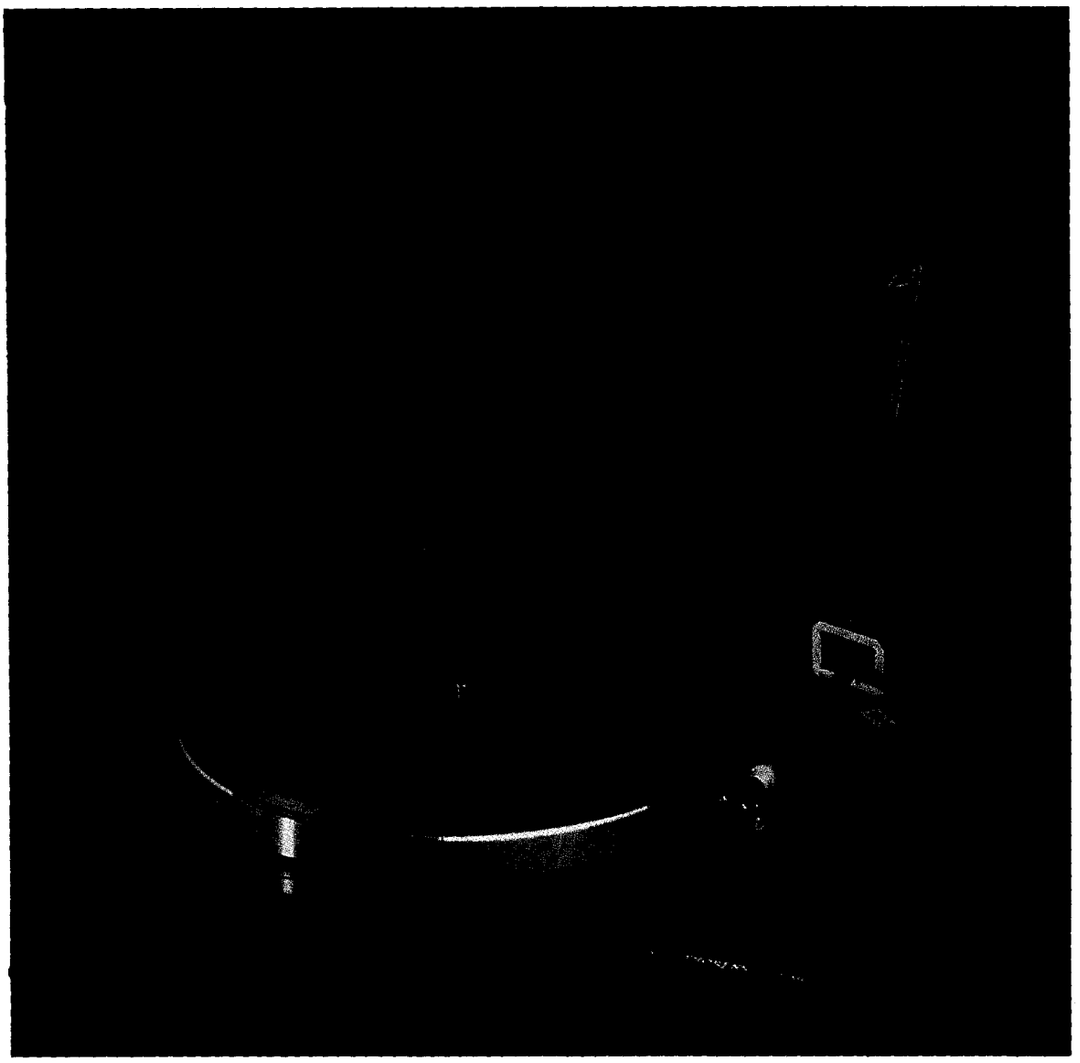
Residual rumble and wow & flutter are very noticeable when playing low volume passages on a record, particularly when only a single instrument such as a piano or violin is involved. Minute differences in turntable performance are readily picked up in this way. Hence, what seem to be vanishingly small differences in turntable parameters can make a substantial difference to subjective enjoyment of a recording.

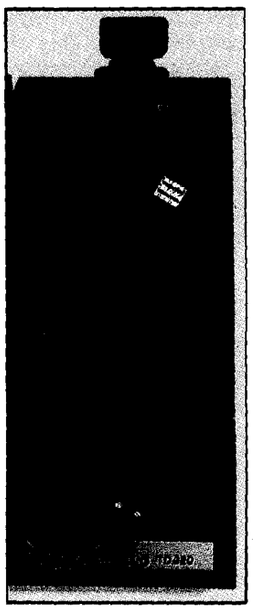
Thorens, new and old

Some Thorens turntable models have become classics, sought after even as second-hand items. The ten turntables in Thorens' current line-up range in price from $599 right through to $10,000-plus! But note that five are under $1000 and two are less than $2000.

