AUSTRALIA'S NUMBER ONE ELECTRONICS MAGAZINE

ELECTRONICS AUSTRALIA

MARCH 1984 AUST $2.30 NZ $2.75

Registered by Australia Post — publication No. NBP0240.

AUSSAT: SATELLITE TV FOR THE OUTBACK

BUILD YOUR OWN TV ANTENNA

MONSTER 25 AMP POWER SUPPLY

DUMMY HEAD FOR BINAURAL RECORDING

NEW SERIES: UNDERSTANDING OP AMPS

FOR QUALITY, PERFORMANCE & VALUE, AARON MUST BE YOUR FIRST 'SCOPE CHOICE

(and for after sales service too!)

1 BS601 – 20MHz/5mV with Built-in Component Tester

$535 ex tax $620.20 tax paid

- Check components on screen
- 19 range timebase • Triggers to over 30MHz • 17nS risetime

2 BS810 – 100MHz/1mV with 4 Channels and 8 Traces

$2295 ex tax $2708.10 tax paid

- 2nS/div max sweep time
- Alternate time base with B ends A mode • Variable trigger hold-off
- Independent position controls
- Signal delay

3 BS625 – 45MHz/1mV with Signal and Timebase Delay

$1095 ex tax $1270.20 tax paid

- Single sweep • Trigger delay
- 7.7nS risetime • X, Y, Dual, Chop, Add, Subtract etc

4 BS310S – 15MHz/2mV Battery Portable

$795 ex tax $922.20 tax paid

- Ideal for field service use
- 2 hour operation from built-in NiCads • Automatic re-charging
- Auto trigger free run • TV sync

5 BS320 – 15MHz/2mV with Digital Storage and DMM

$2295 ex tax $2708.10 tax paid

- Built-in 3½ digit multimeter
- Digital storage mode • Trigger delay • X-Y mode component tester • 3 channel operation for 3-phase measurements

6 BS635 – 35MHz/1mV with Alternate and Delayed Timebase

$875 ex tax $1015.00 tax paid

- 21 range timebase • 100mS-1uS trigger delay • Front panel trace rotate • Multi-mode display

Optional carrying cases available for all 'scopes.

Coline Probes

A comprehensive range of probes and accessories is available. Modular types have pencil slim heads and detachable earth leads. They offer excellent pulse responses and very wide bandwidths. A comprehensive catalogue is available on request.

SP100 – 100MHz Probe

$28 ex tax $32.20 tax paid

With x1, ref, x10 positions. 1.5m lead, BNC connector and selection of tips in heavy duty pouch.

All prices are plus sales tax if applicable and subject to change without notice.

SOLD & SERVICED IN AUSTRALIA BY

ELMEASCO Instruments Pty. Ltd.

NEW SOUTH WALES
15 Macdonald Street,
MORTLAKE
P.O Box 30, CONCORD
NSW 2137
Tel: (02) 736 2888
Telex: AA25887

VICTORIA
21-23 Anthony Drive,
MT. WAVERLEY
P.O. Box 107, MT. WAVERLEY
VIC 3149
Tel: (03) 233 4044
Telex: AA36206

QUEENSLAND
243 Milton Road,
MILTON
P.O. Box 2360, BRISBANE
QLD 4001
Tel: (07) 369 8688
Telex: AA44062

SOUTH AUSTRALIA
99 King William Street,
UNLEY
P.O. Box 1240, ADELAIDE
SA 5001
Tel: (08) 271 1839
Telex: AA88160

WESTERN AUSTRALIA
P.O. Box 95, GOSNELLS
WA 6110
Tel: (09) 398 3362

N.S.W. Ames Agency 699 4524 • George Brown 519 5855, (049) 69 6399 • Davred 267 1385 • DGE Systems (049) 69 1625 • Macelec (042) 29 1455 • Radio Despatch 211 0191 • Sheridan Electronics 699 6912 ***N.T.*** Thew & McCann (089) 84 4999 ***A.C.T.*** George Brown (062) 80 4355 ***VIC.*** Browntronics 419 3986 • G.B. Telespares 328 4301 ***QLD.*** Colourview Wholesale 275 3188 • St. Lucia Electronics 52 7466 • Electronic Shop (075) 32 3632 • W.G. Watson (079) 27 1099 • Nortek (077) 79 8600 • ECQ Electronics 376 5677 • Northern Circuits (070) 51 9063 • Fred Hoe & Sons 277 4311 ***S.A.*** Redarc Electronics 278 7488 • Trio Electrix 51 6718 • Protronics 212 3111 ***W.A.*** Atkins Carlyle 321 0101 ***TAS.*** GHE Electronics (002) 34 2233 & (003) 31 6533.

bankcard

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE

ELECTRONICS AUSTRALIA

Volume 46, No. 3, March 1984

On the cover

This idyllic setting illustrates one of the themes of our story on Aussat beginning page 12. The picture was taken by John Pinfold who also supplied the boots and shirt. The model had better remain nameless.

Features

Hifi, Video and Reviews

Projects and Circuits

Personal Computers

Columns

Departments

Sound level meter and wobbulator

Many people have a graphic equaliser as part of their hifi set-up. With this simple project you can analyse your room acoustics and correctly adjust the equaliser to get rid of peaks and troughs. Construction starts on page 43.

Monster power supply

Big brother to the VK Powermate, the VK Powermaster is a 13.8V supply that delivers a massive 14A continuously or 25A intermittently – just the thing if you run a 200W linear RF amp. Construction details begin on page 54.

Jamo loudspeakers

Jamo's centre bass reflex loudspeakers have a number of unusual design features. We put them to the test on page 40.


SUPER


EVEREADY
SUPER
HEAVY DUTY

ELECTRONICS AUSTRALIA

EDITOR
Leo Simpson
B. Bus. (NSWIT)

ASSISTANT EDITOR
Greg Swain, B.Sc. (Hons. Sydney)

EDITORIAL CONSULTANT
Neville Williams
F.I.R.E.E. (Aust.) (VK2XV)

TECHNICAL STAFF
John Clarke, B. E. (Elect. NSWIT)
Colin Dawson
Robert Flynn
Jeff Skeen
Peter Vernon, B.A., L.L.B. (NSW)

ART DIRECTOR
Merton Jones

PRODUCTION
Danny Hooper

SECRETARIAL
Christine Cleary

ADVERTISING MANAGER
Selwyn Sayers

CIRCULATION MANAGER
Alan Parker

Editorial and Advertising Office
57 Regent St, Chippendale 2008.
Phone (02) 699 3622 Telex 25027.
Postal Address: PO Box 163, Chippendale, 2008.
Advertising Sales Manager: Sel Sayers.
Melbourne — 392 Little Collins St, Melbourne 3000. Phone (03) 602 3033.
Representative: Mark Christian.
Adelaide — Charles F. Brown & Associates Ltd, 178 Fullarton Rd, Dulwich 5065
Representative: Sandy Shaw (08) 332 7711.
Perth — 454 Murray Street, Perth 6000.
Representative: Ashley Croft (09) 321 8217.

Circulation Office
Unit 3B, Sydneygate, Waterloo, 2018.
Phone (02) 699 2388.

Subscriptions
Subscription Dept, John Fairfax & Sons Ltd, GPO Box 506, Sydney 2001.
Enquiries: Phone (02) 699 2388.

Registered by Australia Post — publication No. NBP0240.
ISSN 0313-0150
*Recommended and maximum price only.

Editorial Viewpoint

Computers in the classroom

These days we hear a great deal about the worth of computers in education. Education departments are allocating more money to the acquisition of computers and to the writing of special software to suit the curriculum. Parents and citizens committees are also doing their part and are raising funds for the purchase of computers for their schools.

The net result is that many thousands of computers are now installed in schools throughout Australia. In fact there are now estimated to be some 20,000 computers installed in Australia's 10,000-odd schools. Naturally they are not distributed evenly — some schools are very well endowed while others have no computers at all.

Are these computers being put to good use or is the zeal of the P&C groups misplaced? Are the computers being used to play games or to teach fairly useless subjects such as Basic programming? Some of this does go on but for the most part computers are being used to teach the standard curriculum. In other words, teachers and students are essentially looking at the computer as just another tool for learning. The early results are apparently very encouraging.

To some extent, one might expect encouraging results when computers are first introduced. The teachers using them would tend to be innovative and would naturally put a good deal of effort into extracting the best results from this new teaching medium. Whether that will continue when computers become standard in every classroom, with one computer to two students, remains to be seen.

For most of us who have passed through the school system the results have been mixed. Past teaching methods have often killed student interest. How many people who were taught poetry and music appreciation in school now have no interest in poetry or music? If computers prove to be a tool that quickens student interest in learning for learning's sake they will be a great boon for the future.

Australia to adopt European TV stereo sound

A news item on page seven of this issue announces the approval of the European dual FM subcarrier system as the standard for TV stereo sound in Australia. One justification of this move is that it allows TV broadcasts to be accompained by a second language as an alternative to using stereo sound.

Perhaps a more cogent reason, which was noted in the press release from the Minister for Communications, Mr Duffy, is that it clears the way for production of stereo TV sets in Australia.

Whatever the reasons for its approval there does not seem to be any real demand for stereo TV broadcasts in Australia. Nor has stereo TV been a raging success in Germany where it was originally developed. It is one thing to have the occasional TV-FM simulcast but quite another to have regular stereo broadcasts.

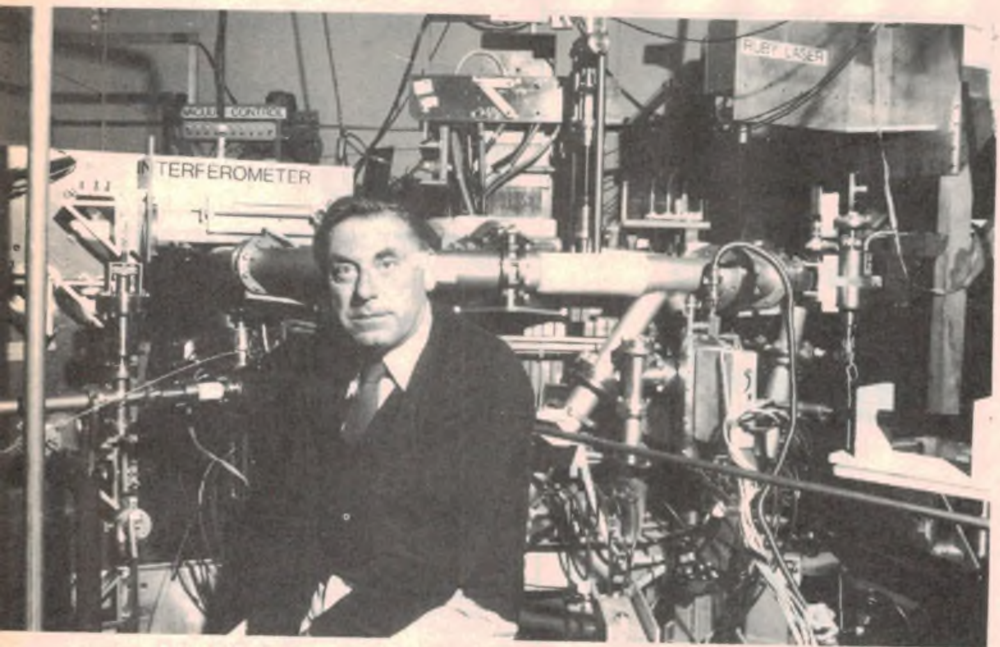
If we had to have stereo TV wouldn't it have been wise to wait for the potentially better and more advanced BBC digital stereo system to be further developed? Eventually all TV broadcasts will be completely digitised so what is the point of Australia being lumbered with this swansong from the analog age?

Leo Simpson

Printed by Magazine Printers Pty Ltd, Regent Street, Chippendale and Masterprint Pty Ltd, Dubbo, NSW for Magazine Promotions, Regent St, Chippendale.

Distribution: Distributed in NSW by Magazine Promotions, 57 Regent St, Chippendale, in Victoria by Magazine Promotions, 392 Little Collins Street, Melbourne; in South Australia by Magazine Promotions, 101-105 Waymouth St, Adelaide; in Western Australia by Magazine Promotions, 454 Murray Street, Perth; in Queensland by Gordon and Gotch (A'asia) Ltd; in Tasmania by Ingle Distributors, 93 Macquarie St, Hobart; in New Zealand by Gordon and Gotch (NZ) Ltd, Adelaide Rd, Wellington.

News Highlights



Dr Sydney Hamberger of the Australian National University with the LT4 Tokamak.

Fusion research "slow and steady"

If fusion energy is ever harnessed, says Dr Sydney Hamberger of the Australian National University, it will be because the problems were overcome by slow, painstaking effort, not sudden breakthroughs. Dr Hamberger is head of ANU's plasma physics research group and he was commenting on press reports of new developments in fusion research in the USA. At the recently held American Physical Society meetings in Los Angeles it was announced that US scientists had finally reached the "Lawson criterion" in research with MIT's Tokamak.

A controlled fusion "burn" depends on getting enough nuclei close enough together for long enough to get a net return on the energy invested in heating up the nuclei in the first place.

According to the Lawson criterion, unless the number of nuclei per cubic centimetre of plasma multiplied by their average length of stay in seconds exceeds 10^{14} the energy produced will never be enough to keep the material hot. Although fusion reactors themselves are still years away, this is the first time the magic number has been reached.

Now the most favoured machine for fusion research, the Tokamak works on the principle of using the magnetic field produced by the plasma's own circulating electrons to help confine the plasma in the middle of the ring. The energy is immediately dissipated if the particles escape to the walls.

One hard problem has been to add matter to the 100 million degree plasma without making it unstable and losing heat too quickly. But instead of injecting gas, the MIT group has used frozen pellets of deuterium, succeeding in getting them right inside the plasma in the middle of the ring before they evaporate. In this way they have been able to overcome the density limit and to just meet the Lawson criterion.

ANU's Tokamak, a descendent of what was once the only such device outside Russia, is being used to work at the detailed problem of keeping a plasma stable. Although operated on a very low budget compared with overseas facilities, the Plasma Research Laboratory has developed sophisticated methods of collecting data and is very cost effective. The Tokamak group has specialised in the study of plasma stability, focusing on how best to control and shape the magnetic field.

In Syd Hamberger's opinion, the "breakthroughs" will continue to be slow and steady. Although fusion research is "big science", it proceeds in a climate of international collaboration and exchange of information that is welcome. However, he says, it will be interesting to see just how long the collaboration will last once commercial possibilities for fusion reactors appear.

Manned stations — the new space race?

The space race will be on again if certain lobbying groups in the United States have their way. The goal, for the US as well as apparently for the Soviet Union, is to establish a permanently manned space station in orbit within a decade.

Pressure for the United States to build a space station reached a new high point towards the end of last year when the Office of Technology Assessment (OTA) came out in favour of the concept after a history of criticism. The success of Spacelab on the last Shuttle flight has also opened the way for co-operation with Japan and Europe on a more ambitious manned orbiting station.

Congress has already set aside the $US8 billion required by NASA to develop a small space station by 1992 and the OTA report published in December in favour of an orbiting station has removed the fears of many at NASA that the project would be blocked.

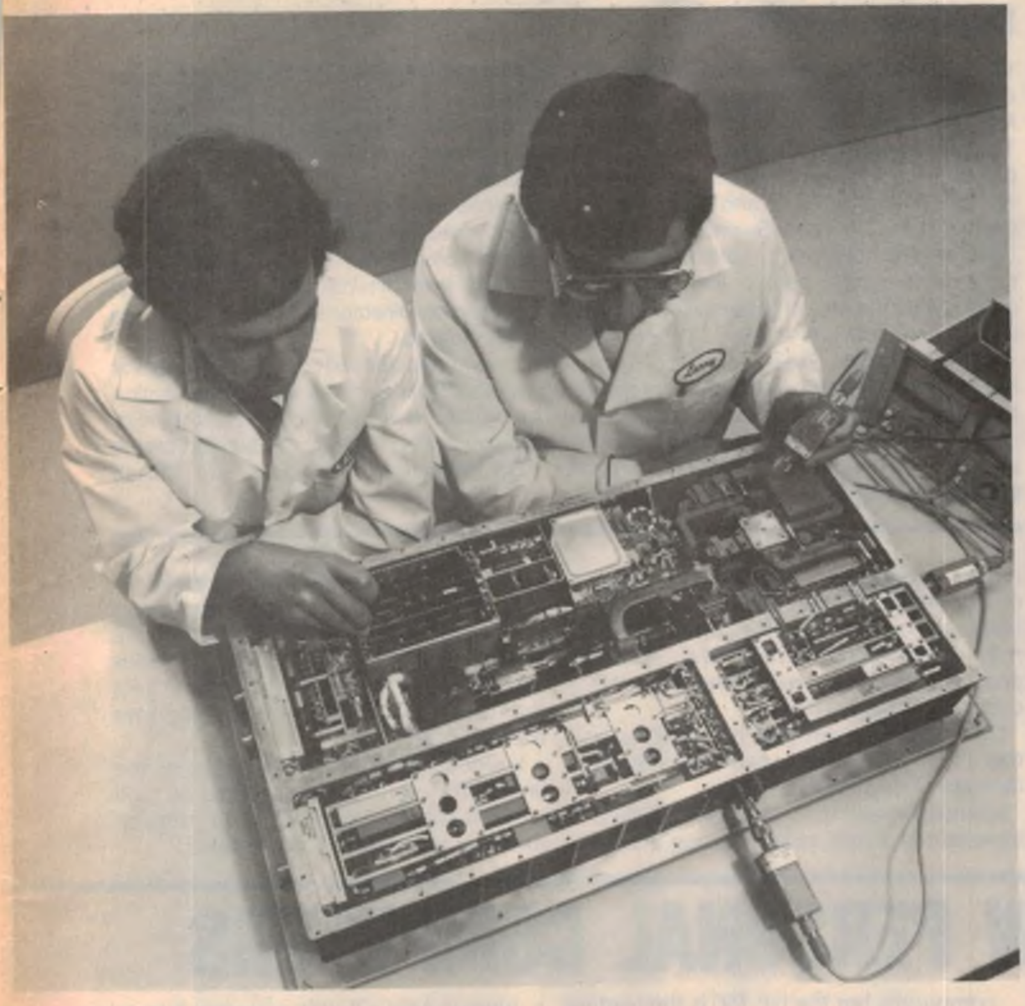
In the report, experts at the Office of Technology Assessment stated that the Soviet Union is clearly intent on establishing a permanent station in space, judging by their efforts to set new space endurance records in the present series of Salyut missions. Going further, the report predicts that the Soviet Union could use a manned station as a jumping off point for missions to the Moon and Mars.

The prospect of further Russian success in space may spur American efforts in the same way that the launch of Sputnik marked the beginning of the first race into space. According to one US analyst the American space program has always proceeded in fits and starts, with rapid bursts of innovation followed by a slowdown when initial objectives are achieved.

In contrast the Soviet Union has moved slowly but steadily, building on relatively inexpensive "brute force" technology.

Meanwhile, US experts claim that the Soviet Union is working to develop its own version of the Space Shuttle. According to US analysts, photographs taken over the Soviet Union during the STS-9 Shuttle mission show a large assembly and launching facility under construction which could be intended for Soviet space shuttle flights.

FOOTNOTE: just as this issue was about to go to press, President Reagan announced that the US would orbit a permanently manned space station within a decade. Cost is put at $8 billion over the next eight years.



Technicians at Hughes Aircraft Company's Radar Systems group are shown here with a Ku band radar assembly, a key component of the Space Shuttle's radar and communications systems.

The radar allows the Shuttle crew to rendezvous with and repair or recover satellites in low orbits and is capable of detecting and tracking targets as small as one square metre at ranges of up to 22km in space. Range is increased to 555km when the target is equipped with an electronic signal enhancer.

Standard announced for dual sound TV

The Minister for Communications, Mr Michael Duffy, has announced that the Department has approved the European dual subcarrier system as the standard for dual sound television broadcasts in Australia.

Dual sound television provides two audio channels which enable programs to be broadcast in stereophonic sound or accompanied by an alternative language. The second sound channel would not be heard on existing television receivers but can be decoded by specially equipped dual sound receivers.

Making the announcement, Mr Duffy said, "as a result of this decision Australian broadcasters who wish to transmit dual sound broadcasts are now in a position to provide this enhanced service." The establishment of the standard also clears the way for the production or assembly of dual sound receivers in Australia.

Broadcasters wishing to introduce the new service will be required to obtain authorisation from the Department of Communications before modifying their equipment to meet the new dual sound standards. According to Mr Duffy, the Government has not yet considered whether the ABC and the Special Broadcasting Service networks would move to the new system. The cost involved in modifying transmission equipment and providing additional distribution facilities will be a major consideration in any decision affecting the ABC or SBS.

Franklin settles with Apple Computer

Apple Computer Inc and Franklin Computer Corporation have settled their long-running copyright dispute in the United States. The two companies announced in January that Franklin would pay Apply damages of $US2.5 million and undertake not to infringe on Apple's copyright.

In its complaint, Apple alleged that Franklin had copied 14 of Apple's computer operating system programs. At the first hearing of the case in 1982 a Federal District court judge held that the operating system was part of the computer hardware, which could only be protected by a patent, not a copyright.

The judge refused to block Franklin from marketing its Ace 1000 and Ace 1200 computers and also indicated that programs stored in Read Only Memory chips may not be copyrighted.

Apple appealed this decision and the Federal Court of Appeals in Philadelphia overturned the previous ruling, stating that copyright rights "are not confined to literature in the nature of Hemingway's 'For Whom the Bell Tolls'." Programs stored in ROM were held to be "works" within the meaning of the US copyright laws. The recently announced settlement of the case means that Franklin will not appeal this decision to the US Supreme Court.

Officials at the Franklin Computer Corporation said they were relieved that the litigation was over. "It put a tremendous strain on our management," said Mr Avram C. Miller, president of the company. "We hope this agreement removes any stigma surrounding the company."

Franklin has developed a new operating system for its computers which does not infringe Apple's copyrights and, according to Mr Miller, users "would not be able to tell the difference when the machine is in operation".

Meanwhile, in Australia, Apple's appeal against the ruling that computer programs in ROM are not "literary works" within the meaning of the Copyright Act was listed for hearing in February.

Already, some overseas firms have threatened to black ban software sales to Australia unless the ruling is overturned or the law amended.

News Highlights

Lasers etch new microchips

Researchers at the Japanese company Toshiba have reported success in using a finely focused laser beam to directly etch circuit patterns onto a silicon wafer, bypassing the lengthy and expensive seven-stage photographic process currently used. An intense beam of ultraviolet light "writes" on the silicon in an atmosphere of chlorine gas which ionises and combines with the silicon as it is burned off, preventing the vapour from interfering with the etching process.

The laser process is claimed to be much faster than photographic etching and poses less risk of damaging other parts of a circuit already formed on the silicon wafer.

At present, integrated circuits are produced from silicon wafers coated with photosensitive material and exposed to an image or "mask" of the circuit pattern. The image is then developed and fixed and etched with a beam of ions. The technique allows circuit features as small as 0.5 micrometres to be drawn, but is a lengthy process. Making a complex chip may require performing the whole process 10 times over, building the circuit up layer by layer.

One of the hazards of the process is that the ion beam can sometimes damage lines already etched.

Scientists working for Toshiba in Tokyo have tested a new process using a laser beamed directly onto a silicon wafer masked by a circuit pattern. Toshiba says the lines are burned accurately off the silicon without causing damage to lines already burned. Line spacings of less than 0.5 micrometres are possible says the company.

Toshiba hopes that application of the laser process in mass production will make it feasible to procure 16 megabit memory chips within a few years.

Business Briefs

- The Managing Director of Plessey Pacific Pty Ltd, Mr Bruce Goddard, has been appointed the new president of the Australian Electronics Industry Association (AEIA). He succeeds Mr Allen Deegan, Chairman and Managing Director of Standard Telephones and Cables Pty Ltd, who did not seek re-election as president but who will remain on the board of directors of the Association.
- The Technical Book and Magazine Company has opened a Computer Information Centre in their shop in Swanston St, Melbourne to cater for all those bemused by the flood of new computers, software and books about computers. "We're keen to create an area in which people interested in computers can browse through the latest publications in comfort," says Mr Paul Radford, Managing Director of the company. The information centre is at 289-299 Swanston St, Melbourne.
- The first Audio Engineering Society regional convention and exhibition will be held at the Melbourne Hilton hotel from September 25 to 27 of It will be the first AES convention to he held in the southern hemisphere and will be organised around the general theme of digital electronics. Exhibition space is still available and papers on the convention theme are invited. For further information contact AES Melbourne, GPO Box 131, South Melbourne, 3205.

TWO HOT NEW PERSONAL COMPUTERS

It's not often that one can attend two "revolutions" in two days, but Sydney's microcomputer community had the chance in January with a flurry of releases from major manufacturers.

Undoubtedly the most significant releases were Hewlett-Packard's HP 150 and the Apple Macintosh, both billed as "the friendliest, easiest to use computer ever introduced", although representing divergent concepts of what is required in a personal computer.

Hewlett-Packard is well-known for laboratory instruments and scientific computers, but the HP 150 is the leading edge of the company's move into the personal business computer market-place.

Ease of use is enhanced by a "touch sensitive" screen, implemented by an array of infrared emitters and photodetectors at the sides and top and bottom of the screen. A finger pointing at the screen interrupts the beam, allowing any two-character screen area to be specified by touch alone.

The HP 150 is in the IBM PC mould, using a 16-bit 8088 microprocessor and running MS-DOS 2.0, allowing it to take advantage of the vast range of software written for the IBM PC and "lookalikes".

Software for the system includes many industry standard programs modified to take advantage of the touch screen. WordStar and VisiCalc, for example, can be run as normal or using a pointing finger to indicate cursor movements and areas of interest on the screen.

The Australian "Attache" range of business accounting software is also available, together with the Condor database management system, terminal emulation programs and Microsoft Basic.

Other features of the HP 150 include an 8MHz clock speed (claimed to run programs 70% faster than the IBM PC), 256K bytes of RAM, expandable to 640K, 160K of ROM and a graphics resolution of 512 x 390 pixels on a 22.5cm (diagonal) green phosphor screen. Two RS232C serial ports and an HP interface bus (IEEE-488) port are available for connection of HP peripherals.

Mass storage is built-in in the form of two 7.5cm "microfloppy" drives. Each

Apple Computer's new Macintosh computer with Imagewriter printer. The specially designed carrying case is optional.

European consortium to research "expert systems"

Europe's three largest computer companies, ICL of Britain, Siemens of West Germany, and Compagnie des Machines Bull of France, are to set up a joint institute to develop new computer techniques for the machines of the 1990s.

Work is expected to begin this year on a European Institute in West Germany to provide facilities for a research staff of 50, with the costs shared equally between the three companies.

The new Institute will concentrate on basic research in artificial intelligence "expert systems" – that is, techniques which allow the knowledge and experience of a human expert in a particular field to be codified and used by a computer.

The move is one of a number of projects undertaken by European industry and governments to compete with Japanese "fifth generation" computer research.

Apprentice of the year is from South Australia

Karen Lines, a-21-year old electronics apprentice with the Apprentice Training School of the Defence Science and Technology Organisation, recently won the 1983 South Australian and the Australian Apprentice of the Year awards. The South Australian award (called the Laurie Brownell Scholarship) entitles her to a nine month's study tour of industries in the UK, which Karen began in February.

The national award (a medallion and $3,000 in prize money) is sponsored each year by the Herbert Vere Evatt Memorial Foundation, which established the Australian Apprentice of the Year Award in 1980. Karen, a four year electronics apprentice, competed against eight finalists.

The Apprentice Training School is part of the DSTO's Advanced Engineering Laboratory, one of three establishments in the defence research centre situated about 25km north of Adelaide. The complex of workshops and laboratories occupies an area of approximately 10 square kilometres and includes extensive facilities for the use of private contractors working on defence projects.

plastic enclosed disk cartridge provides 270K bytes of permanent storage.