Dealers and owners of the earlier TD320, a mid-priced unit when it was introduced, reported generally good results and it enjoyed healthy sales. Thorens has upgraded the arm in the Mk II, fitting their new TP90 tonearm with a removeable headshell and VTA adjustment. The convenient auto-lift is still there.

The TP90 is a straight-style tonearm, not the S-style. It features precision bearings and has been designed so that none of its elements introduces any perturbing self-





Above: Thorens tone arm anti-skating device allows for accurate compensation of the skating force towards the centre of the record.

The TD320 Mk II turntable, a new release from Thorens.

resonances, Thorens claims. It has an effective length of 228 mm and effective mass of 15 grams. Offset angle is 24 degrees. It has a standard half-inch cartridge mounting. The auto-stop mechanism is an opto-electronic type. It's ingenious as it senses the change in tonearm velocity as it moves across the inner grooves, the opto-sensor commanding the motor to stop and the tonearm to be raised. This system has two advantages in that it is friction-free and not position sensitive.

The Mk II features Thorens' floating suspension system which involves a two-chassis arrangement. One carries the motor and controls, the other is isolated by three adjustable leaf springs and it carries the platter and tonearm. Wow and flutter (DIN 45507 measurement) is quoted as less than or equal to 0.035%, rumble (weighted – according to DIN 45539) as less than 72 dB. Quite a respectable set of basic specifications.

The platter is of zinc alloy and weighs 3.2 kg. Two-speed operation is provided. The platter is driven with Thorens' well-known electronically controlled belt-drive system, which Thorens has developed over many years. The turntable measures 444 mm wide by 350 mm deep by 170 mm high, which includes the base (cover closed). It requires 17 V and is powered from a suitable mains adaptor, keeping mains well away from it. The TD320 Mk II is priced at $995 retail.

The TD321 upgrade kit, known as the Super Kit, is designed for retro-fitting to Thorens' TD321 MkII, or it can be fitted at time of purchase.

The TD321 Mk II turntable has the same performance and basic specifications as the TD320 Mk II, but it comes without the tonearm, tonearm lift and auto shutoff mechanism. Otherwise, it has the same performance specifications.

The Super Kit is comprised of a nine kilogram machined, brass alloy platter, a new hub and new set of springs for the suspension. Adding this amount of mass to the drive results in a substantial improvement in performance, Thorens claims. Add your preferred tonearm and you can compile an audiophile's delight record playing system.

If your record collection goes back to the 78 rpm disc era, then Thorens has a turntable for you, too. It's the TD520, a three-speed, belt-drive unit with an 11-inch tonearm (TP90L) fitted to accommodate the wide variety of disc diameters encountered.

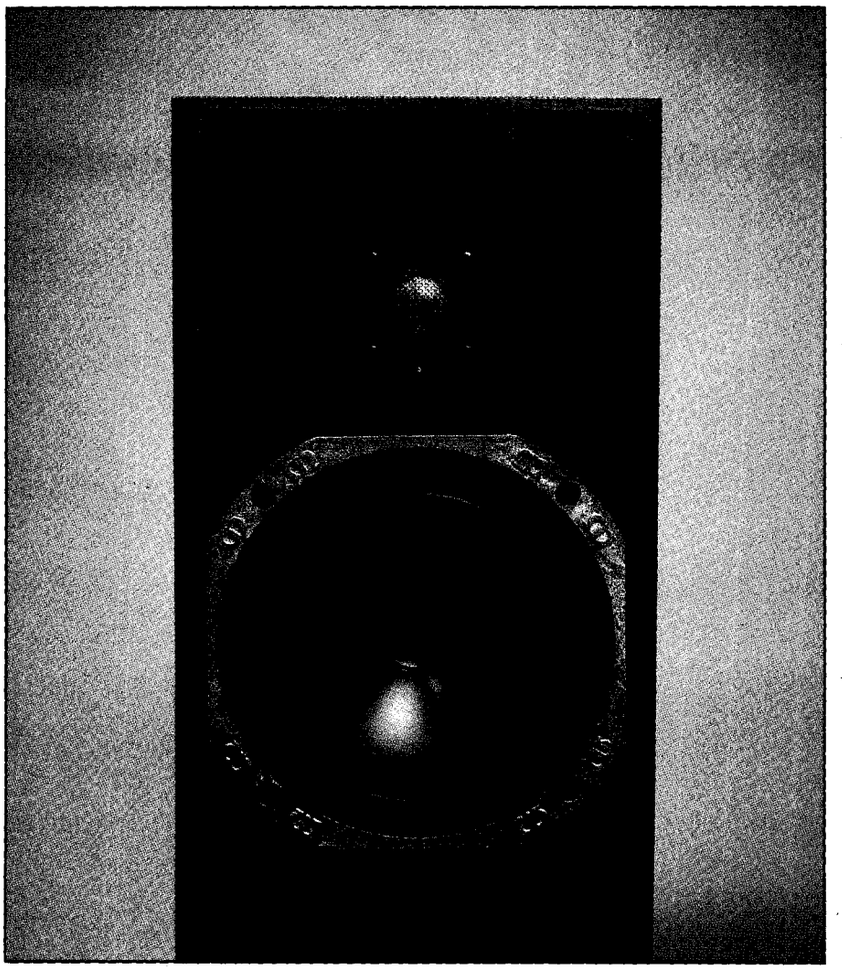
Its 300 mm platter is of zinc alloy and weighs 3.1 kg. Specifications for wow and flutter, and rumble, are the same as for the TD320 Mk II. It's priced at $1785 retail. You can also get the TD521, sans tonearm etc, for $1565. A Super Kit upgrade is available for this, too.