The release of the HP 150 will be backed by a major advertising campaign and involves the establishment of a network of retail dealers.

Apple Computer is of course already a leader in the personal computer field, although coming under strong challenge from IBM. Their response, the Macintosh, will be critical for the company's continued success and may represent the face of personal computing in the future.

Macintosh is based on the advanced 16/32 bit 68000 architecture developed for Apple's Lisa computer. Along with three new enhanced Lisa 2 computers, Macintosh will form the base of the Apple 32 bit "SuperMicro" family of computers.

Like Lisa, the Macintosh computer uses a "mouse" and a high resolution monochrome display to simulate the actual environment of a desktop. Symbols on the screen, called "icons", represent functions such as notepads, files, a calculator and other office tools.

Users select various functions by moving a "mouse", a small pointing device rolled over the desktop next to the computer. There is no need to memorise keyboard commands or codes which may vary between different programs.

Hewlett-Packard's HP 150 runs MS-DOS and features a touch sensitive screen.

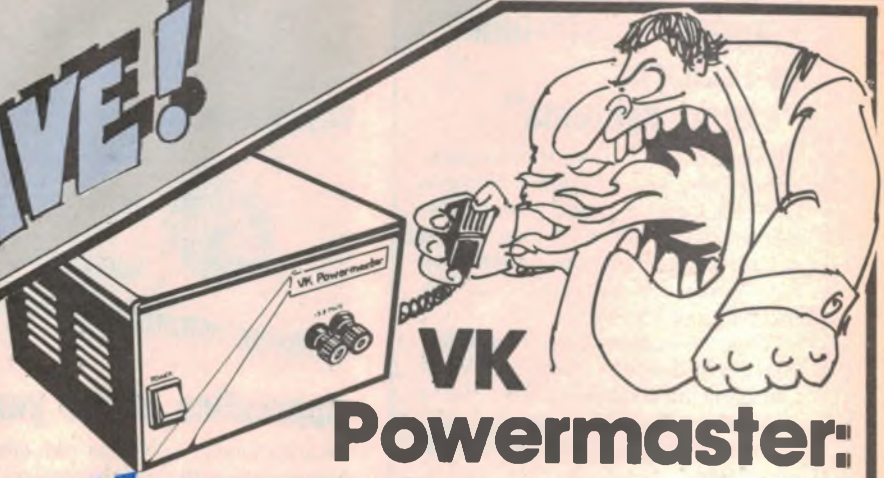
Text and graphics "windows" can be shuffled on the screen, documents revised or discarded, and data transferred between different applications programs by pointing with the mouse and clicking a button. Several documents can be displayed on screen simultaneously in windows that can be moved, expanded or shrunk.

The 512 x 342 pixel graphics resolution of the system can be used to provide different type styles and sizes on the screen, including italics, bold-face and gothic script, all of which can be exactly reproduced by the dot matrix "Imagewriter" printer made for the Macintosh.

Two applications programs are offered with Macintosh, one for word processing

continued on page 134

BUILD DICK'S KITS & SAVE!



VK Powermaster:

NEW 13.8V – 25A PK!!!*

(Short form kit; transformer not included)

What a performer! For amateur linear amplifiers and other power hungry devices – a massive 14 amps continuous or a monstrous 25 amps peak (with M-2010 transformer). Or 6A continuous, 10A pk (with M-2000 transformer).

So you choose the power supply you want to build. With electronic fuse (short circuit or over-current protection) housed in heavy gauge aluminium case. Cat K-3448

Transformers to suit:
14A Transformer Cat M-2010 . **$49.95**
6A Transformer Cat M-2000 . **$24.95**

ONLY **$99**

Don't miss out on these

DICK-SMITH KIT BENEFITS

- Instructions for all kits are written by professionals, in easy to understand language.
- Kits are laboratory tested to prove that they actually work and all components are thoroughly checked by our Quality Control Department.
- We are proud of our kits. We have built our reputation based on their quality and back every kit we sell with our exclusive 7 day satisfaction guarantee.

That's the DICK SMITH GUARANTEE

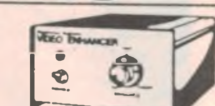
NEW! LET CALLER

ANYONE FOR TENNIS

When you play McEnroe, he won't be able to dispute any calls! Portable, battery operated – use on any Court with wire rope for net. Cat K-3098

SMASHING VALUE **$19.95**

Video Enhancer



VCR's are all the rage. But the quality can be pretty crook. A video enhancer can help considerably. Build this one and find out - and it won't break the bank! Don't forget the patch over your eye . . . Cat K-3463

IMPROVED QUALITY FOR ONLY **$35.95**

See EA OCTOBER 1983

Fluoro Starter

This substitute electronic starter solves the problem of lights going blink, blink, blinkety blink and gives you a smooth rapid start EVERY time you switch on. And all the parts are housed in a standard starter case! Outlasts conventional starters by far! Cat K-3082

See EA OCTOBER 1982

ONLY **$4.50**

INCLUDING EXCLUSIVE MOULDED CASE

500MHz Digital Period/Frequency Counter

Superb design uses the latest IC technology. The low component count makes it very reliable and easy to build. It will measure frequency to 500MHz (with optional pre-scaler – see left) and period both with a 7 digit resolution. It rivals the performance of commercial units costing many times the price! **Cat K-3439**

- **Huge, bright high efficiency, 7 segment display.**
- **3 frequency ranges, 0-10MHz, 0-50MHz, 10-500MHz (with optional pre-scaler).**
- **4 gating times, .01, .1, 10 seconds.**
- **4 period measuring ranges, 1, 10, 100 and 1,000 input cycles to give a 0.1 us resolution.**
- **High input sensitivity, 10mV to 30MHz, 10mV to 50MHz @ 1M input impedance.**

SEE EA DEC 1981

QUALITY FOR ONLY **$125**

Pre Scaler

FOR ABOVE

Cat K-3432 **$34.50**

NEW

TV SERVICEMEN
BUILD-IT-YOURSELF BARGAIN!

TV Pattern Generator

A bargain for the serviceman, technician, hobbyist, etc. We had one of these 5 years ago and sold thousands! Now here's a brand new kit giving crosshatch, dot and raster for fast and simple convergence, etc.

SEE EA NOV. 1983 Cat K-3472

EXCLUSIVE VIDEO MODULATOR INC. IN THIS KIT

ONLY $29.95

YOUR OWN CASINO!
The Dick Smith

Electronic Roulette Wheel

PLAYING MAT EXCLUSIVE TO DICK SMITH

Wow! All the fun and excitment of Las Vagas . . . Wrest Point . . . even Forbes Street. Now you can have a completely random roulette wheel – without the bias of some commercial units.

Cat K-3389 SEE EA MAY. 1983

AMAZING VALUE AT $29.50

A GAME OF SKILL!

Leds & Ladders

A game of skill which is not only a lot of fun to play, but which also gives you a chance to improve your reflexes. Can you climb out of the well without being dumped back in? Easy to construct, the kit comes with all parts required and full instructions. Also included is a specially printed foil label for the box. Cat K-3390

VALUE AT ONLY $16.50

SEE EA AUG. 1980

Alien Invaders

Wow! You could save the earth from those pesky aliens...... and on a kit you built yourself! Multi-level LED display, easy to build and battery operated. Fantastic for Christmas gifts for technically inclined kids

Cat K-3393

SEE ETI AUG. 1983

ONLY $15.95

The not so random Breath Tester

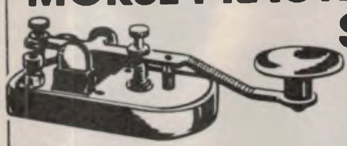
Beware boys in blue and booze buses bailing belligerent Brabhams blowing bad breath into bags before banning. Check out our breath tester kit – it could be the answer to your broblems!

Cat K-3391

See EA May 1983

ONLY $29.95

MORSE PRACTICE SET



Thinking of becoming an amateur radio operator? If you are, you'll need to be able to send and receive perfect Morse at a speed of 5 words per minute (or 10 words for a 'full' licence) before you can pass the amateur operator's licence examination. This Morse Practice Set will help you learn the code, and achieve the speeds necessary.

Cat K-2623

PREPARE FOR AOCP EXAMS . . .

ONLY $4.50

SEE FUNWAY 2 BOOK

IT WILL AMAZE YOUR FRIENDS!

Electronic Door Chime

An exclusive design, this unit plays a different tune every time you press the front door button. Perhaps you like one tune in particular, this is also possible. Everything you need is supplied in this great kit.

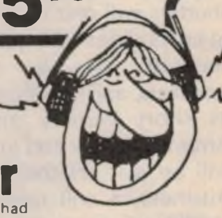
Cat K-3502

ONLY $34.95

SEE EA SEPT. 1979

IT'S AMAZING

Stereo Simulator



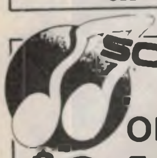
Wish those old video movies had modern stereo sound? This low-cost gadget turns almost any mono signal into amazingly good synthetic stereo!

Easy to build, too!

Cat K-3421

See EA April 1983

$19.95



SOUNDBENDER

With this great little kit you can sound like a Dalek, a Darth Vader, a Cylon, or any one of a dozen robotic spin offs! Cat K-3509

ONLY $24.50

ETI FEB. '82 WAS $29.50

BUILD YOUR OWN

Phoney Patch

SEE ETI MAY. 1983

Phone patching is legal from November 1st. Build your own phone patch and save a fortune . . . very simple kit, suits most transceivers. Compare our price with built-up units.

Cat K-3054

$59.50

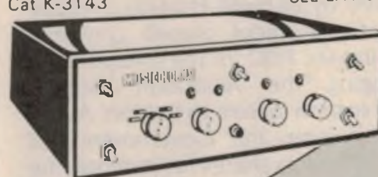
Not Telecom Permitted

THE AMAZING

Musicolour Mk IV

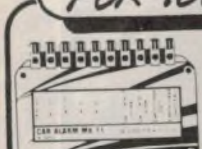
The latest model Musicolour combines all the features of Musicolour III and Light Chaser, plus much more. Chaser plus 4 chase patterns, plus automatic and reverse modes for startling effects.

Cat K-3143 SEE EA AUG. 1981



$109

FOR YOUR CAR!



IMPROVED!

Car Alarm Mk 2

See ETI JULY 1981

The Car Alarm Mk 2 uses a different triggering technique – one that makes it less prone to false triggering! It will detect a current flow ANYWHERE in the vehicle's electrical system.

Cat K-3253

WAS $28.50

$22.50

150W Mosfet PA/ Guitar Amplifier

Guitar and public address amplifier utilising ETI's 499 Mosfet 150 watt power amplifier module as published in ETI March, 1982. Comes complete with pre-amp PCB and special Hitachi mosfets 2SJ49 and 2SK134.

Cat K-3525

$119

SEE ETI MARCH/ JUNE, 1982

THINK OF THE USES

Transistor Assisted Ignition

Ideal for use in all conventional ignition systems, this revised unit adds to stability and gives higher energy. Housed in a die-cast box with deluxe radial fin heatsink for best possible performance. Cat K-3301

SEE EA FEB. 1983

$34

MY KITS LOOK SO GOOD YOUR FRIENDS WON'T BELIEVE YOU BUILT THEM!

DICK SMITH Electronics

See Page 107 for full address details A678M/CT

Australia's domestic AU

The political dogfight over Australia's proposed domestic communications satellite system has died down, leaving in its wake a bewildered public. Here we take a look at what the new system promises.

In July 1985, one of NASA's space shuttles will rest on the launch pad. The main engines will start, followed a few seconds later by the solid rocket boosters, and the shuttle will blast off on its short journey into space. To the American crew and ground technicians it will be just another routine launch; for Australia, it will usher in a new era in satellite communications.

On board that shuttle will be the first of Australia's domestic communications satellites. It will be followed by a second in October 1985, with the full system expected to become operational by the end of the year. A third satellite will remain on the ground to serve as a backup in the unlikely event of an in-orbit failure, or to go into service when additional capacity is required.

The whole satellite project is being conducted by AUSSAT Pty Ltd, a wholly Federal Government owned company formed in May 1982 for the sole purpose of bringing the Australian satellite communication system to fruition. At the time of writing, the Government has offered 25% of its shares for purchase by Telecom, but no decision by Telecom has been announced.

When the system finally comes on line it will be the culmination of a $300 million plus undertaking which, in the long term, will have to establish itself as an economically viable concern. It must be able, on the one hand, to provide a range of communication services not previously available and, on the other, pay its way and show a reasonable profit.

Initially, the complete AUSSAT system will consist of the two orbiting satellites, two control stations, and major earth stations in each capital city, including Darwin and Canberra. The main control station will be at Belrose, in Sydney's northern suburbs, with a back-up control station in Lockridge, near Perth. As well as normal communication facilities, these two stations will control transponder switching within the satellites, station keeping, and general monitoring of satellite status.

The other earth stations will be communications stations only. Customers' signals will be fed to them via conventional terrestial circuits, such as Telecom bearers or private microwave links, transmitted to the satellite, and then re-broadcast to a distant ground station.

The satellite

The two most frequently asked questions regarding the AUSSAT system are: what will it do, and who will use it and benefit from it?

communications satellite

SSAT

by PHILIP WATSON

In simple terms, each satellite will have 15 transponders: four high-power (30W), and 11 low-power (12W) types. Each transponder has a bandwidth of 45MHz. These transponders can be switched in a variety of ways to a number of antennas, providing both spot and broad (national) coverage beams. A total of six beams are available, two broad and four spot. The broad beams are normally used for the low power transponders and the spot beams for the high power units.

The broad beams are intended for professional use, where large diameter, high gain ground antennas may be used, and where the lower power can be tolerated. The spot beams are intended for domestic reception, using much smaller, and cheaper, reflectors and ancilliary equipment.

The spot beams are used to cover different sections of the continent and, except for Papua New Guinea, are used for downlinks only. Between them, the four spot beams cover the mainland, with one each for Western Australia; South Australia and Northern Territory; Queensland; and NSW, Victoria and Tasmania. A fifth spot beam provides both an uplink and downlink for Papua New Guinea, and small spot beams will cover Lord Howe and Norfolk Islands.

TV distribution

One of the most publicised uses for the satellite is to distribute TV signals, particularly to remote areas where no service exists at present and, by reason of the remoteness, a service could not economically be given by conventional means. This is the so-called Homestead and Community Broadcasting Satellite Service — HACBSS.

There are two ways in which the satellite can distribute TV signals to such areas. First, it can broadcast signals direct to the viewer, who would have to provide a small receive-only earth station. Typically, this would consist of a parabolic reflector between 1.2 and 1.8m diameter, a head amplifier and a down-converter, from which signals could be fed to a conventional colour TV set.

The cost of such a station has frequently been quoted as being in the region of $1000, with the hope expressed that increasing demand may reduce this figure. On the other hand, some industry sources have indicated that the cost, initially, is likely to be significantly higher than this, particularly where conditions require the larger 1.8m dish.

The second approach is to use the satellite simply as a link to a local TV station, from which signals would be broadcast in the usual manner. This would still allow important events, sporting fixtures etc, to be brought to remote areas in "real-time".

Regardless of which arrangement is used, it is important to appreciate that the bandwidth required for a TV signal, via a satellite, is many times greater than that needed for conventional broadcasts. Whereas a broadcast station is allocated 7MHz of spectrum space, a satellite circuit, using frequency modulation, will require about 36MHz or, in practical terms, most of one transponder capacity. The same channel could carry up to 1000 telephone circuits in place of the one TV channel.

Initially, it is planned to allow the ABC to provide a direct broadcast service, and it has been allocated five transponders on the first satellite, each transponder feeding a spot beam. In this way the whole of the continent will be covered, but with flexibility to direct different programs to different areas. The ABC radio service will also be carried in a similar manner.

The commercial TV stations will not be allowed to provide direct broadcasts at this stage, but will be able to use the point-to-point capability of the satellite to relay signals to other TV stations. However, the way has been left open for direct broadcasting at some future date. At present, all such commercial TV links are to be encoded to discourage any direct broadcasting concept.

It is hoped that the availability of satellite relay facilities, to any point on the continent, will encourage the establishment of commercial TV stations in remote areas where, in the past, access to network programs was either too expensive via terrestial networks or, in many cases, not available at all.

It has also been suggested that the Government may approve the establishment of additional commercial stations in areas where at least one commercial station already exists. In this event, additional relay capacity will be needed to link them to major networks and the satellite could provide this, avoiding the need to upgrade or duplicate existing terrestial circuits.

A more distant possibility is that it could be used for a subscription TV service if, and when, the Government decides that such a service should be introduced. Many authorities consider that a satellite service would have significant advantages over a cable system.

Communications

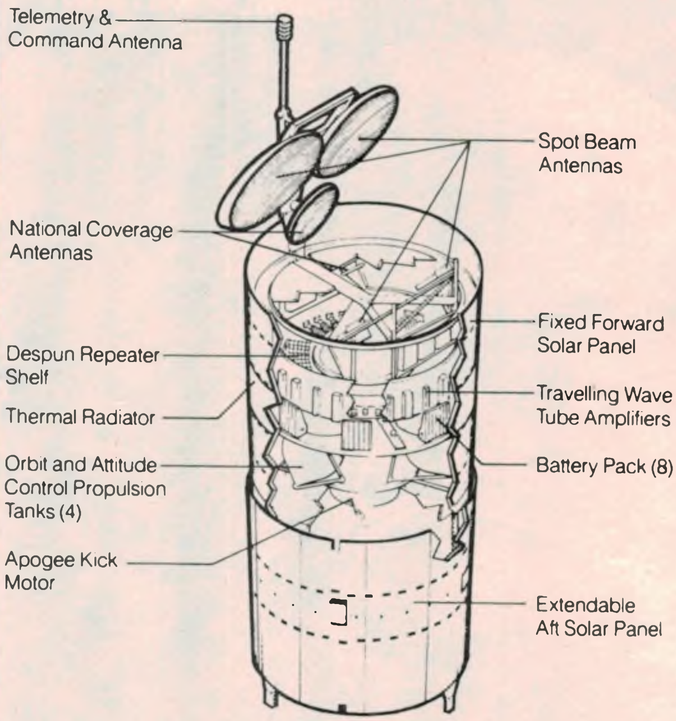
Somewhat less publicised than the radio and TV relaying and broadcasting capability, but every bit as important to those concerned, are the two-way facilities the satellite can provide: voice, telex, data, facsimile, etc. Of these, such well known services as the Royal Flying Doctor network and the School of the Air are ones most quoted as likely to benefit from the satellite.

Ever since the Reverend John Flynn established the Flying Doctor network, using pedal radios, over 50 years ago, residents of the outback have struggled to maintain a vital communication network between themselves and the outside world using HF circuits.

While the system as a whole has done a mighty job in banishing isolation, minimising suffering and saving lives, HF radio circuits are notoriously unreliable. Their performance varies with the season, from day to night, and with weather conditions. They are also increasingly subject to interference from overseas stations which, in spite of international agreements, tend to appear on any frequency which appears, to them, to be unoccupied.

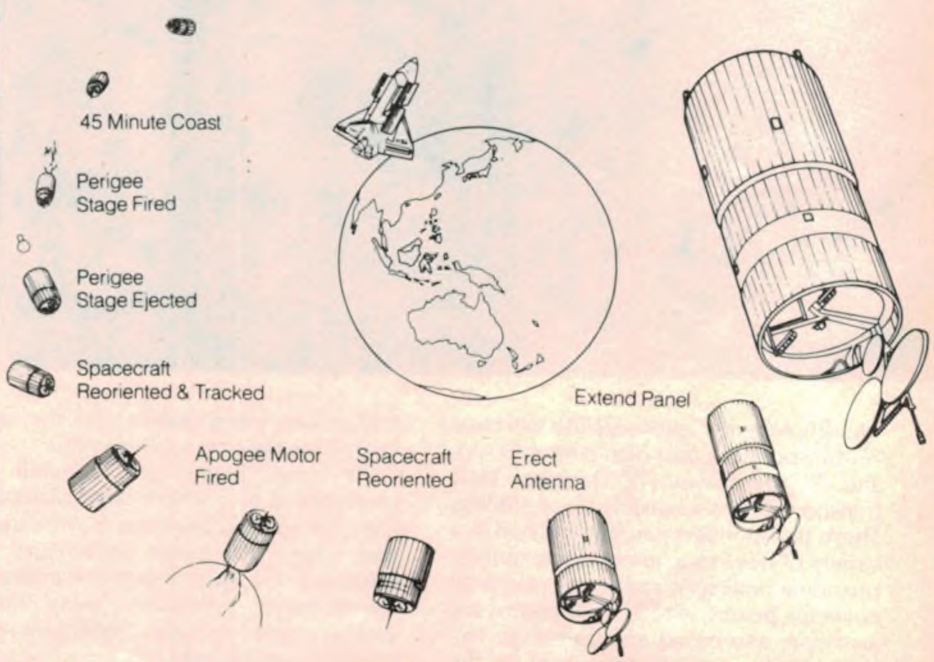
It is small wonder then that the people concerned are interested in any proposals that will provide a communication system more in keeping

DEPLOYED CONFIGURATION



After release from the shuttle a detachable booster places the satellite in a geosynchronous orbit. As the satellite nears its orbital position the antenna is deployed and the cylindrical outer solar panel telescopes into position.

SPACE SHUTTLE MISSION SEQUENCE



with modern day standards. Unfortunately, some early suggestions implied that the satellite would provide a low-cost answer to all these problems, there apparently being some confusion caused by the relatively simple equipment needed for TV reception.

In fact, there is big difference between the equipment needed for a receive-only station, and that needed to provide a two-way circuit such as these services require. Getting a signal up to the satellite is a good deal harder than getting one down, and requires a lot more equipment. For a start, a much larger dish of between 2.4m and 3m will be required, together with a 14GHz transmitter of reasonable power.

As in the case of the receive-only systems, the likely cost of such an earth station has varied considerably according to the source. Figures have varied from as low as $10,000 to as high as $25,000, with $20,000 being the most consistently quoted.

Large station holdings may not find this figure too much of a burden but it would certainly be beyond the financial scope of many smaller, one-man, holdings. Unfortunately, there is no easy solution to this problem at present: that is what it costs and the facility is now available for those can justify the outlay.

It is also interesting to note that when the Flying Doctor Service was introduced in 1928, the pedal wireless sets cost up to £100; about half a year's average

Text continued on page 18

Rooftop dish antennas (below) may become a common sight in Australian cities.

Satellite specifications

The AUSSAT satellites are being supplied by Hughes Communications International, who will also supply the control stations to be established at Sydney and Perth. The satellites type HS376, are drum shaped, measure 2.2m diameter and, in orbit with antennas and solar panel deployed, 6.6m high. They are spin stabilised, with de-spun antennas. Weight at launch will be 1250kg and in orbit 650kg.

The satellites will be placed in a geostationary orbit, above the equator, at 35,790km above the earth. The first two satellites will be located at 156°E and 164°E, which is just east of Australia's eastern coastline. The third satellite will be between the other two at 160°E.

The solar cells will generate 1054W at the beginning of their life, and will charge two 27Ah nickel-cadmium batteries to provide power when the satellite enters an eclipse zone. This happens twice a year, for a few weeks before and after each equinox (March 21st and September 22nd). The eclipse lasts about 70 minutes on these two days, with progressively shorter periods before and after.

The satellites will operate in the 12/14GHz band. Uplinks will be from 14 to 14.5GHz and the downlinks from 12.25 to 12.75GHz; bandwidth will be 500MHz in both cases. They will carry 11 4W transponders and four 30W transponders. Two spare transponders of each type will be carried and can be brought into service in the event of a failure. It is anticipated that the life of each satellite will be at least seven years.

Factors governing the life of the satellite are the amount of station-keeping fuel which can be carried, the life of the solar cells, which deteriorate in space, the life of the travelling wave tubes (TWTs) which are thermionic devices, and the life of the nickel cadmium batteries.

Each satellite carries six antenna reflectors, although physically, there appears to be only three. Each reflector is, in fact, a dual arrangement of one horizontally polarised and one vertically polarised reflector. The reflectors are built in strip form, one behind the other, so that a suitably polarised signal will pass through the front reflector and be reflected by the rear one, while those of opposite polarity will be reflected by the front one. The reflectors measure 61, 100 and 110cm in diameter.

By using cross polarisation, frequencies can be re-used on the same satellite, thus significantly increasing its capacity. Seven of the 15 channels will use horizontal polarisation and eight vertical.

More than one transponder can use the same antenna/reflector combination at the same time. For example, one spot beam may consist of a TV signal from a high power transponder and a communications bearer from a low power transponder, in a different part of the band, at the same time.

All three satellites use exactly the same frequency band and depend on the 4° separation in orbit to avoid interference. Even the simpler dishes, of around 1.5 diameter, have a beam width of about 1°. Pointing accuracy of the satellite antennas will be not more than .05° variation for the smaller dishes, and not more than .03° for the large dishes.

This accuracy is achieved by using an on-board beacon tracking system which locks onto a command signal transmitted from the Sydney control station. This system generates error control signals to correct for north-south and east-west pointing variations.

Associated earth stations, both AUSSAT operated and private, will use a range of antenna dish sizes, according to requirements. The smallest will be those used for receive-only systems designed for domestic TV reception in remote areas. They will range from 1.2m in favourable locations to 1.8m in beam-edge locations.

For single channel two-way voice/data circuits, 2.4 to 3m diameter dishes will be used, with 4.5 to 6m types for receive-only earth stations in high quality regional TV relay applications. The 4.5 to 6m types will also be used for two-way earth stations providing multi-channel voice/data circuits.

Larger dishes will range from 8m to 18m and the AUSSAT stations will use 13m and 18m dishes. The 18m types will be used in high rainfall areas to ensure maximum reliability during heavy rain storms, which can significantly attenuate 12 and 14GHz signals.

-ORMER GUIDE

...NDARY ...IPS	Details
	Centre tapped 5V, 24V, 30V
...mp ...ies ...mp ...rallel	Centre tapped 10, 20, 30, 40, 50 and 60V
	Centre tapped 2, 12.6 and 15V
	Centre tapped 3, 12.6 and 15V
	Centre tapped 5, 24 and 30V

...er
...r

...IDARY ...x. SCR ...IPS

8 Ph (03) 840 1222 Telex 32286

192 Ph (02) 789 6733 Telex 22874

Ph (069) 21 2735 Telex 69960

) Ph (062) 80 5519 Telex 62475

Ph (08) 42 8918 Telex 89234

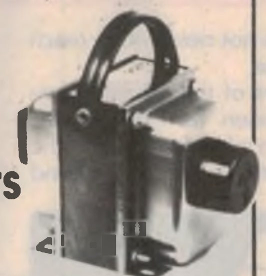
Enclosed Stepdown Transformers

240V, 50 HZ PRIMARY

Ideal for garden lamps, pond lights and water pumps, automatic trouble lamps, safety lights, pool lighting etc

Type No.	VOLTS	SECONDARY AMPS	Details
60269	32	2.25	Type No. 60280, 60426, and 60480 have two fuses in the secondary output for pool lighting applications
60279	32	7.8	
60280	32	5.9	
60425	24	3	
60426	24	7.9	
60453	12	6	
60480	12	15	

Portable Stepdown Transformers



Type No.	VOLTS	SECONDARY AMPS	Details
PT 5578	115	0.35	For shavers radios tape recorders, heating blankets TV receivers appliances and instruments. 2 Pin socket
PT 2164	115	0.87	
PT 2166	115	2.17	
PT 2168	115	4.35	
PT 2170	115	8.7	
PT 9585	240	1	For T.V. servicing, electronic workshops etc. 3 Pin socket
PT 9789	240	2	

Constant Voltage

Isolated, constant RMS Voltage output

Type No.	INPUT	OUTPUT
CV 9024	190-260 RMS	240V-1A
CV 9027	190-260 RMS	240V-4.17A

QUEENSLAND
Cnr. Vernon Terrace & Ethel St., Newstead, Qld., 4006 Ph (07) 52 1131
Telex 43263

WESTERN AUSTRALIA
611 Hay St., Jolimont, W.A., 6014 Ph (09) 381 9834 381 9522 Telex 93973

TASMANIA
Launceston: GHE Electronics
76 York St., Launceston, Tasmania 7250 Ph (003) 31 6533

Hobart: GHE Electronics
162 Argyle St., Hobart, Tasmania 7000 Ph (002) 34 2233

Audio

Type No.	PRIMARY IMPEDANCE	POWER	Details
45012	70/100V Line: 4/8/16 ohm	1/8-4 WATTS	Line to speaker impedance
45035	600 ohm	odbm	PCB Mounting Telecom approved
45065	600 ohm		
LT 347	600 ohm: 600 ohm.	20 dbm	Line isolation to Telecom 1053, 1054

Control Circuit

For switchboards. PRIMARY 240V 50 HZ. Insulation to AS 3126

Type No.	IMPEDANCE	SECONDARY POWER	Details
PT 9169	32 24	1.88	SEC approved
PT 9170	32 24	3.12	
PT 9171	32 24	6.25	

Soldering Iron

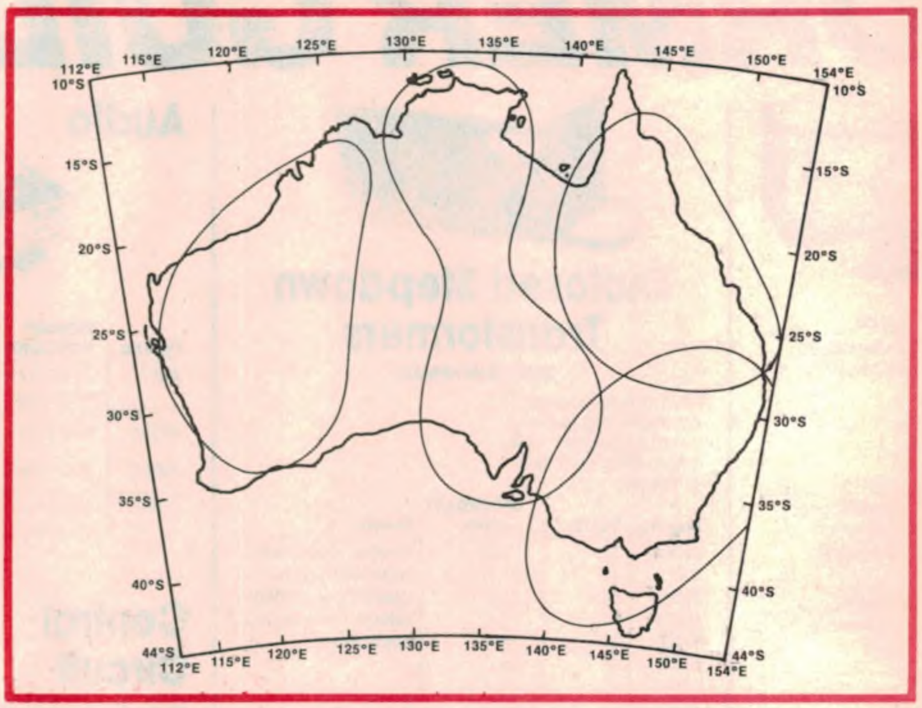
For low voltage soldering irons or similar applications PRIMARY 240V 50 HZ

Type No.	VOLTS	SECONDARY AMPS	Details
60158	3.3	30 Int	SEC approved

Bell and Chime Trans-former

PRIMARY 240V, 50 HZ.

Type No.	VOLTS	SECONDARY AMPS	Details
60999	Choice of 5, 8, 12, and 16 Volts.	1	Specially designed to power door bells and chimes. Double insulated and short circuit protected



Coverage of the four spot beams intended for reception only, is shown above.

wages at that time. On this basis, $20,000 is not such a vast sum by present day standards.

It seems likely that Flying Doctor and School of the Air services will continue to operate on HF for many years to come, while they run a parallel service via the satellite. In the case of small communities a joint effort may be feasible, with signals handled by a communal earth station and distributed over relatively short distances by either private telephone lines, VHF links, or even HF links, which could be reliable over short distances.

Telecom's role

Telecom is currently developing a system which they call the Digital Radio Concentrator System (DRCS). This system is designed to replace many of the wire lines, often privately erected and maintained, which have been the best available until now.

The new system uses UHF radio links from the nearest existing telephone line and can serve 128 subscribers using 15 demand-assigned radio channels. Repeaters at approximately 50km intervals can extend the range to 450km. Some subscriber terminals will also serve as repeaters. It is conceivable that the satellite service could extend this concept into areas not now within reach of a telephone line.

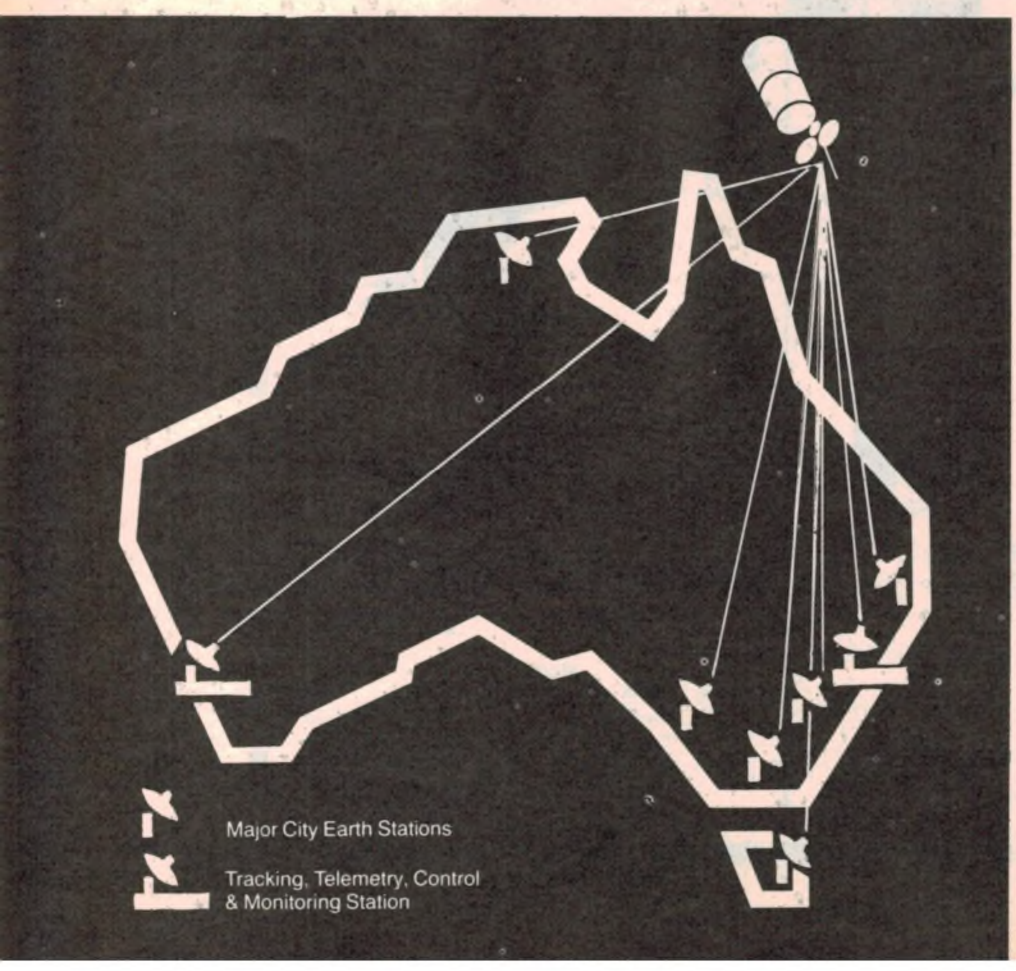
Many other users of the satellite have already been spoken for. Telecom is one, and they are planning to use the satellite in a variety of ways to extend their existing network. These include the provision of fully automated telephones to remote homesteads, and multiple circuits to outlying communities to provide access to telex, facsimile and data transmission facilities.

Three types of earth stations are envisaged for these and other Telecom services: (1) remote telephony earth stations providing a single telephone circuit for individual homesteads; (2) community telephone earth stations with a capacity of up to 12 telephone channels through the satellite; and (3) transportable earth stations similar to (2) for restoring services in emergency situations. Both will use 5m diameter dishes.

Another customer will be the Department of Aviation. They are planning a network of some 440 earth stations at 240 sites to link air traffic control to aircraft via VHF links. This should provide a high quality, flexible network with many benefits to the airlines, the passengers, and traffic control generally. It is likely that this facility will also be extended to provide shipboard communications.

The Defence Department will also be allocated a share in the satellite facilities, mainly for internal administrative communications.

Beyond these established customers there is a whole range of prospective individual customers. Any organisation



working in remote areas, such as mining groups, oil drilling groups (including those off-shore), construction teams, etc are all potential users of the satellite.

They will have to provide their own earth station, or stations, and purchase whatever bandwidth they require from AUSSAT, for as long as they require it. And while it may not be cheap, it will provide a service not previously available at any price.

But the AUSSAT system will not be confined to serving remote areas, valuable though this feature may be. It is suggested that banks, data information organisations, large retail chains, and government departments will want to establish their own statewide or nationwide private links via the satellite. They may use either their own roof-top dishes or AUSSAT's major earth stations via terrestrial links.

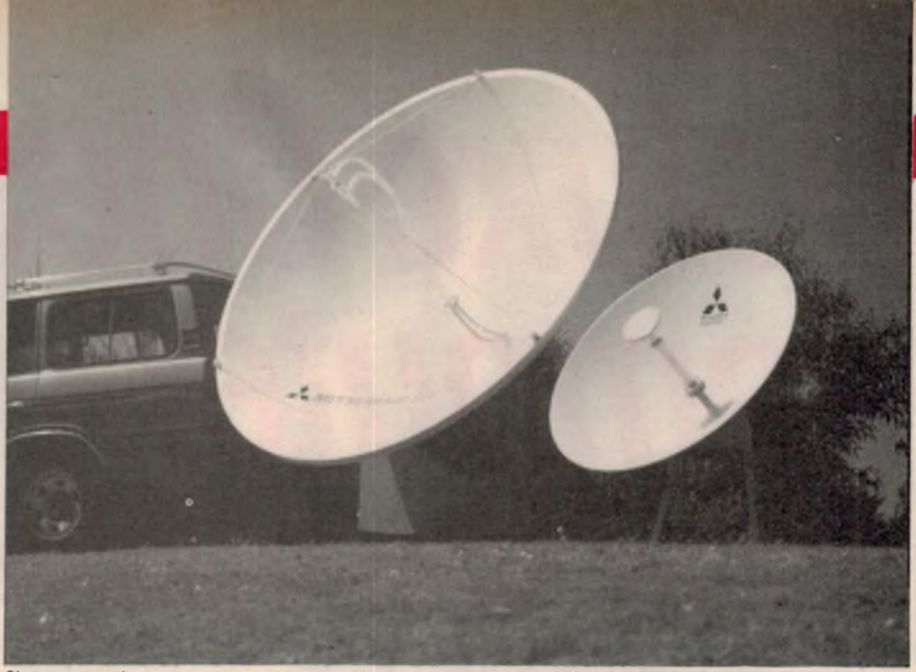
Beyond this again, AUSSAT is looking at casual customer requirements; eg, the company which wants a conference circuit between, say, its Sydney and Perth offices. They may require such a circuit for only a few hours, and not need it again for another 12 months, but it is the kind of service which AUSSAT is looking at and planning for.

But these are only some of the uses to which the satellite will be put, and the mere recital of them may not necessarily convey their true importance. It is virtually certain that, once the system is working, it will be used by a wide section of the community in roles yet to be envisaged.

There has been some criticism of the AUSSAT project, both in regard to details, and of the project as a whole. Some have claimed that the cost cannot be justified, on the grounds that the same amount of money spent on expanding our terrestrial networks would have provided a service which was at least as good, and in some cases better, than that provided by the satellite.

On a short term basis this may be true, but it fails to take into account the flexibility of the satellite system, and its scope for expansion. The fact that the satellite can take a signal from anywhere in Australia and deliver it to anywhere else in Australia, regardless of how remote these places may be, or how much distance there is between them, must surely put it way ahead of any possible terrestrial network, no matter how elaborate.

Another point to be remembered is that the satellite, being literally out of this world, is immune to natural disasters. Provided the earth stations remain intact, what happens in the intervening terrain is of no consequence. And, just as important is the high circuit capacity it can provide in such circumstances.



Sizes of dish antennas vary according to the application. The smaller type is a receive-only antenna.

Most of the detailed criticism has been along the lines of "who will get what", or the fear that the scheme was open to monopoly domination by sections of the radio and TV industry. Most of these fears seem to have been dispelled by recent ministerial announcements, clarifying the structure of AUSSAT, as a Commonwealth Government owned company, and the manner in which it will be required to distribute its services.

So, in answer to the question, "who will benefit?", the answer must surely be all Australians. Granted, the benefit to some – particularly those most in need – will be more immediate and more obvious, but better communications must eventually produce benefits for the community as a whole.

Deluxe Chess Computer —moves its own pieces

by PETER VERNON

"The most exciting computer chess game on the market" is one way of describing Milton Bradley's "Phantom". It is not only a world class chess computer — it actually moves the pieces on the board, as if you are playing an invisible man who also happens to be a chess Grand Master.

Phantom provides a 26cm square playing area in a console measuring 54 x 46 x 8cm (W x D x H). The board is in brown and buff and is plastic coated, which together with the sealed membrane control buttons makes the chess computer reasonably moisture resistant. A removable perspex lid covers the top of the console when the unit is not in use.

At the right side of the console is the power switch and a socket for a 3-pin connector from a plugpack adapter providing both 6V and 12V AC. The manual states that the plugpack should not be left connected to the mains when the unit is not in use.

We see robustness and convenient operation as important considerations because the Phantom chess computer will be the centrepiece of many a family entertainment area and possibly come in for some hard use. To see why, let's take a look at what the system offers.

Operation of the chess computer

Quite apart from the uncanny independent movement of pieces in response to a move from a human opponent, the Phantom chess computer has a full complement of features, sufficient to retain the interest of beginner and veteran alike. Self-education is one important aspect – if you don't know how to play chess the Phantom will quickly teach you the game.

More experienced players will be challenged by the "skill" of the Phantom. The levels of play range from level 1, at which the computer actually strives to let you win, to level 12, at which the computer continues to compute the best move available until the "Stop" button is pressed. Level 2 is sufficient to defeat run-of-the-mill players, with the computer taking an average of five seconds for each of its moves.

The front panel of the Phantom chess computer is an array of pressure-sensitive membrane switches, giving 16 play options in all. Illuminated indicators on the left show which side is to move (Black or White), which piece the computer is about to move, Check or Mate, and other operating modes.

The user can select the level of play, set up a new game or a chess problem, change sides at any point during the game (handy if you're losing!), take back a move or a sequence of moves, ask for hints or set Automatic or Manual modes of play.

In the AUTO mode the chess computer will play both sides of a game, making an interesting conversation piece, chess tutorial or demonstration. Since the user can intervene in the game at any stage then return to the AUTO mode, the Phantom makes an excellent teaching machine.

To enhance the teaching potential there is a "hint" function which can be called up at any time during a game, and a "legal move" option which will indicate the moves which are available to any particular piece in any location on the board.

The Phantom will also allow the player to take back a move or to force the computer to take back its move. Using these functions the game can be played back to any desired point and then re-played, with or without alteration.

All of these functions are also available in the Manual mode, which allows two human players to compete using the Phantom as an "intelligent chess-board". Play proceeds as normal, but the chess computer will still indicate illegal moves and give hints as required. In addition the computer will remember the location of each piece on the board, so that if the game is upset it is only necessary to stand the pieces along the side of the board and press a button to restore the positions.

In addition the entire game between two human players can be re-played, with the computer reproducing the moves made by both sides to allow close study of the situation.

However, while the "Phantom" is capable of storing the moves of a complete game, this memory is not permanent. Turning the chess computer off will erase any stored moves as there is no battery back-up for the memory.

How does it work?

Beneath the playing surface of the "Phantom" are two sliding rods driven by separate motors with opto-interrupter revolution counters. When the motors are powered one rod moves across the board and the other from back to front.

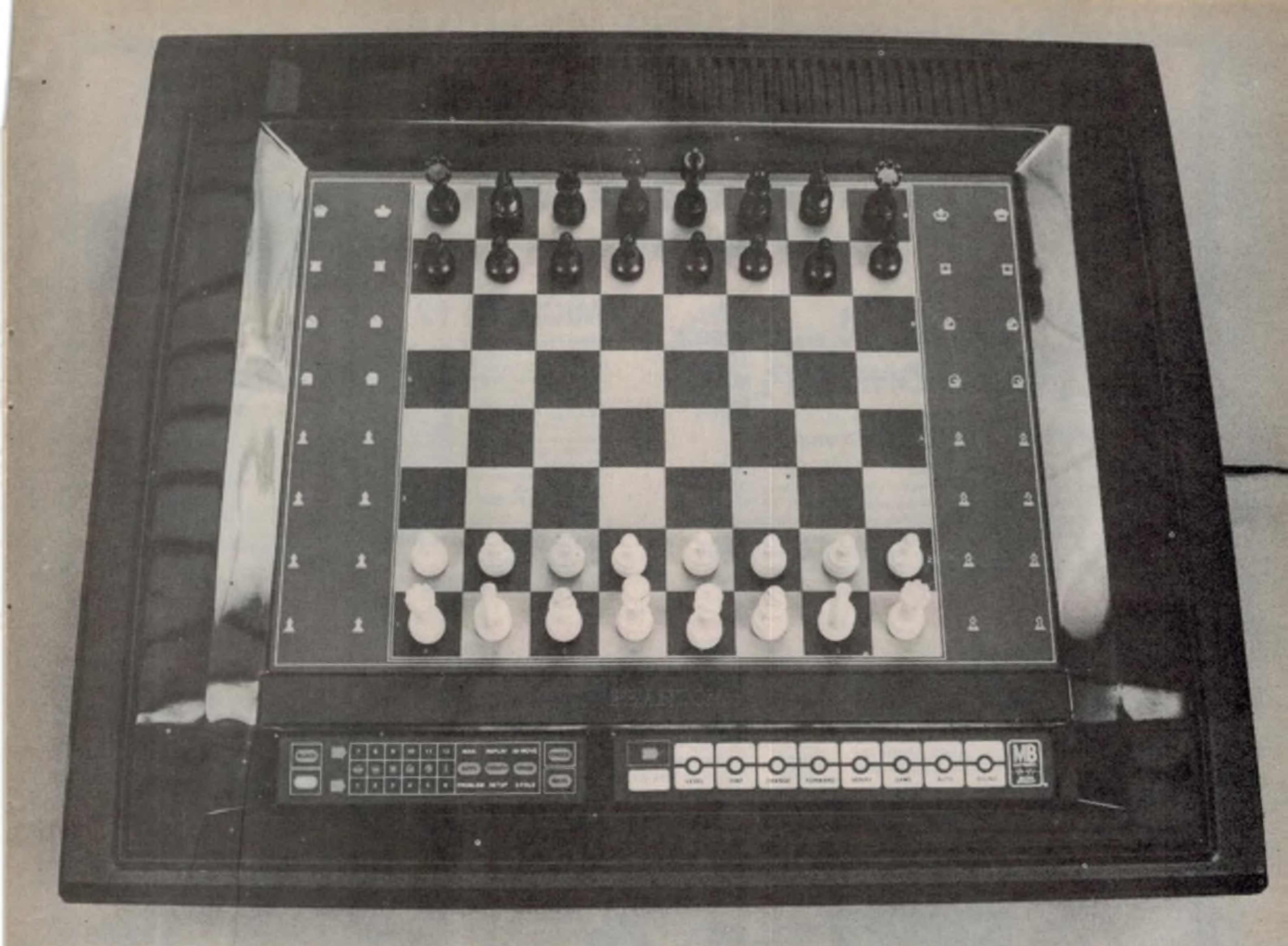
An electromagnet is mounted at the junction of the rods and is energised to attract and move the chess pieces, which have metal inserts in their plastic bases.

The computer does not recognise individual playing pieces, but assumes that they are set up correctly along the sides of the playing board at the start of the game. From these designated locations the chess computer will move the pieces into their correct positions on the board.

"Phantom" will not recognise an incorrect initial disposition. If the human player perversely sets up the game with a king, for example, taking the place of a pawn, "Phantom" will play the game on that basis, treating the king as a pawn. The machine is easy to confuse, if that's what you want to do!

The human player's moves must be "registered" by first pressing the playing piece on the centre of its square and then on the centre of the square to which it is moved. A soft "beep" indicates that the computer has detected the move.

The entire playing surface of the chess



An electromagnet under the board moves the pieces according to instructions from the computer opponent.

computer is in fact an array of membrane switches, with a switch for each square of the chess board and each initial position of the playing pieces at the sides of the board.

The electronics are mounted on a circular board in the base of the unit. Tactics for the chess game, movement of pieces and keyboard scanning is performed by a 6502 microprocessor under the control of a program in Read Only Memory. The human player's moves are stored in 2K of programmable memory for as long as power is supplied to the computer.

In conclusion

The "Phantom" is an attractive, full-featured chess computer. Its array of teaching functions, skill levels and operating modes are exceptional, even apart from the unique method of moving its own pieces. It should appeal equally to those who want to learn how to play chess or improve their game, while the higher levels of play will challenge an expert.

Two booklets are provided with the unit, one covering the operation and functions of the computer, with illustrations for each facility, and the other a straightforward illustrated list of the rules of chess for the newcomer.

"Phantom" carries a recommended retail price of $899 and is available from most department stores.

PHONE YOUR ORDER — ALTRONICS TOLL FREE 008-999-007

BANKCARD HOLDERS — PHONE ALTRONICS TOLL FREE 008·999·007 FOR NEXT DAY JETSERVICE DELIVERY

TAX TIME SELLOUT

Yes it's that dreaded time of the year where we have to shell out 1000's of $ of our hard earned cash to the taxman! **So here's your chance to save a fortune** we're clearing $50,000 of these top selling products at never to be repeated prices to overcome our present dilemma — Regards, *Jack O'Donnell*

Sale continued on pages 80-83.

HIGH RESOLUTION MONITOR

NOW WITH SCREEN INVERT FUNCTION AT NO EXTRA COST

OVER 2000 SOLD

NO MORE HEADACHES AND BLURRED VISION

One of the hassles of sitting there for countless hours operating your computer is *eye strain* (anyone who has just spent 10 hours solid will agree!!) Well our fantastic new MICRON 12 High Resolution Green Phosphor Monitor has a 'reverse' or invert screen function where by simply rotating the contrast control anti-clockwise the screen information and background are reversed. This is especially valuable in poor lighting conditions.

MICRON 12

Green Phosphor Monitor Features: 12" screen. Front controls, on/off, contrast/reverse, brightness. Power 240V/50Hz or 12V DC. Input RCA type. DC Output Jack: 12V/1.1 Amp — power your Micro direct without a power pack. Bandwidth: 10Hz to 20MHz the resultant definition is truly amazing for a low cost monitor.

Guaranteed by ALTRONICS! Incredible Value.

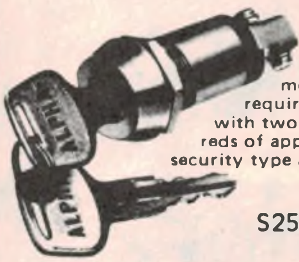
D 1112 **$199.50**

See Review June EA. p.137.

Free Delivery Australia-wide This Month

KEY OPERATED SWITCH

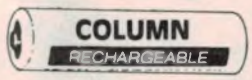
HALF PRICE! BE QUICK. 500 ONLY.



19.5mm mounting hole required. Supplied with two keys. Hundreds of applications for security type applications.

S2500 **$3.50**

NICAD RECHARGEABLE



AA Size 1-2V Genuine Sintered Plate Nicad Construction by Furakawa — arguably the top Nicad designer/manufacturer in the world today. Amazing low price.

S 5020 .... **$1.95 ea**
10 up **$1.80**

"MICROBEE KEYBOARD"

Full 60 Key Qwerty Computer Keyboard exactly the same type as has been used up to now with the famous Microbee Computer. SPST keys. Complete with mounting plate, all key caps etc. Fully assembled. Incredible value — Be Quick!

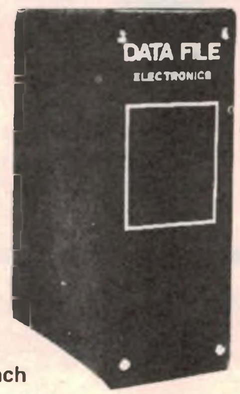
D1510 .... **$29.95**

Microbee is registered trademark of Applied Technology Pty. Ltd.

VINYL BINDER

Holds 12 magazines, each on a spring out wire rod. Just the shot for each year's set of Electronics Australia, ETI or any of your favourite magazine.

Suits all A4 size publications (275 x 210). Very smart Royal Blue colour with beautiful gold embossing.



B 9999 ... ~~$5.50~~
THIS MONTH
$5.00 each
4 or more $4.50 each

WEATHERPROOF SIREN HORN

12V DC operated — Deafening Siren Wail. Super handy for audio signalling, secruity systems etc. Current drain 500MA approx. Completely weatherproof. Attractive off-white PVC finish.

S 5058 ... ~~$19.50~~ NOW $15.00 ea. STREWTH!

MIC INSERT ELECTRET

Great little replacement for tape recorders, etc. Handy for hobby projects. Includes data sheet and application circuit. 50 Hz - 15 KHz

C 0170 .... Now **$1.50 ea**

Powerful 6000 RPM Mini Drill for PC Work

Tons of Torque. Just the shot for PCB work. 12V DC operated from external Power Pack. 1.2mm chuck capacity. Supplied c/w 1mm drill bit.

T2302
Incredible value now only **$10.00**

Drill Bits:
T2320 (0.8mm) ... $1.25
T2325 (1.0mm) ... $1.25

TECHNICIAN'S UTILITY PARTS CASE

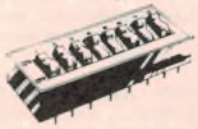
H 0449
Now
$6.50

Lightweight and durable this Parts Case is a MUST!

Featuring:— Clear lid (tell contents at a glance); Positive action snap lock; 30 partition combinations.

DIL SWITCHES

GOLD PLATE SELF WIPING CONTACTS



	EA	10Up
S 3050 4 Way	**$1.50**	**$1.35**
S 3060 8 Way	**$2.00**	**$1.75**

BANKCARD HOLDERS — PHONE ALTRONICS TOLL FREE 008·999·007 FOR NEXT DAY JETSERVICE DELIVERY

PHONE YOUR ORDER — ALTRONICS TOLL FREE 008·999·007

BE VERY QUICK!

A FREE "LEATHER LOOK" CARRY CASE WITH EVERY Q1001 OR Q1002 PURCHASED THIS MONTH

UNIVERSAL MULTIMETER

PORTABLE WITH BENCH STAND

★ 23 RANGES ★

★ 20,000 OHMS/Volt DC ★ 10,000 OHMS/Volt AC ★ Mirror backed scale ★ Overload protected ★ Unique carry handle doubles as a bench stand ★ High-impact resistant case ★ Uses 1 AA Penlight battery (incl.) ★ Comes complete with battery, test leads and instructions. **RANGES: DC Voltage** 0-.25, 1, 2.5, 10, 25, 100, 250, 1000. **AC Voltage** 0-10, 25, 100, 250, 1000. **Decibels** 20 to + 22 db. **DC Current** 0-50, 500 UA, 0-5, 50, 500MA. **OHM Meter** 0-6 megohms in 4 ranges, 30 ohms centre scale. Sizes 135 × 91 × 39.