The record is not dead; long live the turntable!

Further details on Thorens turntables can be obtained from Crestmore, ☎ (02)44-2155.

MONITOR AUDIO 1200/GOLDS

Louis Challis reviews Monitor Audio's 1200 Gold MD Loudspeakers, one of the latest speaker developments from this British company.



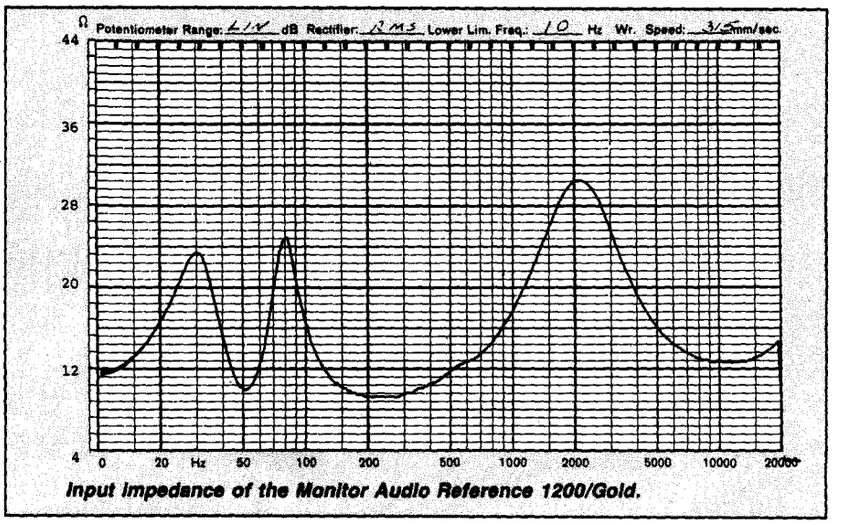
If I were to use the description of tall, dark and slim, you would most probably presume that I was talking about a girl. If I used the same adjectives to describe a loudspeaker, most people would be interested, for one of the most glaring deficiencies in many modern day loudspeakers is their sheer bulk and how much floor space they take up in the living room.

The Reference Monitor 1200/Gold MD is one of the latest speaker developments from Monitor Audio Limited in England, already well known as a speaker cabinet manufacturer for many of the smaller British firms who do not wish to manufacture their own cabinets. The design of these cabinets is both interesting and unusual, in that this two-way speaker system tries to achieve an unusually wide range response. The manufacturer and his literature wax lyrical about the "world's first gold metal dome" which, on closer examination, turns out to be a conventional aluminium/magnesium alloy diaphragm, which is gold anodised during the manufacturing process. This reduces the potential for surface corrosion, hardens the surface (a natural result of most anodising processes), improves the diaphragm's appearance and of course transforms this protection procedure into a delightful marketing feature.