Q1002 .... ~~$24.50~~

This Month . . . **$19.50**

ECONOMY TESTER

OVERLOAD PROTECTED

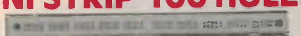
High 2000 OHMS/Volt sensitivity overload protected. Dimensions 90 x 60 x 30. Mirror back scale prevents Parallax error. **Complete with test leads and instructions.** Uses 1 AA Penlight batt (incl.) **Ranges:** DC and AC 0-10, 50, 250, 1000V. **Decibels:** 10 to + 22 db. DCA 0-100MA. OHMS 0-1 meg OHM in 2 ranges.

Q1001 . . . ~~$14.50~~

This Month . . . **$11.00**

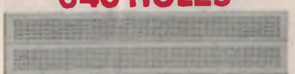
☆ PROTOTYPE SOLDERLESS BREAD BOARDS ☆

MINI STRIP 100 HOLES



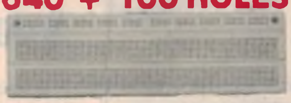
P 1000 .... ~~$2.50~~ **$1.95**

640 HOLES



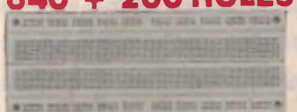
P 1005 .... ~~$9.80~~ **$8.50**

640 + 100 HOLES



P 1007 .... ~~$11.95~~ **$10.00**

640 + 200 HOLES



P 1009 .... ~~$13.98~~ **$12.00**

NON-CORROSIVE NICKEL ALLOY CONTACTS RELIABLE FOR 50,000 INSERTIONS

There's a limit to just how many times you can resolder components while prototyping before you either destroy the component or lift a track from the vero.

These solderless breadboards enable circuits to be literally thrown together in an instant, yet all components remain reusable.

A necessity in all research laboratories to save on expensive development costs.

- ☆ Standard 0.1 inch spacings.
- ☆ Accepts all LSI'S, semis, transistors, diodes, leds and passives.
- ☆ 22-30 gauge solid hook up wire for interconnections.
- ☆ Boards are "Keyed" to enable easy expansion.

400 + 1280 HOLES

ACCEPTS UP TO 16 x 16 pin D.I.L. IC'S

SCREW TERMINALS FOR PS CONNECTIONS

P 1012

~~$29.50~~ **$26.00**

500 + 1920 HOLES

ACCEPTS UP TO 24 x 16 pin D.I.L. IC'S

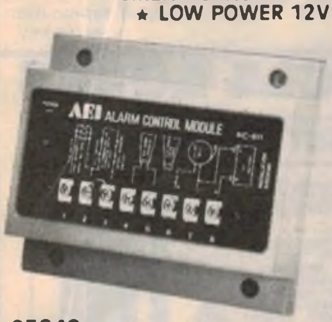
METAL BACKING PLATE FOR SHIELDING OF SENSITIVE CIRCUITRY

P 1015

~~$45.00~~ **$38.00**

ALARM CONTROL MODULE

EASY TO INSTALL ★ BUILT IN SIREN DRIVER — DIRECTLY DRIVES LOW COST 8 OHM HORN SPEAKERS, SIREN HORNS AND MECHANICAL BELLS ★ LOW POWER 12V DC OPERATION.



The AC-811 is a low cost professional burglary protection system which detects the presence of an intruder who breaks into your home, office or business. The system also allows connection of emergency panic buttons, wall vibration switches, smoke and heat sensors, as well as freezing or flooding detectors to form a complete protection system.

EXIT/ENTRY DELAY BOTH N/C AND N/O CONTACTS

Ideal for homes, offices, factories, shops, caravans, any area requiring protection.

S5042

Only $39.50 **Now $32.50**

REED SWITCH & MAGNET SETS

N/C Reed & Magnet

S 5055	$2.50
10 Up	$2.10

N/O Reed and Magnet

S 5056	$2.95
10 Up	$2.75

N/C denotes Normally Closed Contacts when magnet in proximity of switch.

N/O denotes Normally Open Contacts when magnet in proximity of switch.

LOW COST WEATHERPROOF HORN SPEAKER

Save 30%

5 WATT 8 OHM

Fully weatherproof. New unique voice coil construction ensures high dependability on full drive.

C2010 ~~$9.50~~ **Now $6.50**

MINI BUZZER 5-15V DC

Handy little solid-state audio "Buzzer" or signalling device. Just the shot for communicator panels, or for timer alarms or in the car. Polarity conscious.

S 5062 ~~$1.95~~ **NOW $1.00 ea**

PIEZO ALARM

Similar to "Sonalert" type. Absolutely ear piercing sound. Recommended voltage 5-15V DC. Ideal for almost all audio signalling applications. i.e. fire, water and gas signalling, computer alarms, etc.

S 5066 . . . ~~$4.95~~ NOW $3.00

FOR DESPATCH P&P CHARGES AND ADDRESS DETAILS PLEASE REFER TO OUR AD. ON PAGE 83

MICRON SUPER 80

MADE IN JAPAN QUALITY

80 CPS · 80 COLS
BIT IMAGE GRAPHICS
FRICTION FEED AND
ADJUSTABLE SPROCKET FEED

BONUS OFFER 1000 SHEETS OF PAPER FREE WITH EVERY PRINTER (JAN. ONLY) *$10 DELIVERY ANYWHERE IN AUST.

A FEATURE PACKED DOT MATRIX PRINTER FOR UNDER $500

Your "Super 80" printer will enable you to print **letters, reports, graphics generated pictures,** etc and importantly for the programmer, Hard Copy of **program listings.**
Operating under software control from any general purpose micro-computer the Super 80 features **13 different print types** including emphasizd (LETTER QUALITY). **Bidirectional print action** ensures **smooth, quiet operation.**

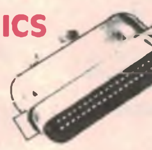
228 ASCII Characters, Handles **4" to 10" Paper**
STANDARD CENTRONICS INTERFACE

VALUE PACKED AT D1174.................... **$499.50**
INTERFACE CABLE TO SUIT MICROBEE D1190......... **$45.00**
SPARE RIBBON D1175............................ **$12.50**

FREE FREIGHT IF PURCHASED WITH PRINTER

CENTRONICS PLUG

36 WAY
D1192
$14.95



When you buy one of our printers you'll need a centronics plug. If you are **MICROBEE USER,** have a look at our **INTERFACE KITS** on the opposing page.

MULTI-TURN TRIMMERS

INDUSTRY PREFERRED TYPE

ALL ONE PRICE
$1.95
10 up $1.80

Resistance	Cat	Resistance	Cat	Resistance	Cat
100 R	R 2410	5K	R 2423	200 K	R 2433
200 R	R 2415	10 K	R 2425	500 K	R 2435
500 R	R 2417	20 K	R 2427	1 M	R 2437
1 K	R 2419	50 K	R 2429	2 M	R 2439
2 K	R 2421	100 K	R 2431		

DIRECT IMPORT PRICE ON QUALITY JOYSTICKS

SELF CENTERING TYPE ★ HEAVY DUTY SUCTION CUPS — STAYS IN PLACE ★ SILVER PLATED SWITCH CONTACTS ★ PISTOL GRIP ★ VERY RESPONSIVE.

TO SUIT COMMODORE VIC-20, ATARI, etc.
D1410 .... **$19.50**

TO SUIT MICROBEE
D1420 .... **$29.50**

NEW MODEL DATA CASSETTE

UNCONDITIONALLY GUARANTEED TO SAVE/LOAD THE RAWEST OF DATA EVERYTIME!

D1122.. **$49.50**

A recorder designed solely for the purposes of data storage now at an unbelievable price

- ★ SLIDE VOLUME CONTROL **a must** for quick checking of levels.
- ★ TAPE COUNTER **a must** for easy location of programmes.
- ★ INBUILT PIEZO TRANSDUCER **enables** you to listen audibly to tape level.
- ★ 6v DC operation - USE WITH M9000 PLUG PACK **ensures** low hum levels.
- ★ ROBUST CONSTRUCTION OF BOTH INTERNAL MECHANISM'S AND EXTERNAL CASE.
- ★ LONG LIFE ALKALINE BATTERY SUPPLIED (4 x AA CELLS)

C20 DATA CASSETTES

Quality MICRON brand.

D1141 .... **$1.50** (10 UP) **$1.25**

Unit shown has extra key

TOP SELLING MOTOROLA BOOKS

SUPER BUY ON TOP SELLING DATA BOOKS

THE SET FOR JUST $25

MOTOROLA MASTER SELECTION GUIDE

B 1104.............. **$7.95**

The most useful book ever printed. Covers MOS IC'S listed by function. LINEAR IC'S listed by function. INTERFACE IC'S listed by function. LSI, memory, TTL ECL power products, SCR'S, diodes, transistors listed by application and ratings. RF, small signal and opto devices listed by application and ratings. Essential Data given for all devices.
TERRIFIC VALUE

MOTOROLA LINEAR IC'S

B 1114.............. **$9.95**

Popular data manual. At last readily available. Approx. 800 pages, full Data Design proceedures and equivalent listings for 1000's of devices under headings OP AMPS, VOLTAGE REGULATORS, CONSUMER CIRCUITS (eg. TV, AUTOMOTIVE, POWER), HIGH FREQUENCY CIRCUITS and SPECIAL-PURPOSE CIRCUITS.

MOTOROLA MEMORY DATA

B 1113.............. **$8.95**

An absolute must for the microprocessor Buff. This is the latest reprint of Motorola's famous Memory Data Manual and includes all the latest specifications and design application data on TTL RAM, TTL PROM, MECL MEMORY, MECL RAM, MECL PROM, MOS dynamic RAM, MOS static RAM, MOS EPROM, MOS EE PROM and MOS ROM.
Worth many dollars more!

MOTOROLA CMOS DATA

B 1105.............. **$11.50**

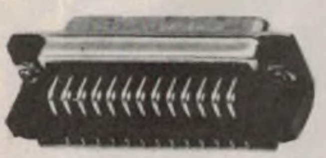
A comprehensive reference covering 40XX, 45XX CMOS family's along with specialty devices such as LCD drivers, telephone and general communication functions and industrial control.
862 pages essential in all spheres of electronics.

BANKCARD HOLDERS — PHONE ALTRONICS TOLL FREE 008·999·007 FOR NEXT DAY JETSERVICE DELIVERY

PHONE YOUR ORDER — ALTRONICS TOLL FREE 008·999·007

NEW D RANGE CONNECTORS

SAVE 25% ON BULK QUANTITIES!



		ea.	10 +	25 +
P 0880	DB 9 Male 9 Pin	2.50	2.20	1.95
P 0881	DB 9 Female 9 Pin	2.95	2.70	2.50
P 0882	DB 9 Male PCB Mnt	3.25	3.10	2.90
P 0883	DB 9 Female PCB Mount	3.95	3.75	3.40
P 0889	DB 9 Backshell Cvr	2.00	1.80	1.50
P 0890	DB15 Male 15 Pin	2.95	2.50	2.20
P 0891	DB15 Female 15 Pin	3.50	3.00	2.80
P 0892	DB15 Male PCB Mnt	3.95	3.75	3.40
P 0893	DB15 Female PCB Mount	4.95	4.60	4.25
P 0895	DB15 Backshell Cvr	2.00	1.80	1.50
P 0899	DB15 Backshell for Microbee	2.50	2.20	2.00
P 0900	DB25 Male 25 Pin	4.50	3.95	3.50
P 0901	DB25 Female 25 Pin	4.95	4.50	4.00
P 0902	DB25 Male PCB Mnt	4.50	4.10	3.85
P 0903	DB25 Female PCB Mount	5.50	5.00	4.70
P 0905	DB25 Backshell Cvr	2.00	1.80	1.50
P 0907	DB25 Backshell for Microbee	2.50	2.20	2.00

S 100 BUS EDGE CONNECTOR

100 Pin

P 0910 . . . . $6.50

10 Up $5.50

PROFESSIONAL QUALITY

SOLDER SUCKERS

Not to be compared with inferior "Hobby types". Saves countless hours in fault finding and repair of complex PCB's.

- SINGLE HANDED OPERATION
- SELF CLEANING PLUNGER
- LONG LIFE TEFLON TIP
- DOUBLE DIAPHRAGM, DUAL O-RING SEAL
- 225mm x 20mm(d) 50mm STROKE POWERFUL SUCTION

T1240. . only **$11.95**

T1241. Replac tip. **$1.95**

SOLDER

200 gram reel. 1mm universal gauge. Suitable for all types of electronic soldering. Resin cored and includes bit saving additive.

T 1200 $4.95 — 5 up $4.50 ea.

ETI CIRCUITS
No. 1, 2 and 3.
~~$2.50~~ ea.. **$2.00**
PROJECT ELECTRONICS
~~$4.50~~ ea.. **$3.00**

REDUCED ONLY . . . $7 SET OF 4

Contains hundreds of cirucit and application notes.

VELOSTAT

Non-static sheeting for storing CMOS IC's, LSI's etc. 1000 times better than aluminium foil will store up to 150 IC's on one 225 x 150mm sheet.

H 0500.......**$2.50 per sheet**

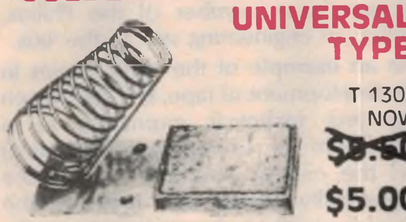
MINI SPEAKER 57mm

Large Ferrite Magnet. Ideal replacement speaker. Great for hobby projects.

C 0610... ~~$1.95~~

Now $1.25 ea.

SOLDERING IRON STAND UNIVERSAL TYPE



T 1302 NOW ~~$8.50~~ **$5.00**

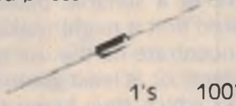
6A/400V DIODE BRIDGE

PRICE SLASHED

Z 0134............**$1.75**

OOPS WE MADE A BOO BOO!

Right now we have around ½ million Premium Quality Genuine Philips IN914/IN4148 Signal Diodes — Out they go at never to be repeated prices.

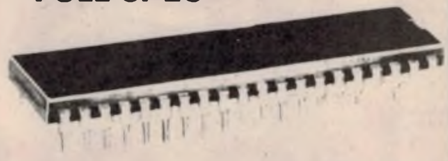


	1's	100's	1000's
Z0101..........	4c	3c	2c

SAVE ON BULK QUANTITIES

HALF PRICE Z80 A

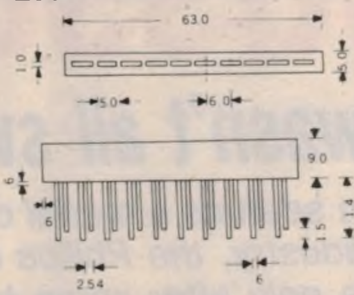
FULL SPEC — FAMOUS SGS BRAND



Z9001 CPU WAS $8.95 NOW **$4.50**
Z9005 PIO WAS $8.95 NOW **$4.50**

NEW PRODUCT

10 SEG. RED BAR GRAPH MODULE



Z 0180 **$2.50** 10 up $2.20 ea.
100 UP $1.80

MINI TOGGLE SWITCHES

OEM QUALITY 250V 2 AMP RATED

6mm mounting hole
12mm x 12.7mm x 20mm (D)

		ea.	10 +	25 +
S1010	SPDT	$1.25	$1.10	.95
S1025	SPDT C/OFF	$1.50	$1.25	$1.10
S1020	DPDT	$1.50	$1.25	$1.10
S1030	DPDT C/OFF	$1.95	$1.75	$1.50

MU 45 PANEL METERS QUALITY CLASS 2.5

Overall dimensions 58W x 52H. Bolt Mounting Centres 38 x 38. Hole required 44mm. Nuts & Washers provided.

SAVE ON BULK QUANTITIES

	FSD	DC Resistance	Price	10 Up
Q 0500	1MA	200	8.25	7.25
Q 0505	50UA	3500	8.25	7.25
Q 0510	5A	.02	8.25	7.25
Q 0520	20V	2000	8.25	7.25
Q 0525	30V	3000	8.25	7.25
Q 0535	VU	-	8.50	7.50

BANKCARD HOLDERS — PHONE ALTRONICS TOLL FREE 008·999·007 FOR NEXT DAY JETSERVICE DELIVERY

PHONE YOUR ORDER — ALTRONICS TOLL FREE 008·999·007

The story of the compact cassette...

It wasn't all sweetness and light!

Often seen as a model of cooperation in the world hifi industry, the Philips compact disc won acceptance only after some heavy "horse trading" and ironical twists of fate characteristic of the tape story as a whole.

RCA's twin-spool cassette worked well but it did not appeal to enthusiasts and was too large and expensive for the home music market. (From "Tape Recording" by Walter G. Salm).

by NEVILLE WILLIAMS

In Australia, late last year, to talk about audio and video tape recording, Bill Andriessen, Chief Applications Engineer for BASF in Germany, was prompted to make a few observations about the early history of tape recording and the emergence of the compact cassette – something which he saw at close quarters as a member of the Philips, Eindhoven engineering staff in the '60s.

As an example of the early ironies in the development of tape, Bill Andriessen reminded technical journalists at a symposium in Launceston (Tasmania) that the earliest attempts to produce magnetically coated tape included the use of finely divided particles of metallic iron. It proved to be chemically unstable, absorbing oxygen and quite literally turning to rust.

As an idea, it was fifty years before its time and it is only recently that tape manufacturers have managed to contain pure iron particles in a binder that will ensure chemical stability – resulting in the much publicised pure metal tapes.

At the time, BASF chemists, who had been concerned mainly with the development of a suitable plastic base film, suggested that it might make better sense to concentrate on the use of "rust" in the first place, or at least gamma ferric oxide (Fe_2O_3) which they knew to have interesting magnetic properties. They were familiar with it as a leading manufacturer of chemicals and pigments.

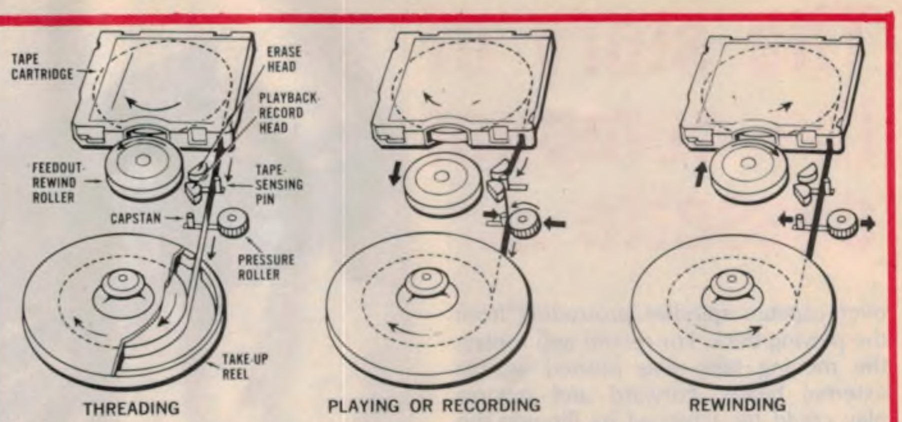
The suggestion proved to be a good one and, in the 50 years since it was taken up, magnetic oxide technology has advanced so far that – ironically again – pure metal coating is finding it difficult to stage a comeback against modern oxide formulations, particularly one like BASF's own Chromdioxid Super II.

With much of the early development concentrated in Germany during the early '30s, it was not surprising that audio tape recording should find its first large-scale application in that country during World War II, as an adjunct to both internal and external radio broadcasting. Unaware of the progress that had been made, the allied nations could only wonder and speculate as to how the Berlin Philharmonic Orchestra could perform at night for German radio, despite the bombing and the blackouts!

It was only after the war that they woke up to the advanced stage of German tape technology and carried off an advanced model Magnetophon for detailed investigation. That much of the story has been told many times.

The Magnetophon used magnetically coated plastic rather than paper tape and a form of AC biasing that was an improvement on a basic patent that had

Akio Morita (left) and Masaru Ibuka, co-founders of Sony. According to "The Sony Vision", Morita forced Philips to sign a no-royalty agreement for their compact cassette system by threatening to do an alternative deal with Grundig and Telefunken.



Devised jointly by CBS and 3M, this single-spool cassette system was easy to use but difficult to manufacture. It did not survive but it triggered Philips and Grundig into action.

been taken out in 1921 by two engineers from the Naval Research Laboratory in Washington D.C. Operating at a tape speed of 22.1ips, with a bias frequency of 80-100kHz, the frequency response was within 1dB from 25 to 10,000Hz.

In reality, the Americans and the British should not have been as unaware as they appeared to be of German progress in magnetic recording. Back in November 1936, the first major concert performance to be recorded on magnetic tape had taken place in BASF's home city: Ludwigshafen in Germany. It featured Sir Thomas Beecham and the London Philharmonic Orchestra!

It has since been suggested, rightly or wrongly, that magnetic tape recording was something that the powerful British and American record interests preferred not to know about.

More to the point, according to Bill Andriessen, the Americans need not have relied on a post-war intelligence "coup" to obtain the technology for further development. As evidenced by the recording session in Frankfurt, the magnetic tape system had never been regarded as a secret in Germany. Everything to do with it had been covered in patent documents progressively lodged in a number of countries, including Switzerland. All that was necessary was for somebody to look it up in the Swiss Patents Office!

Once tape technology got moving again, it was quickly taken up by the professional audio industry, worldwide, subsequently moving down-market for potential domestic use. But, while the novelty factor in this latter role was high, the basic clumsiness of the open-reel tape system became all too apparent. The tape slipped, and fell off the reel, and tangled and broke and, to make matters worse, users were presented with a confusion of speeds and formats.

Open-reel tape decks surged to about 10% market penetration and then faltered. Tape was too clumsy, too "technical" as an everyday domestic music source. Consumers had decided to stay with the disc!

Sensing this, a number of major companies set their engineers to work on ideas for simplifying and rationalising tape handling. It should not be necessary they reasoned, for users to handle or even touch the tape. Ideally, it should be contained in some kind of a magazine which could be placed on or in a tape deck, with the same facility as a disc.

Around 1956, RCA proposed a design which, in some respects anticipated the modern campact cassette. Inside, the tape was spooled between two hubs which, for purposes of drive, slipped

The story of the compact cassette ...

The Philips EL-3302 battery-powered portable, which did much to establish the compact cassette format in Australia.

over capstan spindles protruding from the playing deck. For record and replay, the moving tape was pushed against external heads. Forward and reverse play could be achieved by flipping the cassette over or, in a more complex deck, by the provision of bi-directional drive and additional heads. RCA claimed that the cassette could be slipped on and off as easily as a disc and that it would ultimately render the disc system obsolete.

Official release of the RCA cassette was announced in the July, 1958 issue of this magazine, with a follow-up article in August. The cassette turned out to be quite large (approx.180mm x 130mm) being loaded with standard 6.35mm wide tape, operating at 9.5cm/sec – both figures borrowed straight from open-reel practice. It was a 4-track system but RCA missed out on the opportunity to rearrange the tracks to provide for possible mono/stereo compatibility, as with the ultimate Philips system. In the event, and despite RCAs initial optimism, the system did not survive in the marketplace.

Also of note, according to Bill Andriessen, was a system devised jointly by CBS and the 3M Sound Corporation, working under the general supervision of Dr Peter Goldmark, pioneer of the LP phono disc. This used quite a small cassette containing a single spool loaded with tape only 3.8mm wide. The player/recorder had to thread the tape automatically through to its own in-built take-up spool, and subsequently rewind it before the cassette could be removed.

It so happened that the CBS/3M unit had been designed as an automatic changer but it exhibited the most unfortunate tendency to load the waiting cassette before the last one had been disengaged! It, too, failed to win market support but, ironically, not before it had triggered Philips and Grundig in Europe into taking up the challenge on their own account.

The two companies had been negotiating with CBS/3M for joint manufacturing rights for their developmental cassette deck but were met by a demand for a down-payment of $US1,000,000 plus a royalty on each separate deck and cassette. It was a substantial figure at the time and Philips/Grundig decided that, for that kind of money, they could fund a research program of their own.

This they did, coming up with a design that never got beyond the prototype stage! Like the CBS/3M unit, it used a small, single-spool cassette and automatic tape feed through the deck to the take-up reel. And, like the American design, it was sufficiently complicated to raise doubts – in some quarters, at least – about the wisdom of proceeding to the production stage.

At that critical point in time, another completely separate development team in Philips revealed the existence of an alternative design which ultimately provided the basis for the compact cassette system. But, said Bill Andriessen, "it caused a revolution in Philips . . . an earthquake!"

Officially, the second team had been working on a tape dictation machine but the results were so promising that the team leader, on his own initiative, extended the development to ensure that the system could handle music as well as speech. With grave doubts about the official cassette development approach, he felt that his own project could well hold the key to what the Company had been seeking. He was so right!

Notwithstanding the resulting "earthquake", it was clear to everyone who saw it, that the unofficial spin-off from the dictating machine project was the way to go. It was relatively uncomplicated to produce, easy to use, portable and economical and, in terms of sound quality, at least equal to popular portable transistor radios of the day. What's more, it had the potential to appeal directly to the public, without first having to win acceptance from the tape enthusiast minority.

Unfortunately, when news of all this reached Grundig, they concluded that Philips had deliberately gone behind their back and, while supposedly cooperating in a joint project, had been secretly working on another approach. Grundig's response was to join forces with Telefunken in a development of a system of their own, which was offered to the Japanese and to Sony in particular, free of any royalty charges.

The "horse trading" had begun and further reference to it appears in the book "The Sony Vision" by Nick Lyons.

In 1963, British racing driver Stirling Moss demonstrated this in-car stereo tape system. The cassette resembles the Philips design but leaves the tape exposed.

The Aiwa TP-707, claimed to be the first cassette recorder to be released in Japan. Within three months it was modified to accept the Philips cassette.

(1976, Crown Publishers Inc., One Park Avenue, New York, N.Y.10016.)

At the time, Sony's entire tape division was the responsibility of Norio Ohga, a personal protege of Akio Morita and directly responsible to him and to his co-founder of the Company, Masaru Ibuka.

When Ohga realised the potential advantages of tape cassettes over the reel to reel system, he foresaw that some such system would one day become standard throughout the world. So he began to canvass the possibilities of a standard format with other companies, including Philips, Grundig and Telefunken.

In due course, a representative of Philips turned up in Tokyo with details of their new compact cassette system, a recital of its advantages and an offer of a licensing agreement based on a royalty to Philips of 25 Yen (then about 7c) per cassette. Scores of hard bargaining sessions followed with Sony and other Japanese manufacturers and the royalty was gradually whittled down to 2c.

Matsushita (National) signed at this figure but Morita insisted: "We must not have to pay that royalty".

Ohga duly went back to Philips and told them of Morita's decision. He pointed out that, if Sony chose to do a deal with Grundig and Telefunken on another format, free of any royalty, the Philips compact cassette system could not possibly survive. On the other hand, if Philips were prepared to sign a royalty-free agreement, said Ohga: "We will go along with your cassette, which will then definitely become the standard."

A year later, just such an agreement was signed but with Philips insisting as a condition, that all licencees must also sign an international standards undertaking. They also gained access to Sony's automatic recording level control circuitry, which made a further contribution to popularising the budget-level compact cassette recorders.

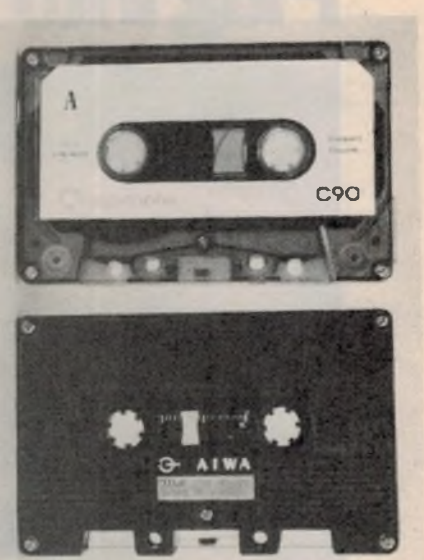
Once the die was cast, Philips launched the compact cassette with a will, their initial unveiling in the USA being at the New York High Fidelity Show in 1963, with the 2-track mono "Carrycorder".