The gold tweeter is protected by a golden hued wire mesh and is recessed with its front plate into the face of the cabinet, for minimum edge diffraction. The attractive, narrow cabinet has the 26mm diameter tweeter ideally positioned close to the top and has a small, innocuous, 150mm diameter combined mid-range woofer positioned just below it. The mid-range woofer incorporates a flexible rolled surround and utilises a stiff, polypropylene diaphragm. The speaker basket is fabricated from a heavy, zinc die-casting and uses a conventional ferrite magnet with a rear vented voice coil – presumably to enhance the thermal dissipation and avoid the need for front venting of the speaker diaphragm. The woofer incorporates a 31mm diameter voice coil with a high temperature aluminium voice coil former and has a long throw to ensure that its frequency response can extend down to 40Hz. The bass driver and the simple, first order cross-over are interconnected by the manufacturer's own heavy duty, low impedance speaker wiring, which is a good feature. The tweeter is, however, connected by much thinner hook up wiring, which negates some of the potential advantages accruing from bi-wiring and/or bi-amping these speakers. Much to my surprise, the speaker cross-over uses a ferrite cored inductor on a cross-over board which has been simply made from particleboard with screwed terminals, in lieu of the more conventional printed circuit board.

Suitably dampened

The inside of the cabinet is suitably dampened with a 50mm thick polyester



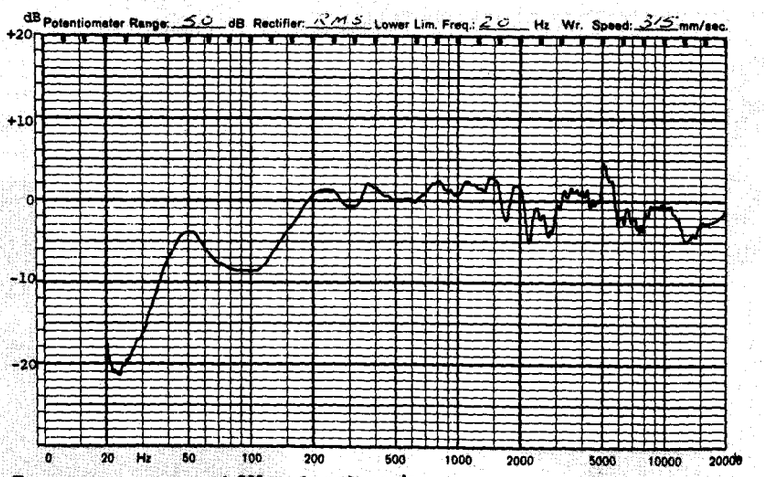
Input impedance of the Monitor Audio Reference 1200/Gold.

foam at the rear and 25mm thick polyester foam on the four sides. The effective volume of the cabinet is only 19.5 litres, although the cabinet size is obviously much larger. Of course, what the designer has done is to place the active portion of the speaker enclosure at an appropriate height, leaving a residual cavity at the bottom. In fact, the speaker cabinet only uses a little more than half the height of the cabinet for the speaker enclosure and the manufacturer recommends that the bottom chamber be filled with sand or lead shot to improve stability and enhance bass definition. This approach is sensible, and will undoubtedly achieve some enhanced definition. The designers have also adopted another uncommon feature, by way of four brass threaded inserts at the base of each cabinet, with matching spikes with threaded shanks.

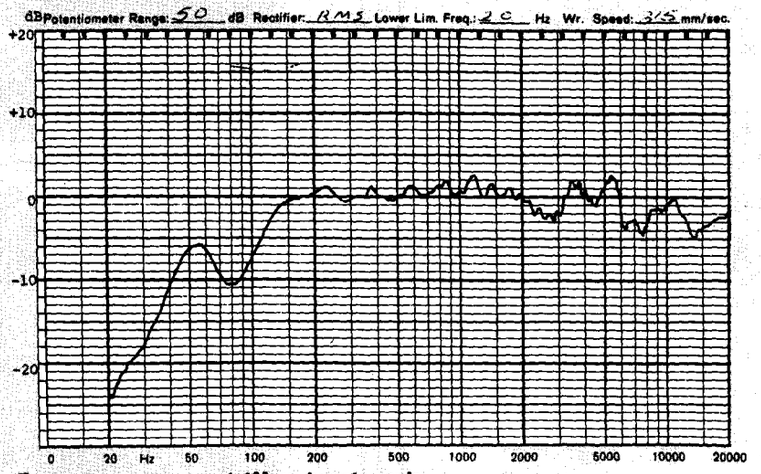
The user can screw in the spikes and then solidly nail the cabinet into a wooden floor to enhance the speakers' stability. The speakers and the upper section of the veneered cabinet are protected by a fine, black cloth-covered clip-on framed panel with four plastic pin retainers. The cabinet is a bass reflex enclosure vented by a 100mm long × 63mm diameter venting port. This port has sharp edges and has not been designed to reduce the potential 'panting' problems that straight edged venting ports usually produce at high signal levels.

The speaker connections are provided using two pairs of colour coded universal terminals recessed high up on the back of the rear face of the cabinet. These allow the user to either bi-wire or bi-amp the drivers, or alternatively, to conventionally feed each speaker cabinet with a single pair of wires. This requires the terminals to be externally inter-connected with the thin jumper leads with which they were provided.

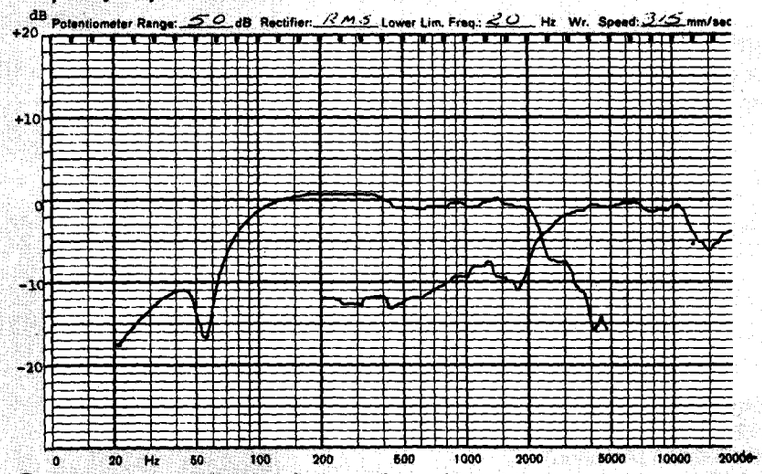
When measuring the frequency response characteristics of a rear vented cabinet in an anechoic chamber, the lower end of the frequency normally exhibits a double hump, which is generally compensated for by the presence of the rear reflection component from the living room wall, normally located behind the speakers in most listening rooms. Even so, the frequency response on axis of the Reference Monitor 1200s is remarkably smooth from 100Hz to 20Hz, and somewhat better than one would expect from a relatively simple two-way bass reflex enclosure. Apart from the hump at 50Hz and the droop at 1000Hz, there are some other



Frequency response at 2M on tweeter axis.



Frequency response at 1M on tweeter axis.

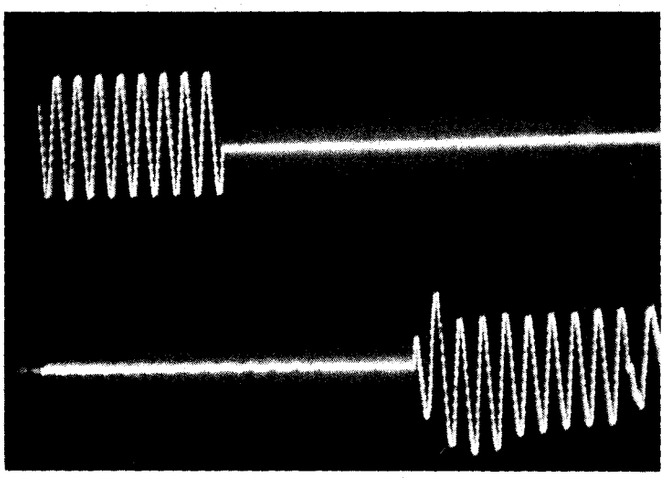


Frequency response at 5cm from woofer and tweeter.

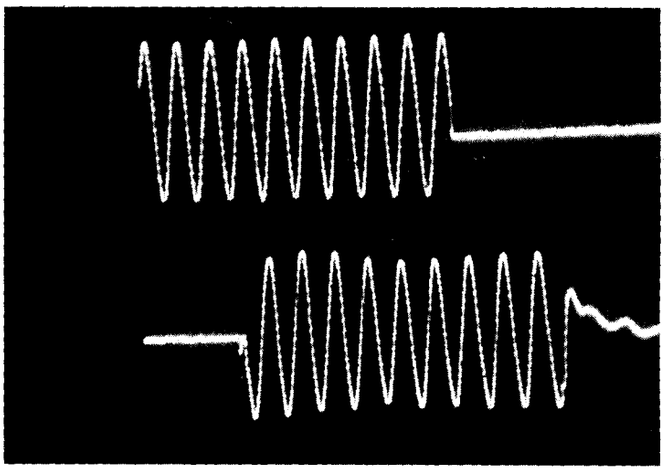
Dimensions:	**Height:**	**912mm**
	Width:	**200mm**
	Depth:	**260mm**
Weight:	**16 kgs**	
Price:	**$3,499.00 R.R.P.**	

significant humps associated with the cross-over at 2.5kHz and, again, a significant droop in the high frequency output beyond 10kHz. The tweeter output and its dispersion is excellent up to 10kHz, but exhibits a slight reduction of output between 10kHz and 20kHz, rising again to a pronounced resonance just below 25kHz. The polar plots