In Australia, their most popular early model was probably the EL3302, also 2-track mono player/recorder operating from five 1.5V "C" cells, and provided with external microphone with remote control switch. While open-reel enthusiasts regarded them as "toys", they were very efficient and effective toys, easy to use and giving surprisingly good results on both speech and music. Their acceptance left little doubt as to the future of the format.

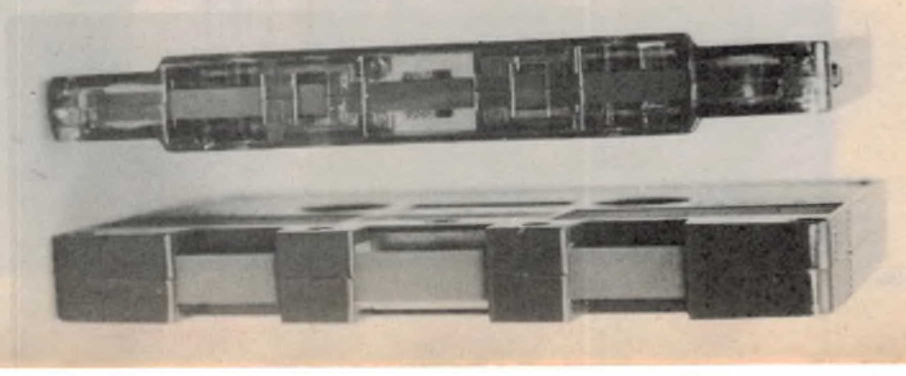
It took a while for Japan's tape industry to get rolling, with AIWA claiming to have introduced Japan's first cassette tape recorder in September, 1964 – model TP-707. However, while it looks the part, closer examination shows that the cassette is thicker and loaded with 6.4mm tape. Four months later, in January 1965, the TP-707 was replaced by the TP-707-P, with the mechanism modified to use Philips type compact cassettes.

Obviously very active in the field, AIWA released the TP-1004 in February '67, claimed to be the world's first portable stereo cassette recorder. This was followed in '68 by the TP-1009, claimed as Japan's first stereo cassette deck tor use in the home. As such, it would have been the first trickle of a flood!

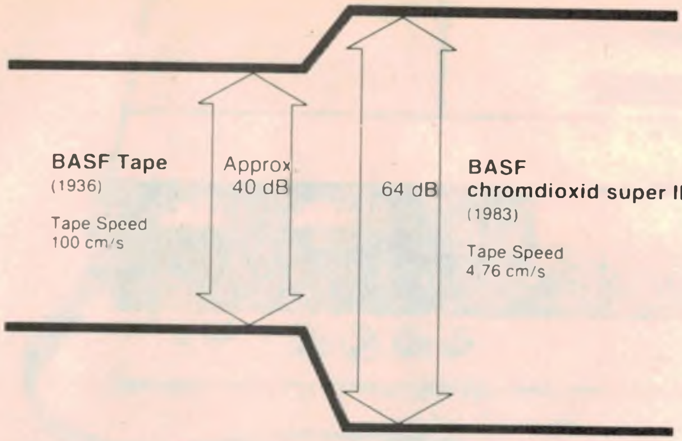
Initially, the compact cassette system was seen as a purely medium-fidelity music source: something that could take



The photos below and at right shows Aiwa's first version of the compact cassette loaded with ¼-inch tape. How did Aiwa pick this format and why didn't it become the standard?



The story of the compact cassette ...



From a BASF booklet, this diagram shows the increase in dynamic range between an old and a modern tape, despite a 20:1 reduction in tape speed.

its place alongside the average portable or car radio – pleasant but not pretentious. It can still fill that role when manufactured to a budget price but its potential has been extended upwards to a startling degree.

Fierce competition has inspired a continuous refinement in the design and production of tape heads and the associated circuitry, while a similar effort has gone into the transport mechanism to reduce wow, flutter and tape misalignment to the barest minimum.

Noise reduction systems have been evolved to minimise the one-time bugbear of tape recording – tape hiss. While not necessarily offering the largest figures, Dolby-B noise reduction is commonly given much of the credit for boosting the compact cassette system from medium-fi to a hi-fi source.

Tape manufacturers, too, have made a tremendous contribution and, while their publicity is studded with advertising superlatives, jargon and ravings about single-decibel increments, they do add up to a very substantial improvement in frequency response and in signal/noise ratio for a given distortion level.

In a booklet made available at the time of Bill Andriessen's recent visit, BASF points out that they have now been involved in intensive research into coated magnetic tape for 50 years.

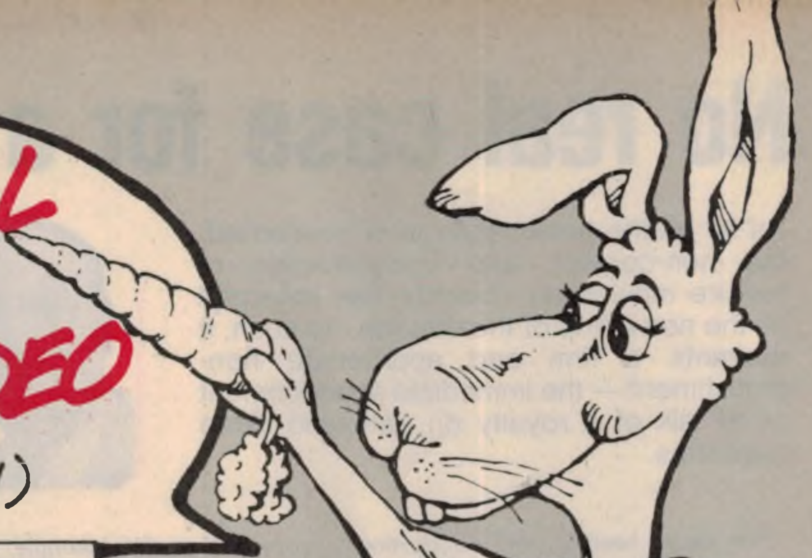
The historic Beecham/London Philharmonic recording in 1936 was made at a tape speed of 100cm/sec but, even so, the dynamic range available was a mere 40dB – the recording quality being roughly equal to that of 78rpm records of the day. In 1984, at compact cassette speed (4.76cm/sec) the dynamic range available from BASF Chromdioxid Super II is claimed to be 64dB, before the use of noise reduction. With Dolby NR, BASF claim about 74dB, with the frequency response extending towards 20kHz, depending on the deck.

Indeed, the compact cassette enters 1984 as the almost universal medium, ranging from basic recorders, right through to a "must" in every domestic hifi system.

Yet it still can't escape those ironies. Refined to a degree that would astonish those who shared in the "horse trading" of the '60s, it now finds itself suddenly and positively eclipsed once again by its old rival: the disc. And, of all things, the compact disc!

WE'RE WELL VERSED IN VALUE VIDEO

(SAY THAT QUICKLY!)



DON'T BUY JUST AN ENHANCER!

The DICK SMITH

Video Processor

Far more than JUST an enhancer! This incredible processor enhances, stabilizes, amplifies and modulates as well . . . Latest imported design is a boon when dubbing, restoring detail normally lost in the process. But it also includes a stabiliser for tapes with 'Copyguard' eliminating the often associated annoying rolling.

Plus it has a video distribution amplifier so you can feed up to 3 other recorders or monitors AND its inbuilt modulator allows you to watch the enhanced picture during playback on any ordinary TV (great for A/B comparison). Incredible ? Wait until you try it: it's even better! Cat Y-85100

WHAT A BUY!

$129.95

Fantastic stereo sound from your mono video with this kit!

Stereo Simulator Mk II

Wish those old video movies had modern stereo sound? This low -cost gadget turns almost any mono signal into amazingly good synthetic stereo!
SEE EA APRIL 1983

Cat K-3421

$19.95

EASY TO BUILD COMPLETE WITH INSTRUCTIONS

It's got everything!

Video to Video Cable

Having trouble with video leads? No more! This incredible video lead pack will match ANY video to ANY video with its unique plug & socket system. Cat W-1287

$19.95

Top quality, top name 3 hour Video Cassettes

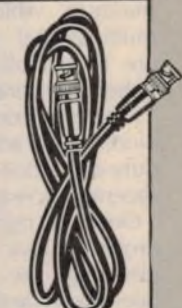
Polaroid Video

Huge bulk purchase of famous name video tapes allow this ridiculous price. Not those imported 'cheapies' which can do a lot of damage to your heads - these tapes are top quality!

VHS Polaroid Cat C-3410
BETA Agfa Cat C-3415

$12.50 ea

BNC to BNC Cable



2 metres quality 75 ohm coax fitted with BNC plugs at each end. Suits many of the VCR's available. Why make one and risk shorts when it's already done for you? Cat W-1285

$6.95

5 up . . . $5.95

DICK SMITH Electronics

See page 107 for full address details.

A 710 JL

No real case for a purchase levy

As far as the public at large is concerned, the non-copying and non-collection of feature movies on cassette has emerged as the non-crime of the decade. As such, it warrants a firm and appropriate non-punishment — the immediate abandonment of all talk of a royalty on domestic video cassettes.

FORUM

Conducted by Neville Williams

The above heading and introduction was prompted by a press release from the Australian Audio and Video Tape Association (AAVTA) regarding a proposed purchase levy on blank recording tape. The proceeds would be distributed, by way of compensation, to those companies or individuals whose copyright in various works *might* be infringed by illicit home taping.

According to the release, legislation is ready for presentation to Federal Parliament which, initially, would impose a levy on blank audio tape. The Labor Government is said to favour such measure, with Senator Gareth Evans hinting that a likely rate would lie somewhere between 2c and 3c per hour of tape.

The AAVTA opposes the Bill on principle but is especially concerned that an imposition on audio tape would provide an automatic precedent for a levy on domestic video cassettes, as well.

Spokesman for the AAVTA, Peter Rose, describes the Bill as a "draconian measure", which would benefit most the multinational record companies "who are in fact already among the world's richest corporations".

From the consumer's point of view, it would be in addition to the present 35% duty and 32½% sales tax – the latter only recently increased from 20%.

On the rights and wrongs of the proposed levy, Peter Rose questions the idea that the record companies have been disadvantaged by home taping. He suggests that the practice may even have helped rather than hindered sales. I quote:

"In one study conducted in the US (the Yankelovich Survey) it was found that two-thirds of the respondents discovered a performer through a tape from a borrowed recording; and the majority of these went out and bought the record".

Peter Rose goes on to point out that a levy as proposed would ignore the rights of purchasers who use tapes for purposes unconnected with record copyright as, for example, education, business, telephone answering and computers.

He also draws the attention to the complex logistics involved in the collection and disbursement of the proposed levy:

"Who would comprise the appointed body that would supervise and enforce the collection, and how will equity in its distribution be ensured? And how much time – and again, taxpayers' money – will go toward performing this mammoth and complicated task?"

While quoting from the AAVTA release, it would involve a complete about-face for me to simply endorse their description of the proposed legislation as "draconian". The fact is that I accepted the principle when I discussed the whole matter back in June, 1981: "THE AUDIO-VIDEO COPYRIGHT PROBLEM – is a levy on cassettes the best answer?" I concluded that article as follows:

"When I started out to write this instalment of 'Forum', I did so with an open mind. Right at this moment, I can't help but feel that a small levy on the price of blank tapes would be the most equitable solution.

"And by 'small' I am talking about a few percent.

"It would be worth that to do our own thing at a private level without pangs of apprehension, guilt, remorse, conscience or whatever.

That conclusion was based on two clear assumptions:

1. The levy would amount only to "a few percent". I guess that the suggested 2c to 3c per hour of taping would be in line with that.

2. Payment of the levy would clear the home recordist of all copyright obligation for purely domestic, non-profit taping. There would be no "double-dipping" to extract further revenue.

Many readers appeared to concur with this conclusion although I did get a reaction from the pro-copyright lobby which contained the observation . . . "and we're not just talking about a few percent". It remains to be seen whether they still think that way and whether they will accept 2c to 3c per hour as a complete settlement of their claim on home recordists.

Video recording

But, having stated that reservation, I must go along with the AAVTA and their apprehension that the Bill could establish a precedent for a proportionate levy on domestic video cassettes. Their view is summed up in the following paragraph:

While the Attorney-General assures us at this stage that a similar levy on videotape is "unlikely", AAVTA and other opponents of the Bill fear that it is an all too likely eventuality, if ever the current measure is passed into law. "It is no secret that major film companies – many of them among the world's richest – have been pressing for 'protection' of their copyrights", Mr Rose said. "Yet industry research has shown that an overwhelming 90% of blank video tapes bought are used merely for the convenience of 'time shift' – unattended recording for viewing at a more convenient time – a practice certainly not injurious in any way to copyright owners".

A couple of years back, when I wrote the previously mentioned article, I was prepared to believe that, given half a chance, Australians would hoard video software in the same way they hoard books and records – providing some justification for the claims of film companies.

But it hasn't worked out that way.

To some extent, I was influenced by acquaintance with several of those odd souls who, by fair means or foul, had managed to acquire odd reels or complete copies of historic films.

Where such films came from was usually clouded in mystery but it was said many of them could have been "rescued" on their way to obigatory destruction, when they were no longer in good enough condition to exhibit.

on video cassettes!

Alternatively, remembering how films used to meander around country cinema circuits in the old days, it would not be unthinkable that the occasional reel could have disappeared somewhere between the Black Stump and Bullamakanka!

Sixteen millimetre and 8mm prints of features and shorts could, of course, be purchased legitimately but at prices which few enthusiasts could afford. Most could only drool over the catalogs and save up for the occasional purchase.

Against this background, it was reasonable to assume that, given access to off-air programs, a VCR, and cassette tape costing less than $5 per hour of running time, the collecting of movies and other video fare would become a widespread hobby, making a nonsense of traditional copyright constraints.

Certainly, that was the way film interests saw it in the USA, when they moved against Sony, following the release and promotion of their Betamax home video recorder. The case has never been finally resolved but, in the meantime, the possession and use of domestic VCRs has become an essential part of the video scene in all developed countries.

Video libraries

In Australia, a significant proportion of those who invested in a VCR may well have had ideas of building a library of favourite movies and TV shows for occasional family viewing. But, if my observations are at all representative, that intention has proved to be self-defeating for most people, lending credence to the claim by AAVTA that 90% of all video cassettes are used for time-shift recording.

People remember how much they enjoyed certain films and assume that it would be quite something to have their own captive copy: "The Sound of Music", "Oliver", "The Quiet Man" or perhaps "One Flew Over the Cuckoo's Nest".

When such a film turns up on TV, they watch it with great anticipation and, at the same time, record a copy for their planned cassette library, with all the adverts dutifully removed. They label it and stand it carefully on a shelf – where it remains, admired but unused, for months on end.

By the time the experience has been repeated 15 or 20 times, the would-be collecter begins to realise that he/she has several hundred dollars worth of cassettes lined up on the said shelf, with little inclination – or time – to play them in the forseeable future. What's more, other movies keep turning up with an equal claim for a place in the collection – a real case of holding a tiger by the tail.

To some, the realisation comes fairly quickly, as to one near-neighbour who called a halt at 25 cassettes. Said she:

"I do want to keep a few things for historic reasons, like highlights from the Commonwealth Games and the America's Cup; and there's a handful of movies that are my special favourites. But the rest will have to go. I'll simply use the cassettes to record things that we can't watch at the one time . . . like cricket and the tennis.

"When we get around to watching them, they'll be wiped, too!"

At the other extreme was an acquaintance who got involved up to his ears in collecting movies and rock shows. I doubt that I ever met anyone else quite as keen. He bought cassettes in bulk, became a slave of the programs, meticulously edited out all extraneous matter, indexed and listed the contents of the cassettes and stowed them in a capacious cupboard.

But, with the score at about 300 features, he realised the burden and the futility of what he was doing. At the rate he was outlaying time and money, he would be better off simply to hire cassettes from a library if and when he needed them as a supplement to normal viewing. In any case, a library worthy of the name would offer a far wider choice than he could hope to assemble personally.

So, older but wiser, he abandoned the whole enterprise, reverted to normal time-shift practice, and sold off the surplus cassettes for their blank value.

While two specific examples cannot prove anything, they do serve to illustrate the point I made earlier: the ambition to create a private collection of video features tends to be self-defeating, and most video viewers come to realise this somewhere along the track.

In short, contrary to my own expectations and the fears of copyright holders, the use of VCRs in the community has not produced a race of viewers madly intent on assembling private film collections, or otherwise acting in a way likely to divert real revenue from the copyright holders.

On the contrary, it has produced a race of viewers likely to trek to the local video library when off-air programs fail to interest – especially during the recent dismal non-ratings period over Christmas/New Year.

Guess who benefits when that happens: surely not those poor, hard-done-by film companies!

There are and there always will be inveterate collectors, of course, just as there are inveterate collectors of everything from old coins to old cars, but they tend to be publicists for the product rather than a liability.

Significantly, while I heard and read many references to patronage of video libraries during the non-ratings period, not once did I hear it described as a golden opportunity to re-screen a private collection. And no wonder: with the TV stations fleshing out their programs with repeats, why would one possibly want to resort to a private supply of the same?

Such are the reasons why I have changed my mind about a possible levy on domestic video cassettes; why, at the beginning of this article, I described home video taping as *the non-crime of the decade* warranting an appropriate *non-punishment*.

The real video pirates

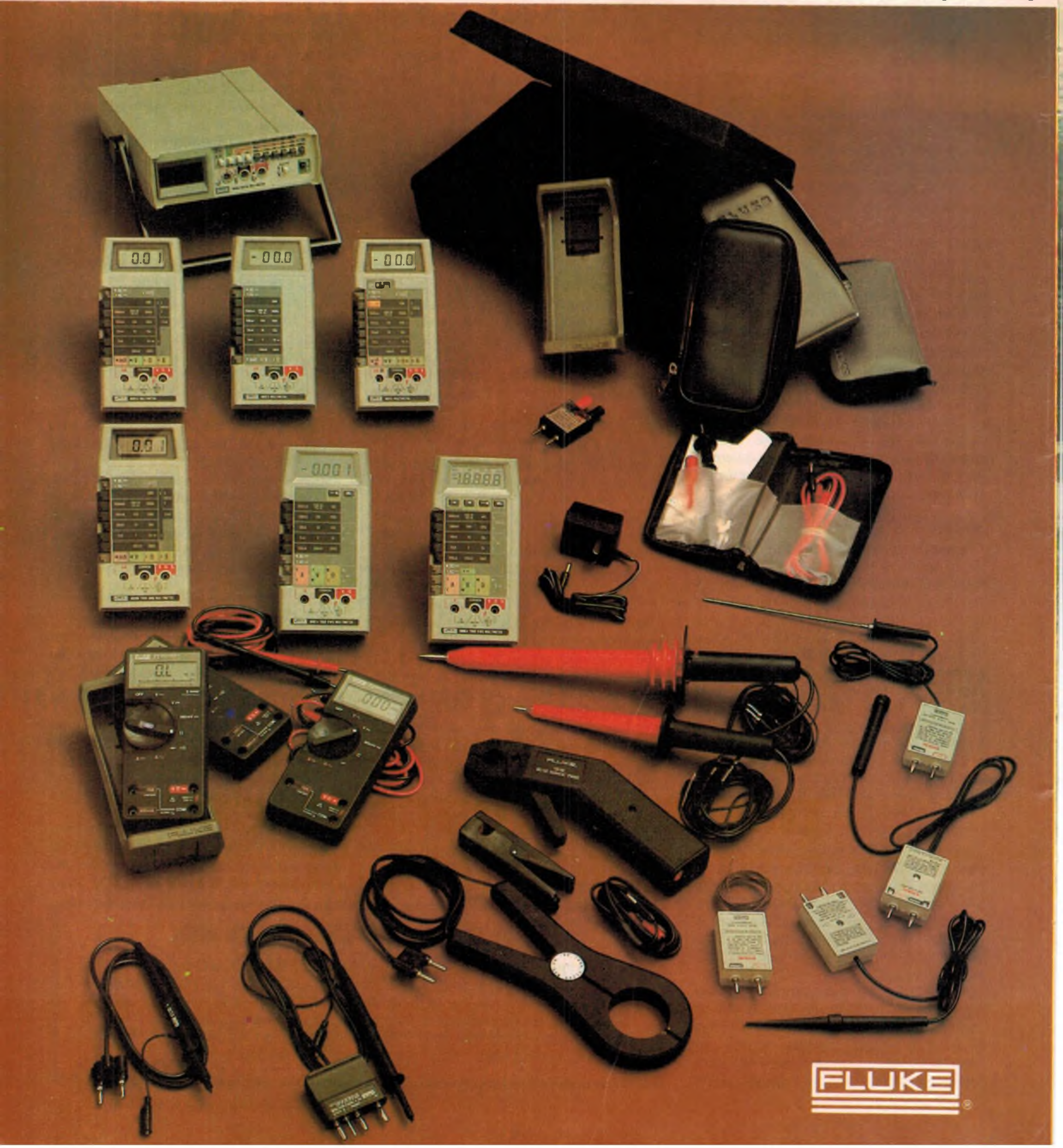
If copyright owners want to optimise income to which they are morally entitled, they should be concentrating their attention on the real video "pirates" – those who sell or rent illicit (and frequently degraded) copies to the public, cheating both the copyright owners and honest video dealers.

And, while they are at it, they could give their attention to another problem that I have heard and seen mentioned on a number of occasions recently: the hesitation of some viewers to patronise a video library in case their name should end up on a list of obvious VCR owners

STOP PRESS: US COURT RULES ON VCRs

In a 5-4 judgement, the US Supreme Court has ruled that home video taping does not violate US copyright law. The landmark decision is the outcome of a suit filed by Universal City Studios and Walt Disney Productions against Sony Corp. of America, and which progressed through several lower courts. The Supreme Court said that since VCRs are mainly used by the public for non-commercial purposes, copyright law was not violated.

FROM HOBBYIST T
FLUKE MUST BE YOUR FI
FOR FEATURES, Q



O PROFESSIONAL – RST MULTIMETER CHOICE UALITY AND VALUE

1 **8050A $540** ex tax $626.40 tax paid
- 4½ digit bench portable • 0.03% basic accuracy • 10uV, 10nA, 10mohm sensitivity • True RMS to 50kHz • dB with 16 reference impedances • Relative reference for comparing values

2 **8020B $269** ex tax $312 tax paid
- 3½ digit • 0.1% basic accuracy • Eight functions including conductance • Continuity beeper

3 **8021B $221** ex tax $256.20 tax paid
8022B $199 ex tax $230.80 tax paid
- 3½ digit • 0.25% basic accuracy • Diode test • Continuity beeper (8021B only)

4 **8024B $346** ex tax $401.20 tax paid
- 3½ digit • 0.1% basic accuracy • 11 functions including temperature with K type thermocouples • Peak hold on voltage and current • Logic detection and continuity testing • Audible and visible indicators

5 **8026B $304** ex tax $352.60 tax paid
- 3½ digit • 0.1% basic accuracy • True RMS to 10kHz • Conductance to 10,000Mohm • Diode test and continuity beeper

6 **8062A $387** ex tax $448.80 tax paid
- 4½ digit • 0.05% basic accuracy • Similar to 8060A without counter and dB • Relative reference • True RMS to 30kHz

7 **8060A $484** ex tax $561.40 tax paid
- 4½ digit • 0.05% basic accuracy • True RMS to 100kHz • Frequency counter to 200kHz • dB and relative dB • Microprocessor self diagnostics • Relative reference for comparing values • Direct resistance to 300Mohm

LOW COST 70 SERIES WITH ANALOG & DIGITAL DISPLAY

3 YEAR WARRANTY

8 **73 $110** ex tax $126.60 tax paid
- 3200 count display • 32 segment bar graph • 18 ranges • Automatic power down • 10A current range • Autorange • 0.7% basic accuracy • 2000 hour battery life

75 $129 ex tax $148.40 tax paid
All the features of the 73 plus:
- Audible continuity tester • Autorange/ Range hold • 0.5% basic accuracy • Low mA range

77 $165 ex tax $189.80 tax paid
All the features of the 75 plus:
- Touch Hold function • 0.3% basic accuracy • Multipurpose protective holster

FLUKE MULTIMETERS CARRY A ONE YEAR MINIMUM WARRANTY AND ARE BACKED BY COMPREHENSIVE SPARE PARTS AND BACKUP SERVICE

ACCESSORIES TO INCREASE THE VERSATILITY OF YOUR FLUKE MULTIMETER

An extremely wide range of accessories is available for your Fluke multimeter. These include:

- **Y8100** – 200A/20A Hall Effect Current Gun with 2% accuracy from DC to 200kHz
- **801-600** – 600A current transformer with 3% accuracy from 30Hz to 1kHz
- **Y8101** – 150A current transformer with 2% accuracy from 48Hz to 10kHz
- **80T-H** – Touch and Hold probe for hard to reach measurements
- **83RF** – High frequency probe covering 100kHz to 100MHz
- **80T-150C** – Universal temperature probe 1°C accuracy from -50°C to +150°C. A wide range of temperature probes and thermocouple probes is available for temperature measurement
- **80K-40** – High Voltage probe measures to 40kVdc or peak ac
- **80K-6** – High Voltage probe measures to 6kV or peak ac with 1% accuracy
- **Y8105** – Rugged case holds multimeter and an assortment of accessories. One of a range of cases and pouches to protect your Fluke multimeter

All prices are plus sales tax if applicable and subject to change without notice.

bankcard

FLUKE®

SOLD & SERVICED IN AUSTRALIA BY **ELMEASCO Instruments Pty. Ltd.**

NEW SOUTH WALES	VICTORIA	QUEENSLAND	SOUTH AUSTRALIA	WESTERN AUSTRALIA
15 Macdonald Street MORTLAKE P.O. Box 30 CONCORD NSW 2137 Tel: (02) 736 2888 Telex: AA25887	21-23 Anthony Drive MT WAVERLEY P.O. Box 107 MT WAVERLEY VIC 3149 Tel: (03) 233 4044 Telex: AA36206	243 Milton Road MILTON P.O. Box 2360 BRISBANE QLD 4001 Tel: (07) 369 8688 Telex: AA44062	99 King William Street UNLEY P.O. Box 1240 ADELAIDE SA 5001 Tel: (08) 271 1839 Telex: AA88160	P.O. Box 95 GOSNELLS WA 6110 Tel: (09) 398 3362

N.S.W. Ames Agency 699 4524 • George Brown 519 5855, (049) 69 6399 • Bryan Catt 522 4923 • DGE Systems (049) 69 1625 • Davred 267 1385 • Macelec (042) 29 1455 • Radio Despatch 211 0191 • Sheridan Electronics 699 6912 • Standard Components 896 1755 ***N.T.*** Thew & McCann (089) 84 4999 ***A.C.T.*** George Brown (062) 80 4355 ***VIC.*** Radio Parts 329 7888 • Browntronics 419 3986 • G.B. Telespares 328 4301 • Elanco 428 4345 • Ellistronics 561 5844 • Stewart Electronic Comps 543 3733 • Sirs Sales (052) 78 1251 ***QLD.*** L.E. Boughen 36 1277 • Colourview Wholesale 275 3188 • ECQ Electronics 376 5677 • Electronic Shop (075) 32 3632 • W.G. Watson (079) 27 1099 • GEC Electrical Wholesale (079) 51 3155 • Nortek (077) 79 8600 • Solex (077) 72 2015 • Fred Hoe & Sons (07) 277 4311 ***S.A.*** Trio Electrix 51 6718 • Protronics 212 3111 • Lab Service 278 7488 ***W.A.*** Atkins Carlyle 321 0101 • Protronics 362 1044 • Brookeades 276 8888 • Cairns Instrument Services 325 3144 ***TAS.*** GHE Electronics (002) 34 2233 & (003) 31 6533 accessible to thieves. Frankly, I don't know what the answer is, but the problem is real.