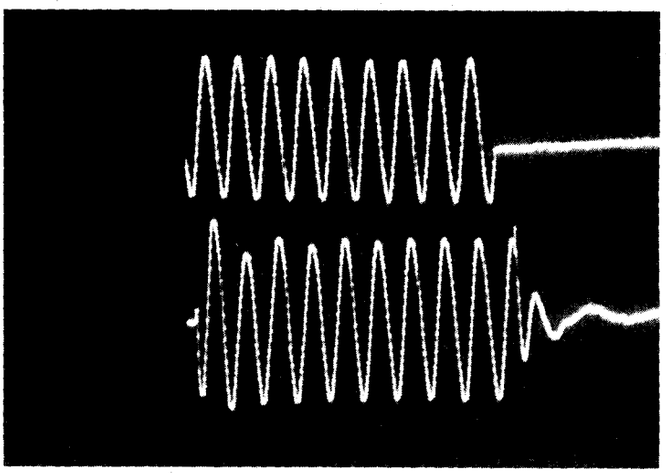
Tone burst response (for 90dB steady state SPL at 2M on axis). Upper trace is electrical input. Lower trace is loudspeaker output.



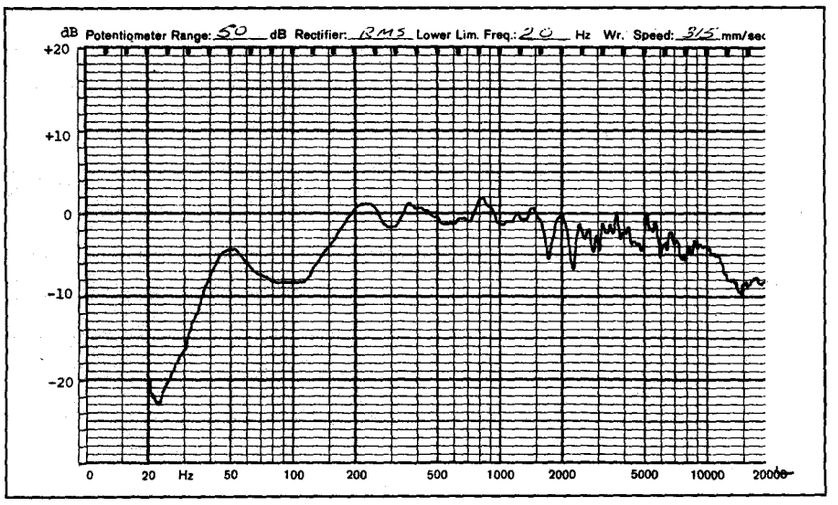
100 Hz (20mS/div).



1 kHz (2mS/div).



6.3 kHz (0.5mS/div).



Frequency response at 2M 30° off tweeter axis.

confirm that the dispersion angle is certainly better than ±20° at frequencies up to 10kHz, but becomes somewhat narrower above that frequency.

The speaker input impedance is peaky, with three major peaks at 30Hz, 80Hz and 2kHz, the highest of which is 32 ohms at the cross-over frequency. The lowest impedance is slightly higher than 8 ohms and consequently there should be no problems in paralleling a second speaker system with the Monitor 1200s.

Significant ringing

Phase response is quite smooth, and the tone burst responses reveal significant ringing, particularly at 6.3kHz where supplementary components are added to the original signal. The total harmonic distortion levels are generated at both the bottom end of the frequency range and the top end. The total harmonic distortion at 100Hz with only 90 dB at 1m results in 1.4%THD and similarly at 6.3Hz the 90dB signal results in 1.8%THD.

The speakers require approximately 13.8 watts to provide 90dB at 1 metre and this indicates that the overall electro-acoustic efficiency of the speakers is modest. An amplifier with an output capability of at least 70 watts should be required for satisfactory listening levels. The manufacturer's literature suggests that recommended amplifier powers are 15 to 200 watts; that statement would appear to be an over-simplification of the speaker's real power requirements.