BBC fingers time lag

By way of a change of subject, I received through the post a photostat of an item from the British magazine "New Scientist" dated November 17, 1983. Titled "BBC fingers time-lag", it has about it the aura of yet another "golden ears" story, this time about compact discs.

According to the report, BBC engineers may unwittingly have solved a problem that has puzzled hifi listeners with keen hearing: why it is that they prefer the sound from European compact disc players to those produced in Japan. I quote:

"The BBC has found that Japanese players reproduce the left and right channels alternately, in very rapid sequence, whereas European machines play both channels simultaneously. Staggering the playback causes a time-lag between channels, which in stereo creates a slight phase shift. This can worry some listeners.

"In mono, the phase shift shows up by cancelling high frequencies. Until now, no one has thought to listen to compact disc in mono. But the BBC has to use mono on its medium-wave and short-wave stations."

The reports states that, when a digital recording is made, the left and right-hand channel signals are sampled simultaneously but one data stream is delayed by a few microseconds so that the two can be interleaved into a single stream. At the playback stage, the correct time relationship can be restored by the use of a buffer memory.

This is done in CD players sourced from Philips but not necessarily in Japanese players. Sony's player on sale in Britain, it reports, has only a single D/A converter chip, which switches rapidly between channels. This and the lack of a buffer memory results in a time lag of 11.34 microseconds in one channel, producing an effective phase shift, and high frequency cancellation in mono mode. Says "New Scientist":

"The phenomenon could explain why some golden-eared enthusiasts prefer the sound of a Philips player, or a Marantz player which has Philips chips, even though these players offer far fewer features than the Japanese models do."

When I read this, I remembered a diagram that I had seen in some preliminary data on the Matsushita/Technics CD players SL-P7, SL-P8 and SL-P10. There was no accompanying text and I wasn't sure at the time what it was all about. Looking at it again, in the light of the above, it was clear that Technics engineers were well aware of the phase "problem" – if such it is.

The diagram provides a direct comparison between the phase characteristic curves and the mono-mode response curves with simultaneous and alternate sampling. I imagine that they would apply wherever the simultaneous/alternate option was exercised whether in the player or in the original recording chain.

The frequency response in mono mode with simultaneous sampling is dead flat to 20kHz but, with alternate sampling, it is down by 0.5dB at 10kHz and 2.5dB at 20kHz. While these figures would certainly be measurable, they would have no practical significance in an ordinary AM radio system or in any other system I can think of that would involve playing a compact disc in mono.

In normal stereo mode, the two signals are not brought together and do not cancel. Both are flat to 20kHz and their interaction is purely spatial, as a by-product of phase.

The extent of that phase shift with alternate sampling, relative to the ideal, is shown in the curves – and it looks quite depressing at first glance: beginning at about 1kHz, the phase discrepancy reaches 80° at 20kHz.

How awful; how positively dreadful! The only thing is that, according to the accompanying diagram, you can produce that much phase shift by moving either loudspeaker system 3mm from its ideal position in a perfectly symmetrical listening situation. Or, if you like, by simply moving your head by 1.5mm either way from the ideal central position!

I haven't checked on Technics' figures but, having toured their loudspeaker and acoustic research facilities, I'm prepared to take their word for it.

A fertile imagination

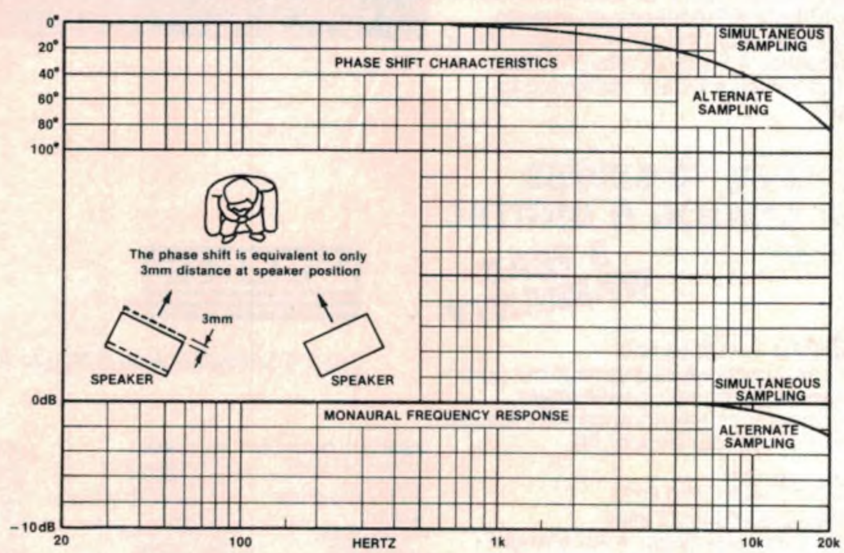
What emerges is that the phase discrepancy between simultaneous and alternate sampling is but a tiny fraction of what is present naturally and unavoidably in any practical listening situation. That being so, we can surely attribute the foregoing observations to a super-fertile imagination rather than to "golden ears".

That is, of course, unless the golden-eared gentry have equipped themselves with completely symmetrical hifi systems in completely symmetrical listening rooms, with a rigid steel head clamp set firmly and centrally in the concrete sub-floor.

Suddenly I see before me the image of "The man in the iron mask". Or the Biblical text in Deuteronomy 9-6: "For thou art a stiffnecked people!"

Our own reaction is that, if there is a discernible difference between compact disc players from Japan and Europe, and that is a big "if", this small phase discrepancy is only likely to be a part of the story.

THE EFFECTS OF ALTERNATE SAMPLING

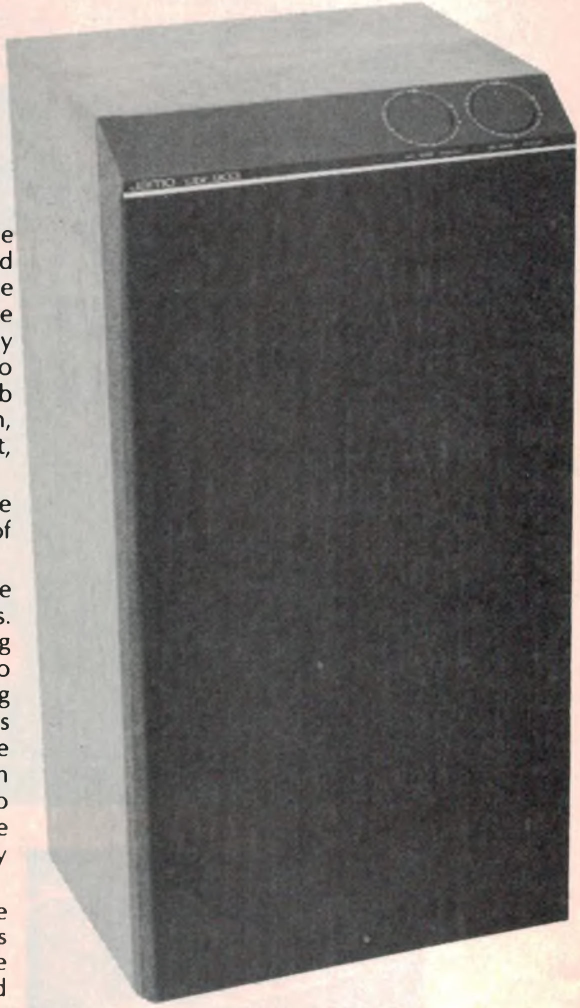


Included in preliminary data from Technics on their SL-P7/8 compact disc players, we came across this diagram – presumably their answer to criticism of alternate sampling.

Jamo CBR 904 bass reflex loudspeaker

At first glance the Jamo CBR 904 is a conventional three-way sealed loudspeaker system but the maker calls it a bass reflex unit. It does not have a normal vent or port but a tunnel which is concentric with the woofer.

by LEO SIMPSON



Jamo call this port or tunnel system CBR which stands for "centre bass reflex". Jamo have patented their system but the idea itself is not new. Older readers will remember the "distributed port" enclosures which were developed in the early sixties.

The exploded diagram on the opposite page shows how the CBR system is put together. First, there is an outer bass-reflex tube which is mounted on the inside of the enclosure baffle. This tube surrounds a smaller diameter steel tube which is affixed to the woofer itself. The space between these two tubes thus forms a circular bass reflex port which is claimed to provide symmetrical loading on the woofer cone.

An unusual feature of the CBR design is the method of mounting the woofer. This, together with the steel inner tube, is suspended in the circular port by means of four rubber blocks. These are claimed to restrict the transmission of woofer vibration to the front panel of the enclosure and so reduce colouration.

The baffle itself is unusual in that it is slightly curved to bring the tweeter and woofer forward with respect to the woofer. When the enclosure is mounted on its small stand it is tilted back so that the correct phase relationship between the three drivers is produced.

As an alternative to placing the speaker cabinet on stands, Jamo have made provision for hanging the system on a wall, either vertically or horizontally. For this reason the rear panel is recessed slightly. Jamo advocate wall-mounting so that the woofer is at head height.

Reinforcement in the form of a network of ribs on the inner surface of the baffle combine with the integral outer bass reflex tube to produce a very rigid structure.

Two other features on the baffle make it unusual: overload protection LEDs and the tweeter and midrange controls. The latter are accessible even when the grille cloth frame is in place and are normally flush with the sloping panel surface. To adjust, the user merely presses the knob whereupon it pops up by about 5mm, which enables it to be rotated. Once set, the control can be depressed again.

Both controls are constant impedance pads with a maximum attenuation of 13dB which is more than ample.

Just below the tweeter and midrange controls are the two overload LEDs. These flash when the system is being overdriven and indicate that the drive to the tweeter (or midrange) is being reduced. While the presence of LEDs may indicate a fairly comprehensive overload protection scheme the system is dead simple and just uses two thermistors, each in series with the appropriate leg of the three-way crossover network.

While we are not keen about the use of non-linear elements such as thermistors for overload protection, we have to concede that an overloaded driver produces gross distortion. We would assume that the thermistors have negligible effect when the system is being driven normally.

Jamo make a feature of their genuine wood cabinets. The model 904 is made of particle board covered in timber veneer on four sides with the rear panel finished in matt black veneer.

Overall dimensions of the Jamo 904 are 60 × 30 × 27cm and enclosure volume is quoted at 48 litres. Our calculations put the internal volume at around 36 litres and when internal braces and hardware are allowed for the effective enclosure volume would be close to 30 litres. This is a little on the small side for the woofer used if optimum bass performance is to be obtained.

Apart from the steel tube surrounding it and the unusual method of mounting, the woofer appears to be a conventional driver with a nominal diameter of 20cm and a synthetic rubber roll surround. The voice coil diameter appears to be 35mm and the effective cone diameter is 160mm. The chassis is a steel pressing and is fitted with a substantial ferrite magnet. Free-air resonance of the driver is around 45Hz.

For champion performance from compact discs,

look to the audio giants.

Totally faithful sound reproduction is no longer out of reach.

Thanks to Sanyo's compact disc technology, a quantum leap into the future of audio enjoyment.

Ask to hear a demonstration of Sanyo's CP 300 Compact Disc Player. The sound quality you'll experience from the 12cm, up to an hour-long, one-sided compact disc is identical to that of the original digital master tape.

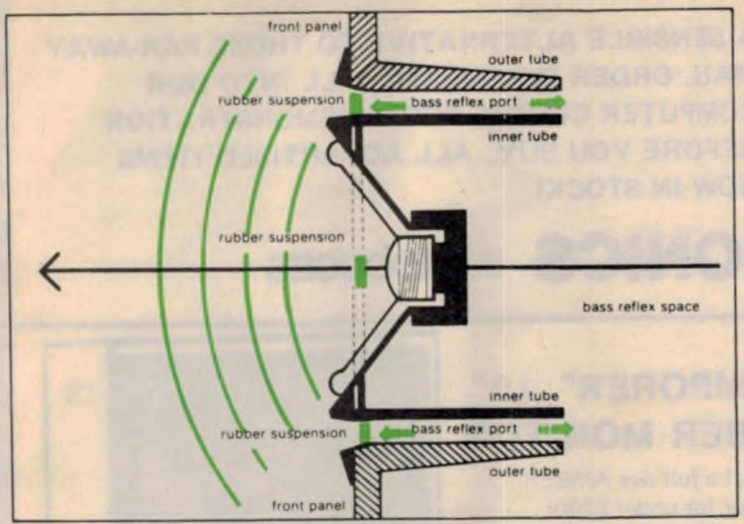
Examine the unit carefully. You'll find winning features like horizontal slide loading system; soft-push microcomputer controls; 16-selection programmable auto-search system; and synchronous recording to name a few.

Already, this digital audio technology using laser optics is transforming the audiophile's world, with the kind of champion performance from compact discs that only the audio giants can deliver.

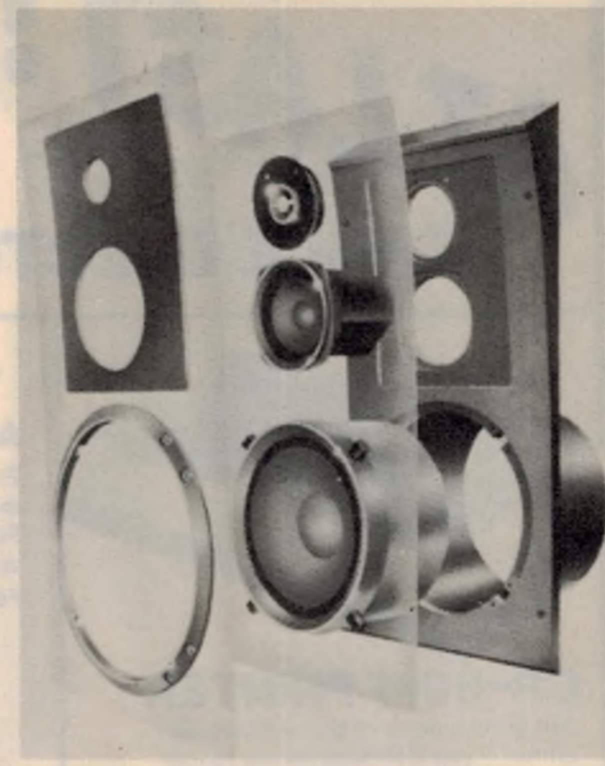
But with Sanyo, that's life.

SANYO

That's Life!



These diagrams show how the Jamo CBR woofer is assembled and functions as a bass reflex port.



Both the tweeter and midrange drivers are of closed-back construction. The tweeter is a 25mm dome with integral horn while the midrange driver is a cone type with roll surround and a nominal diameter of 10cm. Both are surrounded with a layer of black foam glued to the baffle which presumably reduces diffraction effects at the baffle openings. It also looks good when the grille cloth is removed.

The crossover network is a three-way second-order circuit giving attentuation slopes of 12dB/octave. Crossover frequencies are 850Hz from woofer to midrange and a 4.5kHz from midrange to tweeter. Air-cored inductors and bipolar electrolytics are used in the circuit.

The 904 should prevent no loading problems to most amplifiers. Jamo state the impedance as 4-8 ohms but it is closer to the higher figure. Minimum impedance is at 200Hz and is five ohms. Because the 904 is a bass reflex system it has the two customary low frequency impedance peaks, at 35Hz and 100Hz, in this case.

Sensitivity of the 904 is quoted as 92.8dB for one watt at one metre which means that it is just above average for a typical hifi loudspeaker.

Power handling capacity is generous with the 904 rated to 140 watts on music signals. In practice, when combined with the slightly above average sensitivity, a pair of 904's will be more than adequate for most users.

The 904 is supplied with a 2.5 metre twinlead cable which is fitted with a 2-pin DIN plug. However, Jamo recognise that in many installations much longer and heavier cables will be required. With that in mind the spring-loaded terminals on the rear of the enclosure will accept cables with conductors up to 2.5mm in diameter. Just another of the thoughtful design features of this Danish company.

Listening tests confirm that the Jamo 904 definitely has a European heritage. The sound quality is a little on the bright side with a rising treble response but that is easily corrected by setting both the treble and midrange attenuators to between −2 and −3. At this setting the 904 sounds very good indeed with a sweet treble and a very smooth midrange response quite free of colouration.

The bass too is smooth but not quite up to the standard of the treble and midrange. It is a little lumpy below 100Hz although still quite strong down to just below 40Hz. Modest boost may be applied to lift the lower bass without danger of frequency doubling.

The 904 performs well on classical orchestra and organ and gives a good account of itself with rock music too.

As might be expected with a 25mm dome tweeter, the treble dispersion of the 904 system is very good so the tonal quality changes little as the listener moves off axis from the tweeter. The stereo image is quite stable too, indicating that both the treble and midrange have little in the way of nasty peaks or troughs. Altogether they give an eminently satisfactory performance.

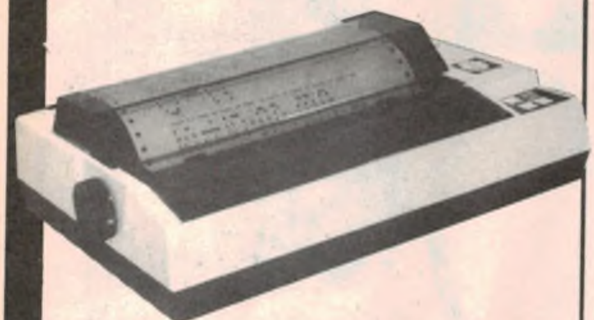
In short, the 904's must get high marks. They have quite a few good design features, some of which are not found on any competing designs. We would be quite happy to have a pair in our laboratory.

Recommended retail price for a pair of Jamo 904 systems is $795. If stands are purchased with the speakers, the cost is $60 per pair. Further information may be obtained from the Australian distributors for Jamo, Scan Audio Pty Ltd, PO Box 242, Hawthorn, Victoria. Phone (03) 819 5352. (L.D.S.)

AT LAST!

A SENSIBLE ALTERNATIVE TO THOSE FAR-AWAY MAIL ORDER SUPPLIERS! CALL INTO OUR COMPUTER CENTRE FOR A DEMONSTRATION BEFORE YOU BUY. ALL ADVERTISED ITEMS NOW IN STOCK!

EAGLE ELECTRONICS INTRODUCES

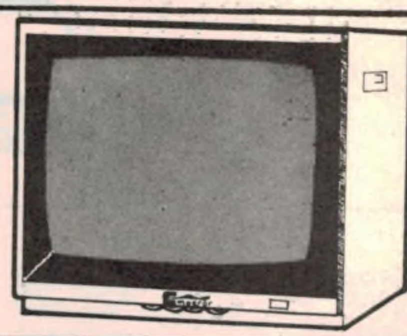


CP-80/I PRINTER

Ask us for a demo of this very popular printer — you'll be surprised by its advanced features and low cost. Interfaces to all popular computers like APPLE and IBM with Centronics interface — RS232 interface also available.

only $495

"EMPORER" 12" AMBER MONITOR



Finally! a full size AMBER monitor for under $200! Forget that eye strain from staring at a tiny green screen.

Features:—

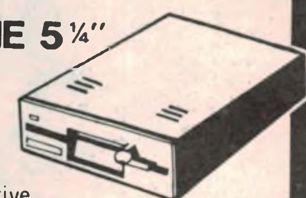
- 10-20MHZ bandwidth
- Low cost, high quality
- Light, compact and easy to carry
- Low power consumption
- High resolution
- Suitable for all popular computers

UNBEATABLE VALUE AT

at only $199

APPLE II PERIPHERALS

SLIMLINE 5¼" DISC DRIVE



- Direct Drive TEAC mechanism.
- Metal Band positioner.
- 13 or 16 sector.
- 40 tracks — density 48 TPI.
- Track to track — less than 6ms.

only $379

Z80 (CP/M) Card	$59
RS-232 Card	$63
Printer Card (with cable)	$69
Disc Controller	$54
80 Column Card	$89
Joystick	$19

ALL PRICES INCLUDE SALES TAX

CONDOR

At last it's here! — the CONDOR is fully compatible with the IBM-PC at a fraction of the price — check out the features of this fully-configured business system!

- 16 bit 8088 processor running at 4.77 MHz.
- 128K RAM — expandable on-board to 256K.
- Twin Panasonic 320KB disc drives (640KB total).
- 1 x RS232 serial communication part.
- Real-time clock with battery backup.
- Fully detachable slim-line keyboard with 95 keys including 8 separate cursor control keys.
- Centronics parallel interface.
- Graphics — 320 x 200 color, or 640 x 200 b/w.
- Monitor — capable of driving RGB, color or b/w monitors.
- Comprehensive user manual.

IBM PC compatible hardware and software

CONDOR uses the superb MS-DOS 2.0 operating system and will run the countless packages designed to run under MS-DOS such as Lotus 1-2-3, Multiplan, Wordstar, Visicalc, DBASE II, CopyIIPC etc. CONDOR will also run CP/M-86 and associated software. Software supplied with CONDOR includes MS-DOS 2.0 (licenced by Microsoft Corp.).

LIMITED STOCK!

$3490

Eagle

Eagle Electronics Computer Centre
83 Princes Hwy., St.Peters. (cnr. Short St.)
P.O. BOX 350, SUTHERLAND, N.S.W. 2232, AUSTRALIA. TELEPHONE: (02) 516 4540

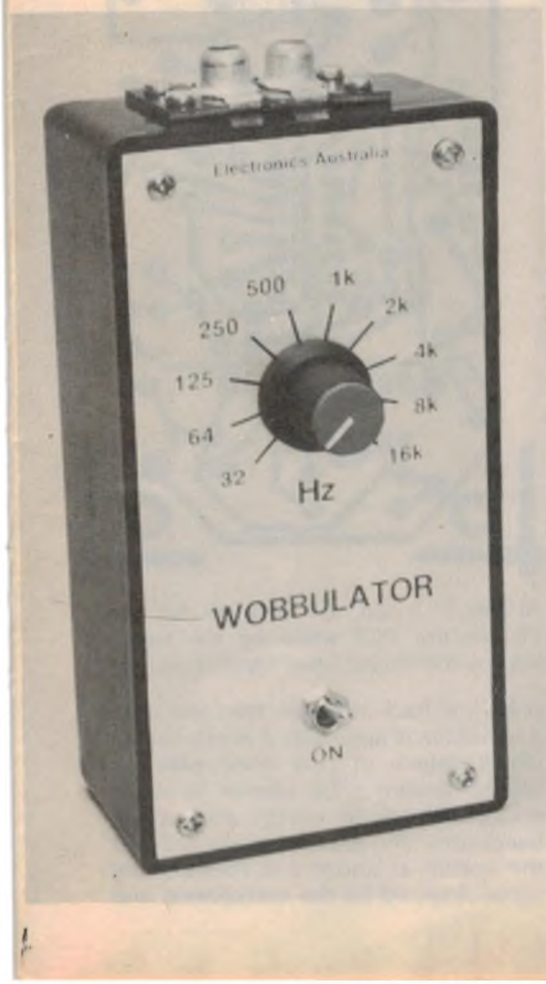
Tune up your hifi system with a

Wobbulator and Sound Level Meter

Many people own a graphic equaliser as part of their hifi system. With this simple project, you can analyse your room acoustics and correctly adjust the equaliser to get rid of those nasty peaks and troughs in the frequency response.

By JOHN CLARKE & GREG SWAIN

With the trend towards the purchase of complete hifi systems these days, many enthusiasts now regard a graphic equaliser as standard equipment. Certainly a graphic equaliser can look impressive, with a row of 20 or more vertical slider controls – just the thing to impress the uninitiated.



In many cases, though, they serve as little more than a "knob-twiddler's" delight. The inveterate fiddler can play to his heart's content, pushing the knobs up and down to obtain all sorts of weird and wonderful sounds. You can accentuate the highs, boost the lows, fiddle the middles and so on. But once the novelty has worn off, the equaliser is likely to be switched out of circuit altogether or used simply as a glorified tone control.

That's a shame (and a waste of money), since a graphic equaliser is a useful tool that can give real improvements to the sound quality of your hifi system. But there is a catch: an equaliser is not easy to use unless you have another instrument called an analyser. The two instruments go together and allow you to adjust the response of your hifi system to cancel out the peaks and dips in the frequency response of typical loudspeakers and in the response of the listening room itself.

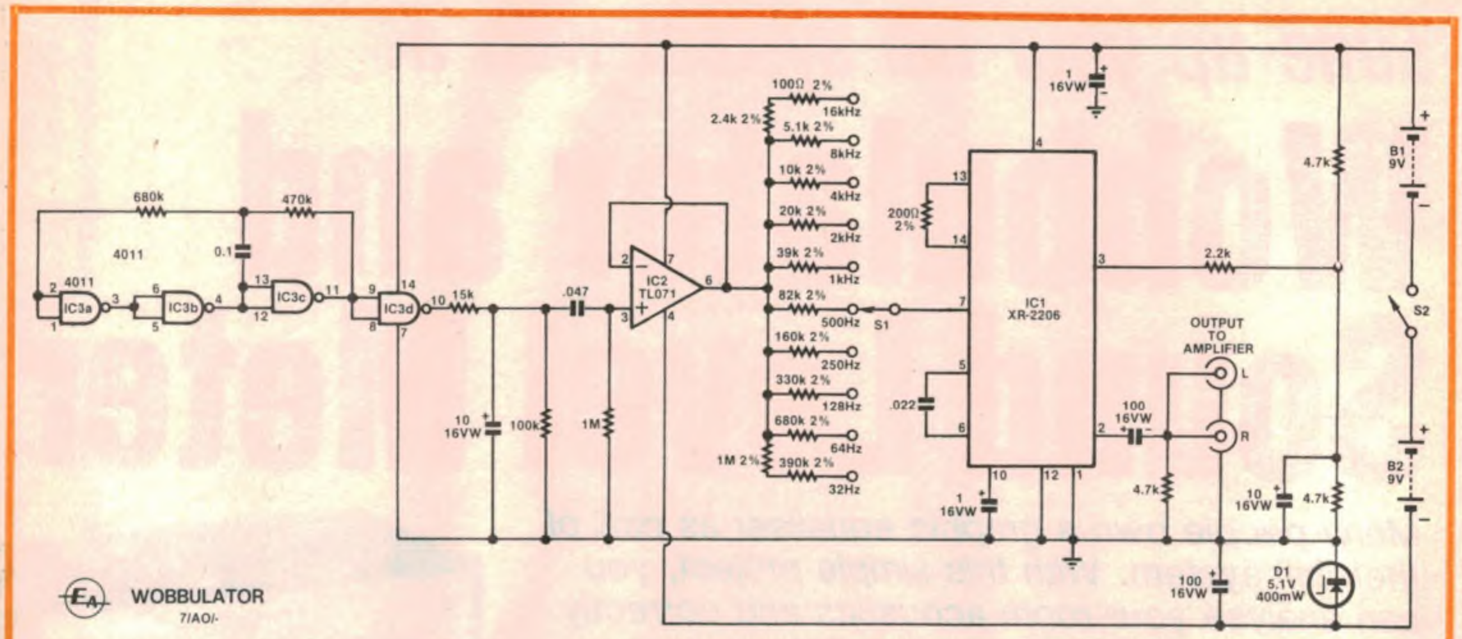
By way of explanation, loudspeakers are definitely the weak link in the hifi chain and even good quality units have peaks and dips in their frequency response. On a larger scale, interaction between the loudspeakers and the listening room can also significantly modify the response of the signal reaching our ears. It is these effects that the graphic equaliser is designed to correct.

In practice, it is not possible to eliminate the peaks and dips completely although, properly used, a graphic equaliser can effect a considerable improvement.

Equalisers explained

Before we explain how an equaliser and an analyser are used together, let's take a closer look at the equaliser itself. Most stereo graphic equalisers divide the audible spectrum into octaves and are thus often called octave equalisers. An octave is a band of frequencies in which the highest frequency is twice that of the lowest. For example, an octave may cover the range from 750Hz to 1.5kHz or from 3kHz to 6kHz.

Each slider control is used to provide around 15dB cut or boost over a



The Wobbulator consists of an XR-2206 function generator which is modulated by a CMOS oscillator.

Wobbulator and Sound Level Meter

particular octave and the equaliser will have enough sliders to cover the whole audible frequency range from 20Hz to 20kHz. This means that there are usually 10 sliders for each channel, each labelled with the respective centre frequency for its octave as follows: 32Hz, 64Hz, 125Hz, 250Hz, 500Hz, 1kHz, 2kHz, 4kHz, 8kHz and 16kHz.

Note that the interval between any two centre frequencies is also an octave (or very close to it). As an economy measure, some octave equalisers cut out one or two sliders and stretch the range of each octave a bit, but the principle remains the same. By suitably adjusting each slider, we can impose a correction "curve" on the input signal to produce an "equalised" system that corrects for the peaks and dips in the loudspeaker and room response.

The trouble with using a graphic equaliser is that nobody has sufficiently well calibrated ears to tell what is wrong with the system and the listening room. After those first few tentative alterations, even the most acute listener is bound to become totally confused, a fact that every enthusiast is usually blissfully unaware of at the time of purchase. No wonder that many people simply press the bypass button to switch the equaliser out of circuit!

Octave analyser

To avoid this confusion you must use an octave analyser. This is an instrument which consists of an in-built noise source, a microphone pick-up, and a level meter or bar graph display. Not surprisingly, the analyser breaks the audio spectrum into the same octave bands as the equaliser, although there are different ways of doing this.

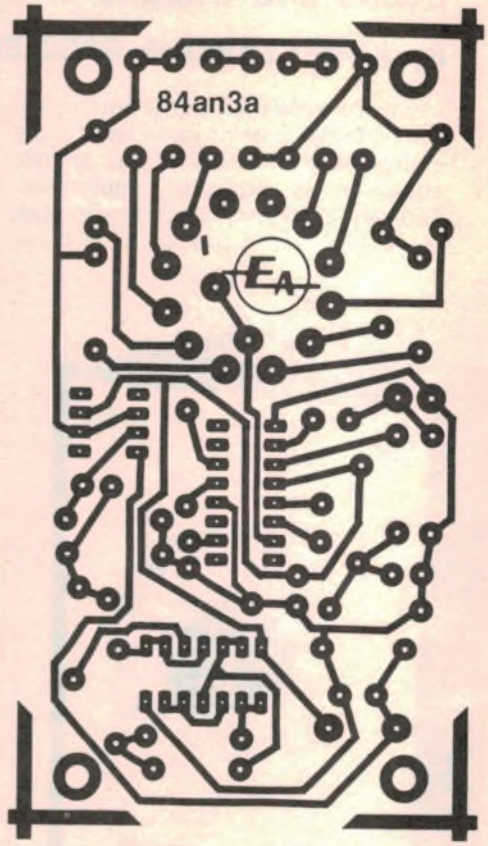
What happens is that the noise source is fed through the equaliser, amplifier, and loudspeakers of the hifi system. The resulting signal is then monitored by the microphone, suitably processed, and fed to the display which shows the signal level. Because each octave is displayed separately, the user is now able to manipulate the equaliser controls to bring each band to the same level.

It really is as simple as that. You display and adjust each octave in turn until the worst deficiencies have been eliminated. There's no more guesswork, no more confusion and no more frustration. At last you can use your graphic equaliser in the role for which it was originally designed.

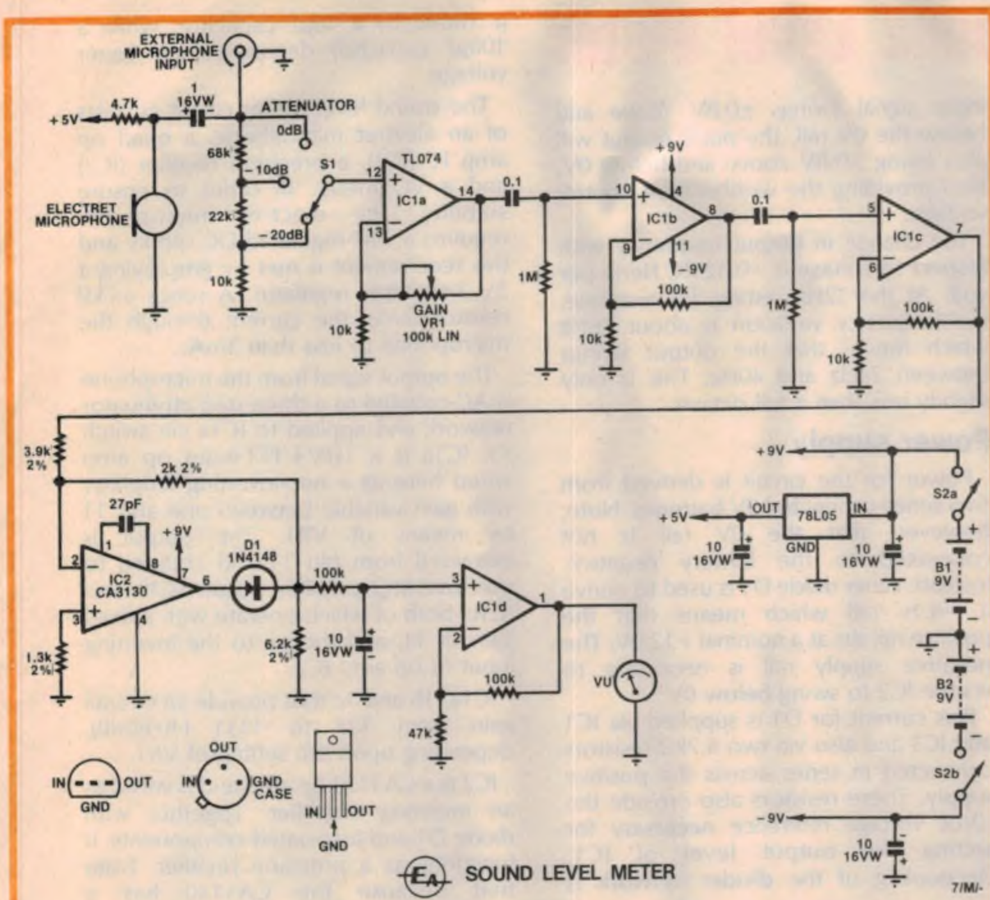
The whole process takes about two minutes and can produce quite startling improvements in sound quality. As with all things though, you don't get something for nothing. An equaliser/analyser cannot turn a poor loudspeaker into a good one. You have to start with good quality equipment.

Once properly set up, the equaliser should not be altered unless there is a major change in the system. Further adjustments to the program quality are best made using the normal tone controls to emphasise or cut the highs and lows as required.

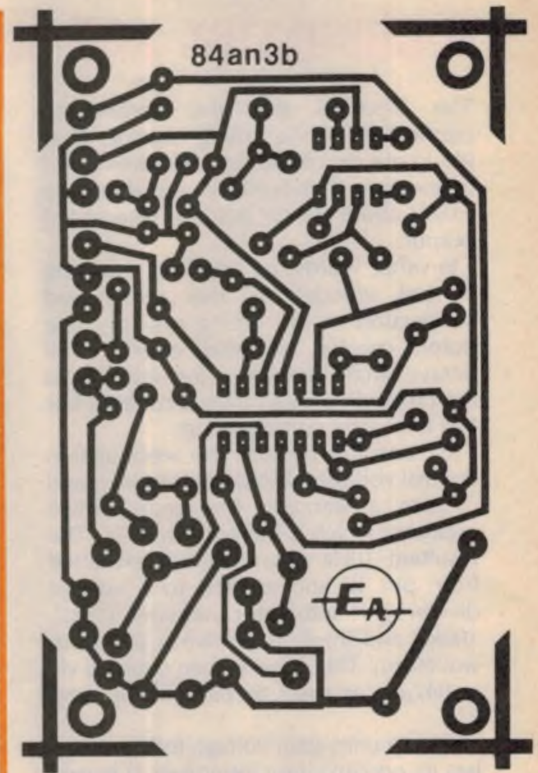
Several approaches can be employed in implementing a practical analyser system. Our last graphic analyser was published back in March 1981 and used a rather novel approach. It employed an inbuilt source of pink noise which is simply random noise (similar to white noise) with equal energy per octave bandwidth. The pink noise was fed into the system as above and the resulting signal detected by the microphone and



Above is actual size artwork for the Wobbulator PCB while on the facing page is the Sound Level Meter PCB.



The Sound Level Meter. Signals from the microphone are amplified, fed to a precision rectifier (IC2), and applied to a VU meter.



Cost Estimate

We estimate that parts will cost approximately $27 for the Wobbulator and $37 for the Sound Level Meter. These figures include sales tax.

fed to ten octave band filters.

Up to that point, the circuitry was perfectly conventional. It was the method of display that we thought rather clever. The outputs of the ten octave filters were processed and fed to a colour TV receiver to produce a histogram bar-graph display, the height of each bar corresponding to the signal level for a particular octave. All the user had to do was adjust the equaliser controls until the bar graphs were all of equal height.

We were rather proud of the instrument, the more so since the on-screen display concept was a world first as a magazine construction article.

By comparison, our latest design employs far simpler circuitry and should set you back no more than about $65 all up.

The approach used here is quite different. Instead of a pink noise source, the new design employs a wobbulator signal source (or frequency modulated oscillator) and a sound level meter. The wobbulator and sound level meter circuits are housed in separate cases, the two units together forming a complete low-cost equalisation analyser system.

In greater detail, the wobbulator is a switched sinewave oscillator with ten nominal output frequencies centred on the various octave bands; viz 32Hz, 64Hz, 128Hz etc. As well as being switchable, the oscillator frequency is continuously swept over the selected octave band using a 10Hz modulation waveform. The output level is around 100mV RMS, making it suitable for direct connection to the auxiliary inputs of a stereo amplifier (the equaliser is in the tape loop).

The sound level meter is used to measure the resulting response at the listening position. It uses an electret microphone pickup, the output of which is amplified and fed to a precision rectifier, and thence to a VU meter. Thus by switching the wobbulator to each octave band in turn and checking the response on the sound level meter, the user can quickly adjust the equaliser controls to give the requisite flat frequency response.

Wobbulator circuit

The wobbulator circuit can be divided into three sections: an XR-2206 function generator IC (IC1), a buffer stage (IC2), and a CMOS oscillator (IC3) which provides the wobbulation control signal.

Heart of the circuit is the XR-2206 IC. This is a monolithic function generator capable of producing high quality sine, triangle, ramp and pulse waveforms over the range .01Hz to more than 1MHz. It comes as a 16-pin DIL package which contains a voltage controlled oscillator (VCO), a multiplier and sine shaper circuit, and current switches which control the VCO frequency.

The VCO produces a triangle waveform and this can be converted to a sinewave by connecting an external pulse shaping resistor between pins 13 and 14. Our circuit uses a fixed 200Ω pulse shaping resistor which gives a sinewave output with sufficiently low distortion (about 2.5%) for the job. The output level is set to around 100mV by the 2.2kΩ resistor between pin 3 and ½Vcc (half supply).

The frequency of oscillation, fo, is generally determined by the external timing capacitor C across pins 5 and 6, and by the external timing resistor R connected to pin 7. For our purposes, the requisite frequency range can be achieved using a fixed .022μF timing capacitor. Switch S1 selects one of ten timing resistor positions to give the required octave centre frequency.

For those interested in the maths, the output frequency is simply fo = 1/RC.

Wobbulator and Sound Level Meter

This assumes that the commoned connection of the timing resistors is at 0V. In our circuit though, the commoned connection is moved up and down by ±0.8V about the 0V point to give an FM output.

In other words, by applying a varying control voltage to the commoned connection of the timing resistors, the output can be "wobbled" over the full octave range. In practice, just slightly less than the full octave range is covered but this is of little consequence.

IC2 and IC3 provide the wobbulation control voltage. NAND gates IC3a, b and c form a standard three-gate CMOS oscillator which is buffered by IC3d. The resultant 10Hz squarewave is extracted from pin 10 and applied to a voltage divider and integrator network (15kΩ, 100kΩ and 10µF) to derive a sawtooth waveform. This signal is then coupled via a .047µF capacitor to pin 3 of op amp IC2.

IC2 is a unity gain voltage follower and has its non-inverting input (pin 3) biased to 0V via a 1MΩ resistor. In this configuration it has a high input impedance, thus minimising loading on the sawtooth input waveform. Since the input signal swings ±0.8V above and below the 0V rail, the pin 6 output will also swing ±0.8V above and below 0V, thus providing the wobbulation control voltage.

The change in output frequency with respect to voltage is −0.32/RC Hertz per volt. At the 32Hz setting, for example, the frequency variation is about 16Hz which means that the output swings between 24Hz and 40Hz. This is only slightly less than a full octave.

Power supply

Power for the circuit is derived from two series-connected 9V batteries. Note, however, that the 0V rail is not connected to the battery negative. Instead, zener diode D1 is used to derive a −5.1v rail which means that the positive rail sits at a nominal +12.9V. The negative supply rail is necessary to enable IC2 to swing below 0V.

Bias current for D1 is supplied via IC1 and IC3 and also via two 4.7kΩ resistors connected in series across the positive supply. These resistors also provide the ½Vcc voltage reference necessary for setting the output level of IC1. Decoupling of the divider network is provided by a 10µF capacitor, while a 100µF capacitor decouples the zener voltage.

The sound level meter circuit consists of an electret microphone, a quad op amp IC (IC1), a precision rectifier (IC2) and a VU meter. In order to ensure stability, the electret microphone requires a well-regulated DC supply and this requirement is met by employing a 5V 3-terminal regulator. A series 4.7kΩ resistor limits the current through the microphone to less than 1mA.

The output signal from the microphone is AC-coupled to a three-step attenuator network and applied to IC1a via switch S1. IC1a is a TL074 FET-input op amp wired here as a non-inverting amplifier with gain variable between one and 11 by means of VR1. The output is extracted from pin 14 and coupled to non-inverting amplifier stages IC1b and IC1c, both of which operate with a fixed gain of 11, and thence to the inverting input of op amp IC2.

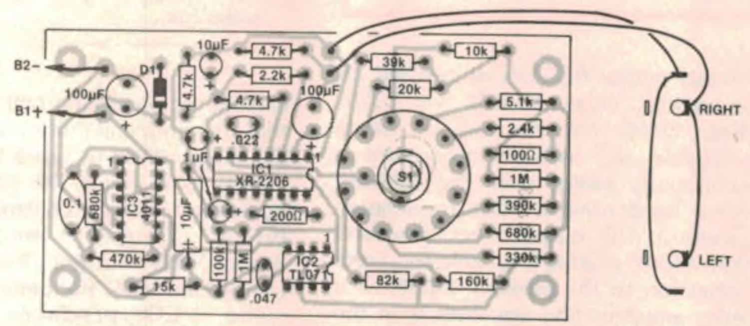
IC1a, 1b and 1c thus provide an overall gain from 121 to 1331 (40-60dB), depending upon the setting of VR1.

IC2 is a CA3130 op amp and is wired as an inverting amplifier. Together with diode D1 and associated components, it functions as a precision rectifier. Note that because the CA3130 has a maximum supply rating of 16V, IC2 is operated from half supply. This has no effect on circuit operation.

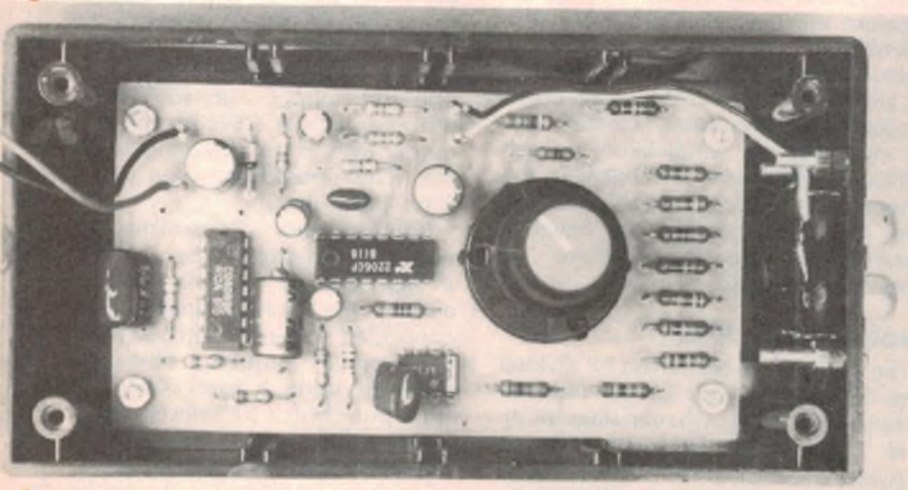
The precision rectifier works like this: when the input swings negative, pin 6 of IC2 swings positive and forward biases D1. The output signal thus appears at D1's cathode and, because the diode is in the feedback loop of the op amp, diode non-linearities are considerably reduced. The gain of the stage is determined by the ratio of the 2kΩ and 3.9kΩ resistors; thus gain = 2kΩ/3.9kΩ = 0.5128.

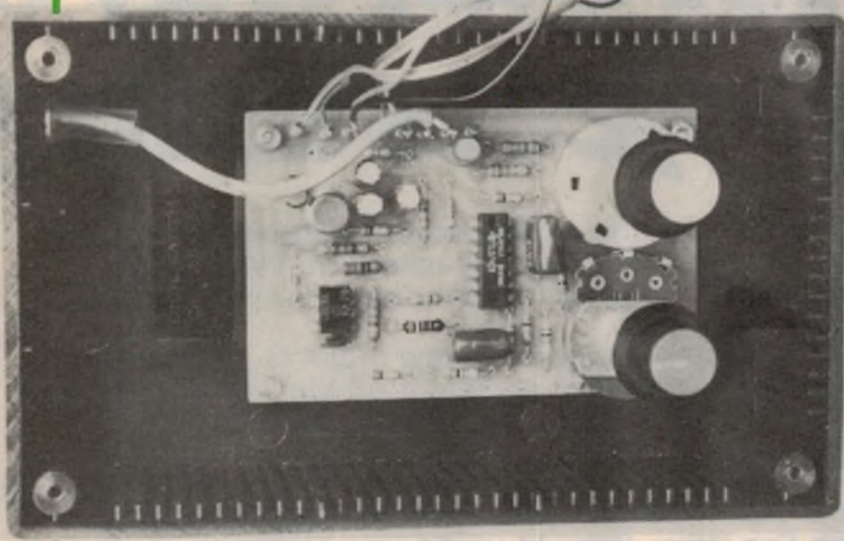
When the input subsequently swings positive, pin 6 of IC2 swings to 0V and diode D1 is reverse biased. This means that the output of op amp is effectively disconnected from the signal output. The circuit now behaves as a simple potential divider which reduces the input signal by 6.2kΩ/(6.2kΩ + 2kΩ + 3.9kΩ) or 0.5124.

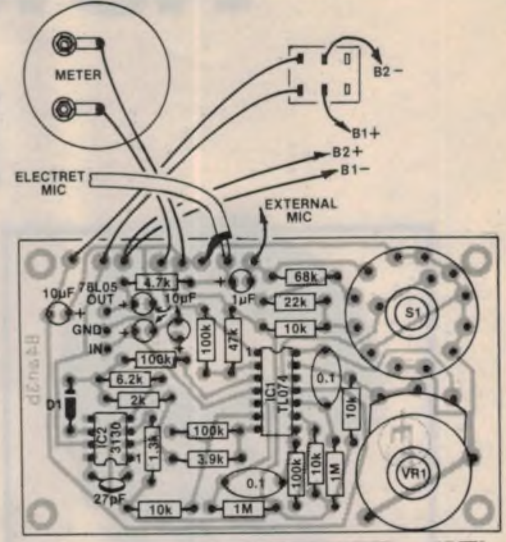
So IC2 operates as a full-wave rectifier that attenuates both positive and negative swings of the input signal by about 0.5, and produces a positive output signal. This signal is filtered to provide a steady DC level and applied to non-inverting amplifier IC1d. IC1d operates with a gain of three and directly drives the VU meter which displays the relative signal level. Note that the circuit does not depend on, or provide for, the ballistics or other specified parameters of the VU meter. We have specified a



Above & below: parts layout and general view of the Wobbulator PCB.







Switch S1 and gain control pot VR1 are mounted directly on the Sound Level Meter PCB (see text).

VU meter merely to provide the dB scale.

Power for the circuit is derived from two 9V batteries, with on/off switching provided by double-pole switch S2. Two 10μF capacitors decouple the resulting ±9v supply rails, while a third 10μF capacitor decouples the output of the 78L05 3-terminal regulator.

Finally, the circuit diagram shows an external microphone input. Generally speaking, an electret microphone has quite adequate specifications for the job although the response of the circuit can be improved by substituting a high quality microphone. If an external microphone is to be used, the electret microphone and 5V regulator circuit should be deleted.

Construction

Construction is straightforward with both circuits built on PCBs and housed in plastic zippy cases. The Wobbulator PCB is coded 84an3a and measures 55 x 103mm, while the Sound Level Meter PCB is coded 84an3b and measures 58 x 94mm.

Begin construction by assembling the two PCBs, taking care to ensure that all polarised parts are correctly oriented. It's not necessary to follow any strict sequence, although it's best to mount the resistors first, followed by the capacitors and the semiconductors. Note that the 4011 IC is a CMOS device, so solder its supply pins (7 and 14) first to enable the internal static protection diodes.

The use of PC stakes at all external wiring points is recommended as they greatly simplify the job of wiring. You will need 14 PC stakes in all, four for the Wobbulator and 10 for the Sound Level Meter.

PARTS LIST

Wobbulator

1 PCB, code 84an3a, 36 x 103mm
1 Scotchcal front panel, 63 x 121
1 plastic utility case, 130 x 68 x 41mm
2 9V batteries (Eveready 216)
2 battery clips to suit
1 single pole, 10-position rotary switch
1 knob to suit
1 SPDT toggle switch
1 2-way RCA socket panel
4 6mm spacers

SEMICONDUCTORS
1 XR-2206 monolithic function generator IC
1 TL071, LF351, CA3140, op amp
1 4011 quad 2-input NAND gate
1 5.1V 400mW zener diode

CAPACITORS
2 100μF/16VW PC electrolytic
1 10μF/16VW PC electrolytic
1 10μF/16VW pigtail electrolytic
2 1μF/16VW PC electrolytic
1 0.1μF metallised polyester
1 .047μF metallised polyester
1 .022μF metallised polyester

RESISTORS (¼W, 5%)
1 x 1MΩ, 1 x 680kΩ, 1 x 470kΩ, 1 x 100kΩ, 1 x 15kΩ, 3 x 4.7kΩ, 1 x 2.2kΩ

RESISTORS (¼W, 2%)
1 x 1MΩ, 1 x 680kΩ, 1 x 390kΩ, 1 x 330kΩ, 1 x 160kΩ, 1 x 82kΩ, 1 x 39kΩ, 1 x 20kΩ, 1 x 10kΩ, 1 x 5.1kΩ, 1 x 2.4kΩ, 1 x 200Ω, 1 x 100Ω

Sound Level Meter

1 PCB, code 84an3b, 58 x 94mm
1 Scotchcal front panel, 92 x 155mm
1 plastic utility case, 158 x 95 x 51mm
2 9V batteries (Eveready 216)
2 battery clips to suit
1 University TD-48 VU meter
1 single pole, 3-position rotary switch
1 DPDT toggle switch
1 100kΩ linear potentiometer
1 electret microphone
2 knobs to suit
4 6mm standoffs
1 rubber grommet (9mm bore)
10 PC stakes
1 120mm length of 9mm dia. aluminium tubing
1 140mm length of 10mm inside dia. heatshrink tubing
1 200mm length of shielded cable

SEMICONDUCTORS
1 TL074, LF347 quad op amp
1 CA3130 op amp
1 78L05, 7805 5V 3-terminal regulator
1 1N4148 diode

CAPACITORS
4 10μF/16VW PC electrolytic
1 1μF/16VW PC electrolytic
2 0.1μF metallised polyester
1 27pF ceramic

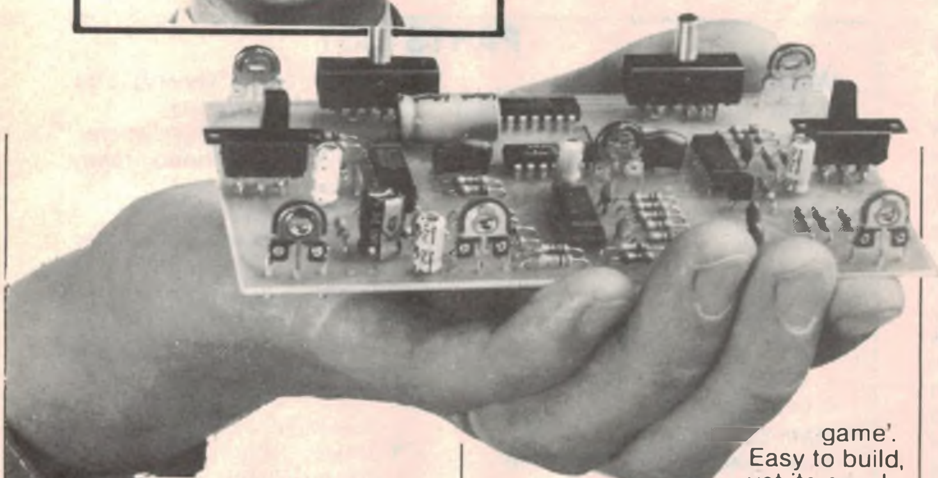
RESISTORS (¼W, 5%)
2 x 1MΩ, 4 x 100kΩ, 1 x 68kΩ, 1 x 47kΩ, 1 x 22kΩ, 4 x 10kΩ, 1 x 4.7kΩ

RESISTORS (¼W, 2%)
1 x 6.2kΩ, 1 x 3.9kΩ, 1 x 2kΩ, 1 x 1.3kΩ

MISCELLANEOUS
Machine screws and nuts, rainbow cable, solder etc.

"Now for Fun Way 3 projects using

"Here it is – the one everyone's been asking us for! A completely new volume of Fun Way into Electronics, leading on from the incredibly successful Volumes 1 & 2.
This one has 10 exciting new projects, all based on integrated circuits – making it an ideal choice for anyone who's worked their way through the introductory books and kits.
Join the many thousands of hobbyists, school students and club members who have learned Electronics the Fun Way. It could lead to an exciting new career!"



1 LIGHT AND SOUND

Not just one project, but many! You can use it to produce all sorts of sound effects, to flash lights, as a strobe, as a continuity tester, even a Morse Code practice set.
Simple and easy to build, too.
Cat K-2665

$8.95

2 TWO UP

Put yourself in the winner's circle with this space-age electronic version of Australia's 'national game'. Easy to build, yet its novel design gives realistic 'flick of the wrist' operation.
Cat K-2661

$9.95

3 CRICKET

Put this project in a quiet, dark place, and it starts chirping; turn on the light or make a noise, and it stops! Infuriating – just like a real Nocturnalis Stridulus Gryllidae (Cricket to you). Cat K-2663

$9.95

4 MINI STEREO AMPLIFIER

Just the shot for turning your headphones-type 'Walkie' stereo or FM radio into a full speaker system for your bedroom! Or you can use it as an amplifier for a loudhailer or mini PA system.
Cat K-2667

$14.95

5 MINDER

Another one that's really many projects in one – this time for the car or boat. A 'lights on' or 'door not shut' warning, or a burglar deterrent flasher.
It's almost as good as a real alarm!
Cat K-2660

$7.95

* Note the boxes shown are not supplied in the basic kits. The front panels are in the Fun Way 3 book.

– ten exciting new Integrated Circuits!"