The decay response spectra reveal that the speaker has some significant resonances around the cross-over frequency, and again at around 5.5kHz, which, I discovered, are audible in much of the program content. The tweeter's general performance over the range 5kHz to beyond 20kHz is quite commendable and the general impression from the decay response spectra is that the designers have achieved a commendable result in controlling most of (but not all) of the speaker resonances and a significant portion of the cabinet resonances as well.

Review of the Monitor 1200s extended over a period of more than three weeks, during which time I was able to assess a wide range of music from rock (played by my son) through to some delightful classical music. One of the new discs I repeatedly listened to was *Goya...A Life In Song* with Placido Domingo, Gloria Estefan, Dionne Warwick (and a cast of thousands) (CBS 463294 2), released just as I took the speakers home.

This disc in particular provided the opportunity to assess speech, which, although acceptable, is not the forte of these particular speakers. Their ability to reproduce low frequency sounds at reasonable listening levels surprised me and was better than initially indicated by either the anechoic frequency response assessment or the decay response spectra.

What the Goya record did confirm was that the high frequency output, particularly beyond 10kHz, was a trifle muted and lower than the musical content deserves. It did not conform to what I have come to regard as an optimum level of high frequency output. The music on the tracks *Espana* and *Viva Espana* provide superb listening content which the Reference Monitors reproduced well, but not up to the standard I would regard as befitting a speaker described as a Reference Monitor.

Brilliant recitals

Another disc which reproduced particularly well was Mikhail Pletnev's *Beethoven Sonatas* (Virgin Classics VC7 90737-2), on which this outstanding Russian pianist provides a series of brilliant recitals. The speakers reproduced the music with great clarity and minimal trace of distortion or colouration.

The third piece which I played was Grieg's *Peer Gynt* with Barbara Hendricks, Soprano and Esa-Pekka Salonen conducting the Oslo Philharmonic Orchestra (CBS Master Works MK 44528). This gorgeous piece of Grieg's fantasy provided exquisite music with a definite audible colouration in the stringed section and during the Soprano's recital.

The Reference Monitor 1200/Gold MDs consitute a sensibly conceived, small loudspeaker system. The bass response is

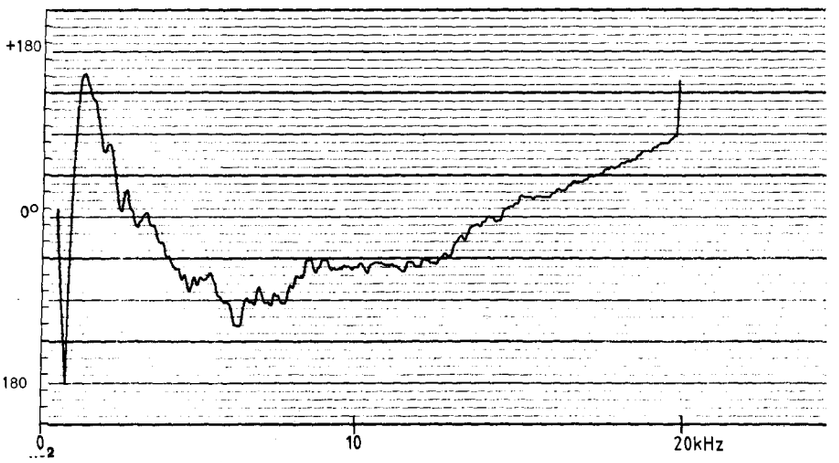
MEASURED PERFORMANCE OF MONITOR AUDIO REFERENCE 1200/GOLD MD SPEAKERS

Serial No	**1006**			
Frequency response	**35Hz-30kHz**			
Cross-over frequencies	**2300Hz**			
Sensitivity (for 90dB average at 1m)	**10.5 VRMS = 13.8 Watts (nominal into 8 ohms)**			
Harmonic distortion: (Levels as indicated)		**90dB**	**96dB**	**90dB**
		100Hz	**1kHz**	**6.3kHz**
	2nd	**38.0**	**44.7**	**53.5** dB
	3rd	**44.4**	**48.3**	**53.0** dB
	4th	**55.6**	—	**47.0** dB
	5th	**53.3**	—	**35.4** dB
	THD	**1.4%**	**0.70%**	**1.8%**
Input impedance				
	100Hz		**16**	**ohms**
	1kHz		**17.6**	**ohms**
	6.3kHz		**13.0**	**ohms**
	Minimum at 250Hz		**9.2**	**ohms**
Date: 25-6-89				

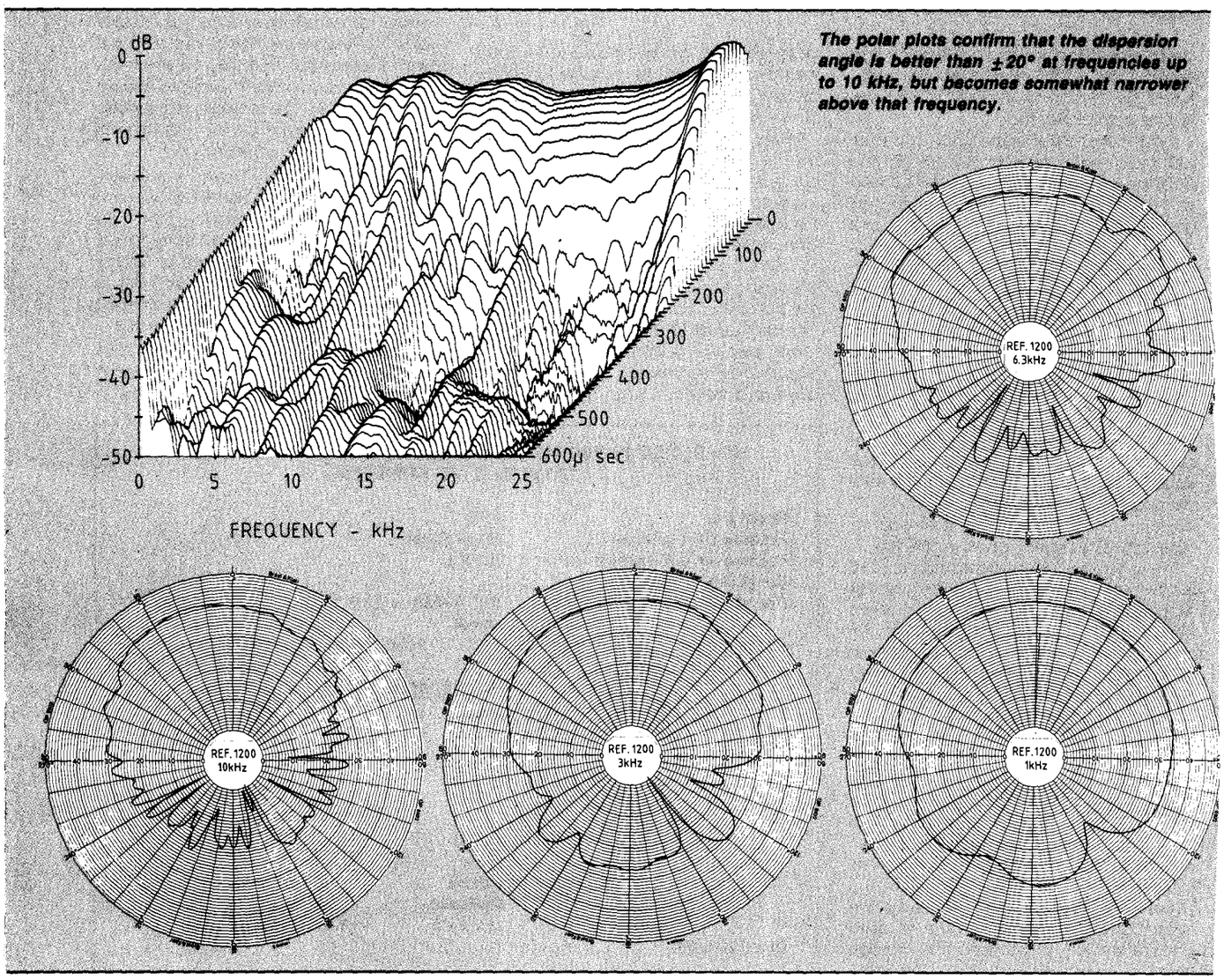
reasonably good considering the size of the cabinet used, but when these speakers are called on to produce low frequency sound levels exceeding 95 decibels, the level of audible distortion produced is most certainly not in keeping with the title Reference Monitor. There are other equally important construction details which I must pointedly question, particularly the use of a ferrite cored inductor in the speaker cross-over.

This cost saving feature leaves me somewhat chilled and a trifle concerned, particularly when these speakers have a price tag with an R.R.P. in excess of $3,000.

The Reference Monitor 1200s are well suited to a small apartment where their visual attributes are important, where listening to classical music is their primary function and where listening levels are likely to be below 90 decibels at 2M. eti



Phase response at 2M on tweeter axis.



The polar plots confirm that the dispersion angle is better than ±20° at frequencies up to 10 kHz, but becomes somewhat narrower above that frequency.