6 MINI COLOUR ORGAN

Just like the light show at the local disco. Connects to your radio or cassette recorder, adds an extra dimension to your musical entertainment. Easy to build and can be battery operated, so it's safe. Cat K-2664

$12.95

7 COMBINATION TIME LOCK SWITCH

Use it as a combination lock for a burglar alarm, or as a challenging 'brain teaser' party game. Just try cracking the combination without setting off the alarm! It's really good.
Cat K-2666

$12.95

8 LI'L POKEY

Just like the one-arm bandits at the club! A barrel of fun to play, but you won't risk losing your shirt or your pocket money. A satisfying project – your friends will be most impressed!
Cat K-2662

$19.95

9 BINARY BINGO

A lot harder to play than it looks – just try it and see! Tests your reaction time, also helps you learn binary numbers. Four levels of skill. Easy to build, battery operated for safety.
Cat K-2668

$19.95

10 MINI SYNTH

Incredible – a real music synthesiser, with decay, frequency doubling and halving, tremolo Its really unique feature is that YOU become the note generator! Whistle, hum or sing and see what interesting effects you produce!
Cat K-2669

$19.95

• Please note: all projects shown with optional cases. The labels shown are all printed in the Fun Way 3 book.

And the book . . .
Dick Smith's Fun Way Into Electronics, Volume 3: over 100 pages with easy-to-follow instructions for all these projects, plus handy information every hobbyist needs. Cat B-2610

ONLY $6.95

DICK SMITH Electronics

See page 107 for full address details.

EXCLUSIVE TO DICK SMITH
HURRY . . . FIRST PRINTING ALMOST SOLD OUT!

A682/LL

Wobbulator and Sound Level Meter

The two rotary switches are soldered directly to the PCBs while the gain control potentiometer is mounted flat against the Sound Level Meter PCB and supported by two PC stakes soldered to the pot body. It will be necessary to clean the solder points on the pot before soldering in order to avoid dry joints. Connections between the pot terminals and the PCB are run using short lengths of tinned copper wire.

With the PCB assemblies completed, the Scotchcal labels can be affixed to the lids of the cases and used as drilling templates for the front panel hardware. You will also have to mark out and drill mounting holes for the VU meter, the PCBs, and the RCA socket panel. This done, the PCBs can be mounted on 6mm spacers and the internal wiring completed.

The electret microphone is mounted on the end of a 120mm x 9mm dia. aluminium tube so that it will be clear of any surfaces that may cause unwanted reflections. To make up the assembly, solder the microphone to a 200mm length of shielded cable, then butt the microphone and the tube together with the cable running down the centre of the tube. The microphone is now secured by fitting a 140mm length of plastic heatshrink sleeving over the microphone body and the full length of the tube.

This assembly can now be attached to the Sound Level Meter by pushing the tube into a mains cord grommet fitted to the top of the case.

The pot and switch shafts can now be trimmed to suitable lengths, the batteries connected, and the cases assembled. The batteries are isolated from the PCBs using foam insulation which also serves to secure the batteries when the lids are screwed down.

Using the analyser

Let's conclude by taking a look at how the two instruments are used together to analyse the response of your hifi system.

To begin with, it should be pointed out that each channel of the hifi system is analysed in turn. First, set the Wobbulator to 1kHz and connect it to the auxiliary inputs of the stereo amplifier using a stereo cable fitted at both ends with RCA plugs. Switch on and adjust the volume control for a comfortable level, then cut out one channel by rotating the balance control fully in one direction.

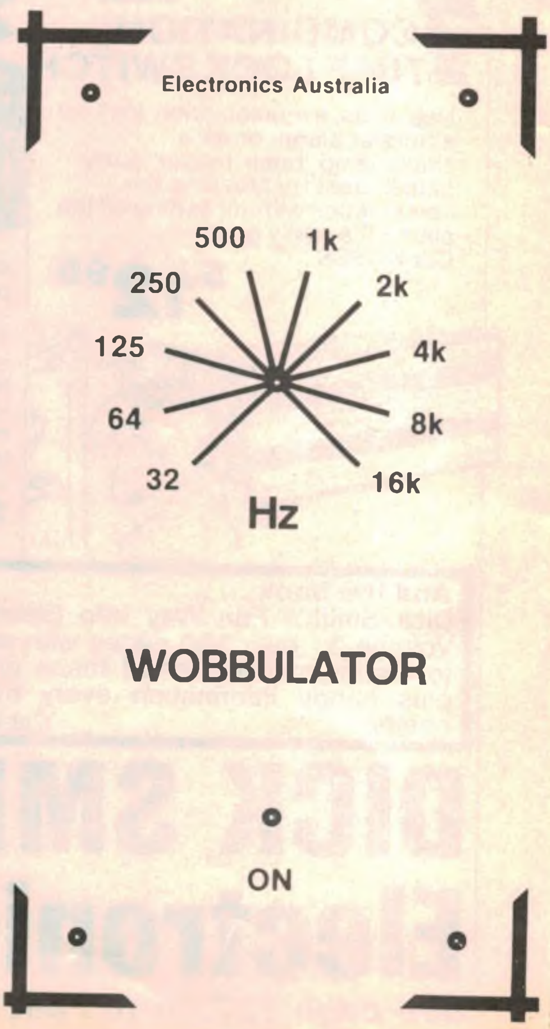
The slider controls on the equaliser should all be set initially to 0dB (ie, to the centre position) while the amplifier tone controls should be set flat or, where the facility exits, switched out of circuit.

Readings on the Sound Level Meter are made at the central listening position. Support the meter on a solid object at about head height and check that there are no obstructions between the microphone and the loudspeaker. The microphone should point to a spot about midway between the two loudspeakers.

The next step is to set the 0dB reference level. This is done simply by adjusting the gain and attenuator controls as appropriate until the meter reads 0dB. Having done that, you must not move the meter or adjust either control for the remainder of the equalisation procedure, otherwise you will have to start all over again.

You are now ready to commence equalisation. It's really quite easy. You simply switch the Wobbulator to each of the octave frequencies in turn and adjust the corresponding equaliser slider control until the meter reads 0dB (or as close to 0dB as possible). Since there is a degree of interaction between each control, it is a good idea to repeat the procedure a couple of times.

Once you are satisfied with the result, the balance control can be fully rotated



in the opposite direction and equalisation carried out on the other channel. Don't expect to achieve perfect equalisation, though. In practice, you will be doing well if you can equalise to better than ±6dB.

In some cases, it will be found that the equaliser does not have sufficient range to cope with the large peaks and dips that can occur at bass frequencies. In particular, placing a loudspeaker too close to a wall or in a corner position can lead to heavy emphasis in the 100Hz region.

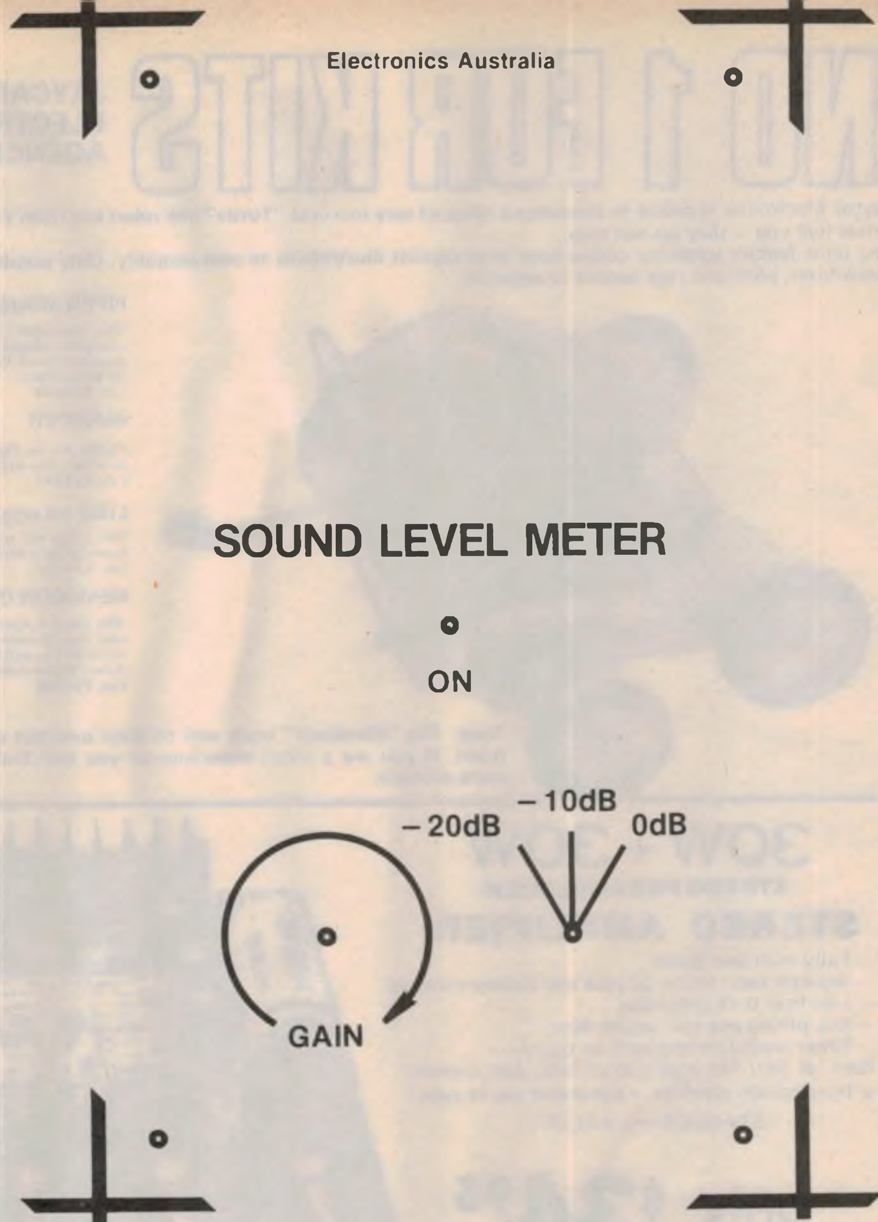
If this occurs, the correct thing to do is to try moving the loudspeaker away from the wall, or corner position, to reduce the worst peaks in the frequency response. Raising the loudspeaker can also help smooth the response by reducing floor reflections or absorption due to thick carpeting. Of course, if you do move the loudspeakers you will have to start the equalisation process all over again.

In fact, the trick is to use the equaliser as little as possible, since too much boost can rapidly push an amplifier or loudspeaker into overload. It is also important to avoid having all the controls either above or below the centre. If this occurs, alter the volume control on the amplifier and repeat the equalisation process for each channel.

One point that should be kept in mind is that an equaliser cannot be used to augment the designed-in frequency response of a loudspeaker by very much. Many small loudspeaker systems, for example, have a rapid rolloff below 100Hz. Applying large amounts of bass boost in these circumstances would only succeed in driving the loudspeaker into overload.

Finally, once you have finished equalisation, it's possible that you will find the sound too bright. That's because in a typical concert hall the treble frequencies are naturally attenuated by absorption by the walls, seating, audience, etc. Thus, it's common practice to equalise a system to approximate a typical auditorium by adjusting for a 3dB/octave rolloff above 2kHz.

This slight treble rolloff will result in a response that is about 6dB down at 10kHz and is the response that you've learned to recognise as flat. However, the degree of high end rolloff is your own decision and may even be influenced by the type of music you wish to hear.



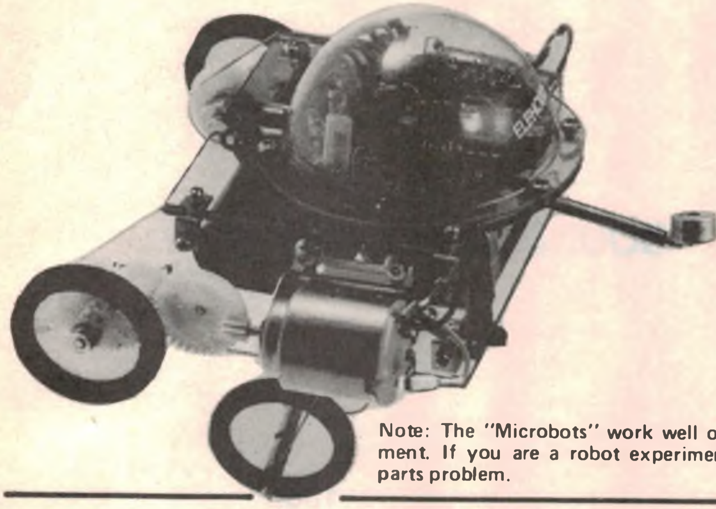
Above is the front panel artwork for the Sound Level Meter while the Wobbulator front panel artwork is shown on the facing page.

NO 1 FOR KITS

JAYCAR/
ELECTRONIC
AGENCIES

FROM $39.95

Jaycar Electronics is proud to announce a range of very low cost "Turtle" like robot kits. Don't let the low prices fool you — they are not toys.
The units feature solderless connections with explicit illustrations to ease assembly. Only simple tools (i.e. screwdriver, pliers etc.) are needed to assemble.



PIPER MOUSE

This "microbot" is powered by 2 DC motors that drive wheels. When a special ultrasonic whistle is blown, the unit goes left, right, straight ahead according to your command. Complete, including perspex dome cover!
Be a Pied Piper!
Cat. KJ-6680 ONLY $39.95

AVOIDER (not illustrated)

Similar to the Piper Mouse, but this unit travels on its own. It avoids objects because it has an infra-red beam system. Very clever!
Cat. KJ-6682 $44.95

LINE TRACER (not illustrated)

This robot will automatically follow a black line drawn onto a sheet of paper. It uses an infra-red feed back system.
Cat. KJ-6684 $39.95

MEMOCON CRAWLER (not illustrated)

This robot is controlled by a keyboard which is supplied. The operation of the unit is programmed by the keyboard and stored in RAM. All movements can be controlled as well by lights (beams) and sound (buzzer).
A very sophisticated unit.
Cat. KJ-6686 $79.95

Note: The "Microbots" work well on their own but can also be used as a platform for robotic development. If you are a robot experimenter you will find them useful as they help resolve the mechanical parts problem.

30W + 30W

STEREO PREAMPLIFIER

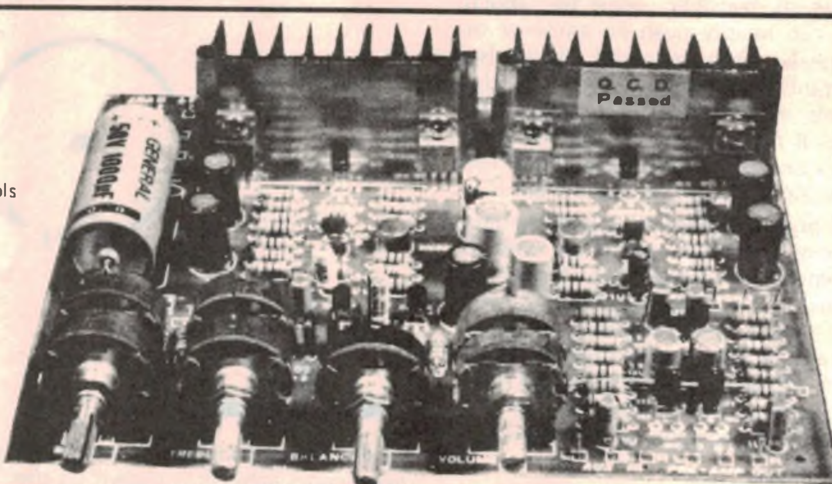
STEREO AMPLIFIER

- Fully built and tested
- Separate bass, treble, balance and volume controls
- Less than 0.1% distortion
- Mic, phono and aux. inputs (line)
- Power supply components on board

Back at last! No hassle amplifiers. Just connect a transformer, speakers a signal and you're away!

STAGGERING VALUE

only $34.95



minitune

Ref: EA June 1983

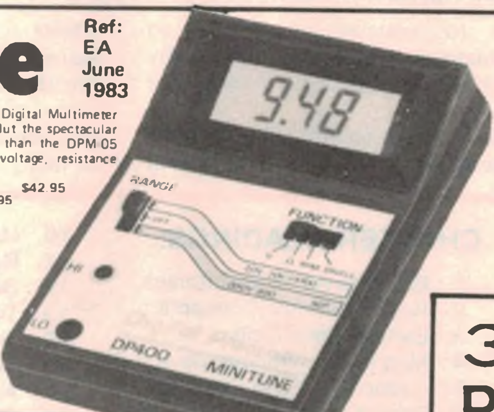
Following the spectacular success of the DP2010 Digital Multimeter kit, we now have an ENGINE ANALYSER KIT! But the spectacular thing is the price! It is ACTUALLY CHEAPER than the DPM 05 Display and Case!! The Minitune will measure voltage, resistance (down to a very low range), RPM and Dwell Angle.
Cat. KJ-7012 $42.95

TEST LEADS TO SUIT ONLY $2.95

Specification

Function	F.S.D.	Resolution	Accuracy
Voltage (d.c.)	20V	10mV	0.5% +1 digit
	200V	100mV	0.5% +1 digit
Resistance	200Ω	100mΩ	0.5% +1 digit
	20kΩ	10Ω	0.5% +1 digit
R.P.M.	20 000r.p.m.	10r.p.m.	1% +3 digits
Dwell	90	0.1	2% +3 digits

$42.95



NEW ETI JOYSTICK CONTROLLER

Ref: ETI Dec. '83

True proportional control with this kit. Includes recommended joystick unit.

ONLY $24.95

BBD EFFECTS BOX

Fantastic low cost instrument using the versatile MN3001 Bucket-Brigade Delay Line to achieve brilliant sonic effects. Now you can emulate the commercial rock groups with Phasing, Flanging' Reverb and Echo. The Jaycar kit includes all components INCLUDING IC sockets and the TU-04 box. (Not cut down but this is easily done). Jaycar has a specially built cabinet for this kit with all holes pre-punched etc., at only $10 extra but only if you buy the original kit from us. Available as a separate item for $29.50. WHEN THE KIT IS PURCHASED WITH THE DE LUXE CASE THE TU-04 CASE WILL NOT BE SUPPLIED.

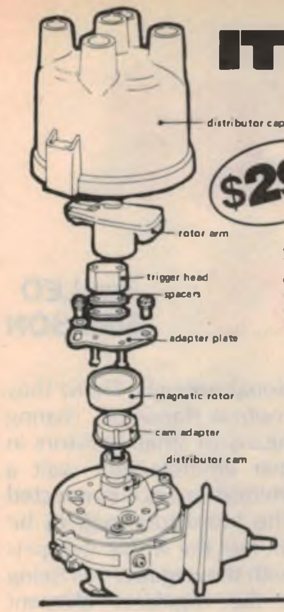
Special cabinet to suit Cat. HB-6445 $10
Complete Kit Cat. KE-1522 ONLY $79

3½ DIGITAL PANEL METER (not illustrated)

Low cost unit. Completely self-contained. No longer an expensive proposition! This easy-to-build kit (takes about 1 hour) is self-contained, compact and even comes with a front panel filter/bezel. It can be battery 6V or DC powered.
- 200mV. Full scale (+/− 199.9mV)
- Input impedance 10 to the twelvth ohms
- Required DC 5-6V @ 150mA
- Guaranteed to reset to zero at zero input voltage
- Automatic reverse polarity indication
- Assembly instructions include notes on using your DPM for: Amp-meter, AC-Voltmter, Anmeter, Thermometer, Frequency Counter, Capacitance Meter (circuits supplied)

STAGGERING VALUE
Cat. KJ-6670 $29.95

IT HAD TO HAPPEN



$29.95

With this kit and the interface electronics you can forget about contact breaker point problems!
Cat. KJ-6655 $29.95

New PCB for TAI Kit includes Hall Effect interface. Cat. HP-8786
ONLY $3.95

PLEASE NOTE
this system must be used in conjunction with an electronic ignition. The Hall Effect device will not switch enough current to replace the contact breaker points on their own!

A professionally engineered electronic ("breakerless") contact breaker system.
Yes, only Jaycar has a complete Hall effect triggerhead assembly designed to adapt to an extensive number of cars. Each kit contains the following:
- HALL EFFECT TRIGGER HEAD
- MAGNETIC ROTORS FOR BOTH 4 & 6 CYLINDER CARS
- OVER 6 CAM LOBE ADAPTORS
- OVER A DOZEN DIFFERENT ADAPTOR PLATES FOR YOUR PARTICULAR DISTRIBUTOR
- OTHER HARDWARE (i.e. SCREWS etc.)
- YOU CAN REMOVE THIS SYSTEM AND RE-EQUIP YOUR CAR WITH THE ORIGINAL BREAKER POINTS WHEN YOU SELL THE CAR!
- AS EASY TO INSTALL AS A SET OF POINTS!
- INSTRUCTIONS (SIMPLE-TO-FOLLOW) INCLUDED!

This set is designed to fit most European and Japanese cars. In fact it will also fit many Australian cars fitted with Lucas, Bosch, Motorcraft, AC Delco or Autolite electrics. If you wish to check first, please send SAE for car/distributor list.
Because we have no way of knowing, you get the fitting set for ALL of the distributors available. Basically you end up with a jar full of parts that you don't need to use! (Perhaps for your next car?)
Quite frankly, we are amazed that we can supply such a comprehensive kit for this price. To produce a kit that will adapt to the dozens of different distributors around is amazing!
Remember, once you have installed a breakerless system it will never wear out and that part of your system will remain in tune FOR EVER.
We expect this kit to sell well. To ensure that you receive one, check with us early!
Cat. KJ6655

Jaycar will not be knowingly undersold FOR GOODS OF THE SAME QUALITY. If you find that a competitor is cheaper, get all the facts and tell us! If you are right we will match OR LOWER his price!
Please understand that we cannot match the price of goods that are NOT the same quality as ours.

500MHz DFM

Ref: EA Dec '81 – Feb '82
Jaycar has by far the best kit version of this project in Australia. We now supply 2 x GOLD plated BNC input connectors at no extra cost!
KA-1390 (50MHz) $129
KA-1392 (500MHz option) $20

VIDEO ENHANCER

Ref: EA Oct 1983
Get improved performance from your VCR.
Cat. KE-7016 $35.00

$35

Breath Tester

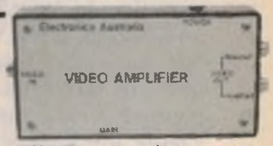
In all states and territories in Australia it is an offence to drive a vehicle with an alcohol/blood concentration above a certain limit. In most states it's 0.05 others 0.08. Either way it's only a relatively small number of alcoholic drinks.
Because it's only a small number of drinks, many people (quite wrongly) believe that they remain below the statutory limit.
The KA1522 Breath Tester can help here. A unit with the same circuit diagram was featured in May "Electronics Australia". It CANNOT give you an actual blood/alcohol content reading, however it can go close. And it can give you a relative reading between inebriated friends!!! Great at parties!!!
Grab the whole kit now for only $29.95. You never know, it may save your licence or your life!

ONLY $29.95

Video Amplifier/-Buffer

Ref: EA Aug 1983

The answer to a maidens prayer!
This device can be made to fit inside a TV set (or in a separate box if necessary). It basically enables you to connect straight into the video drive of your TV, turning it into a colour monitor. This means that the video signal from your computer, VCR, TV game etc., does not need to be converted to RF and go through the TV IF strip. You will be amazed by the clearer, sharper signal that has less interference! Notes on how to fit to various TV sets are included.
Cat. KA 1527 $14.95



Jiffy Box to suit
HB-6003 $2.20

INFRA RED DIMMER KIT

$25.95

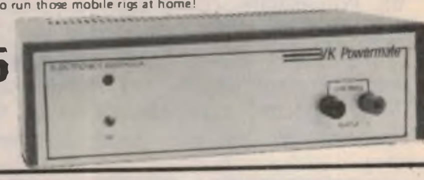
Ref: EA January 1984
Now you can dim or turn off the lights from the comfort of your armchair!
Short form kit contains all parts for I.R. kit. Note this must be used with a Jaycar KA-1509 Touch Sensitive Dimmer ($19.95)
Cat. KA-1530 $25.95

VK POWERMATE – NEW MODEL

$89.95 comp

Ref: EA Dec '82
Get up to 13.8V @ 10 amps to run those mobile rigs at home!
The Jaycar kit is complete.

$89.95



50V/5A laboratory power supply

Ref: EA May/June 1983
Cat. KE-1520
$149.00

ETI 644 DIRECT CONNECT MODEM

Two models (i) Short form which contains ALL PCB components as specified by ETI (BEWARE!!). The genuine ETI PCB with plated thru holes, solder mask and component overlay is supplied. We alos supply at NO EXTRA CHARGE a full set of quality IC sockets. A must with plated thru PCB's – Remember this when making comparisons (ii) Full kit. Includes: all of the above plus 12V plug-pack, case, front panel, switch and LED bezel and Cannon DB-25 RS-232 connector. Makes a complete stand alone modem.
* Capable of a range of Answer/Originate operating modes * Selectable Baud rate * Software controlled. * Uses new patented technique * More reliable and faster than most acoustic modems. Arlec transformer as used in this project only $22.00

Ref: ETI October 1982

"NEW UPGRADED MODEL FEATURING THE LATEST IMPROVEMENTS AND MODIFICATIONS"

SHORTFORM KIT
Cat. KE-4600
ONLY $169

COMPLETE KIT
Cat. KE-4601
ONLY $199

VIDEO SENSATION AT LAST
A Video Enhancer/ Distribution Amplifier designed EXCLUSIVELY for AUSTRALIA

NOT A KIT
BUILT, TESTED AND GUARANTEED

Jaycar has had designed a high quality, high performance Video Enhancer which is specifically for the Australian 625 line 50 frame PAL-D system.
As far as we know it is the ONLY Australian designed, Australian built unit available!!
But, guess what? The Jaycar AV6501 Enhancer is CHEAPER than its inferior imported Asian counterparts!!
This unit is professionally designed and University tested! It works and it works well.

$59.95

Jaycar

Incorporating ELECTRONIC AGENCIES

SHOWROOMS

SYDNEY
117 YORK STREET – PHONE: (02) 264 6688 and (02) 267 1614
TELEX: 72293
CARLINGFORD
Cnr CARLINGFORD & PENNANT HILLS ROAD – PHONE: (02) 872 4444
CONCORD
115 – 117 PARRAMATTA ROAD – PHONE: (02) 745 3077
HURSTVILLE 121 FOREST ROAD PHONE: (02) 570 7000

NUMBER 1 FOR KITS

POST AND PACKING CHARGES

$5 – $9.99 ($1.50)	$10 – $24.99 ($3.20)
$25 – $49.99 ($4.50)	$50 – $99.99 ($6.50)
$100 – $198 ($8.00)	Over $199 ($10)

"Free INSURANCE for Road & Registered Post over $200"
All heavy or bulky items (over 20kg.) sent Comet Road Freight $12.00 anywhere in Australia.
SHOP HOURS CARLINGFORD, CONCORD & HURSTVILLE
Mon – Fri 9am – 5.30pm; Sat – 9am – 12pm; Thurs night 8.30pm
SHOP HOURS SYDNEY
Mon – Fri 8.30am – 5.30pm. Sat – 8.30am – 12pm. Thurs night 8.30pm
MAIL ORDERS AND CORRESPONDENCE: P.O. Box 185, Concord, 2137

Mail Order By
BANKCARD
Via Your Phone

VK Powermaster – for high-power RF linears

by LEO SIMPSON

The VK Powermaster is the big brother of the VK Powermate we described in December 1983. The Powermaster can deliver 14 amps continuously or up to 25 amps on an intermittent basis to power RF linear amplifiers.

When we presented the upgraded VK Powermate design in December 1983 we were fully aware that some amateur users would want more in the way of a 13.8V supply. The VK Powermate would not run large linear amplifiers with a rating of 150 watts or more. So we were pleased to be approached by Garry Crapp, the R&D manager at Dick Smith Electronics, with a design for a bigger supply.

In reality, there is no reason why the VK Powermate could not have been upgraded to the same ratings as this Powermaster design. We could have used the same transformer, rectifier and filter capacitor complement as in the Powermaster and we would also have used four 2N3055 power transistors and a different over-voltage protection set-up. But doing all that would have required a completely new printed circuit board design. Hence the attraction of the Powermaster design.

The Powermaster design features instantaneous short-circuit protection which is attractive for a supply of this high rating. It is a completely discrete design with no integrated circuits being used. In itself this is of no particular moment but the alternative approach of the designer, Rex Callaghan, is an interesting one.

Design details

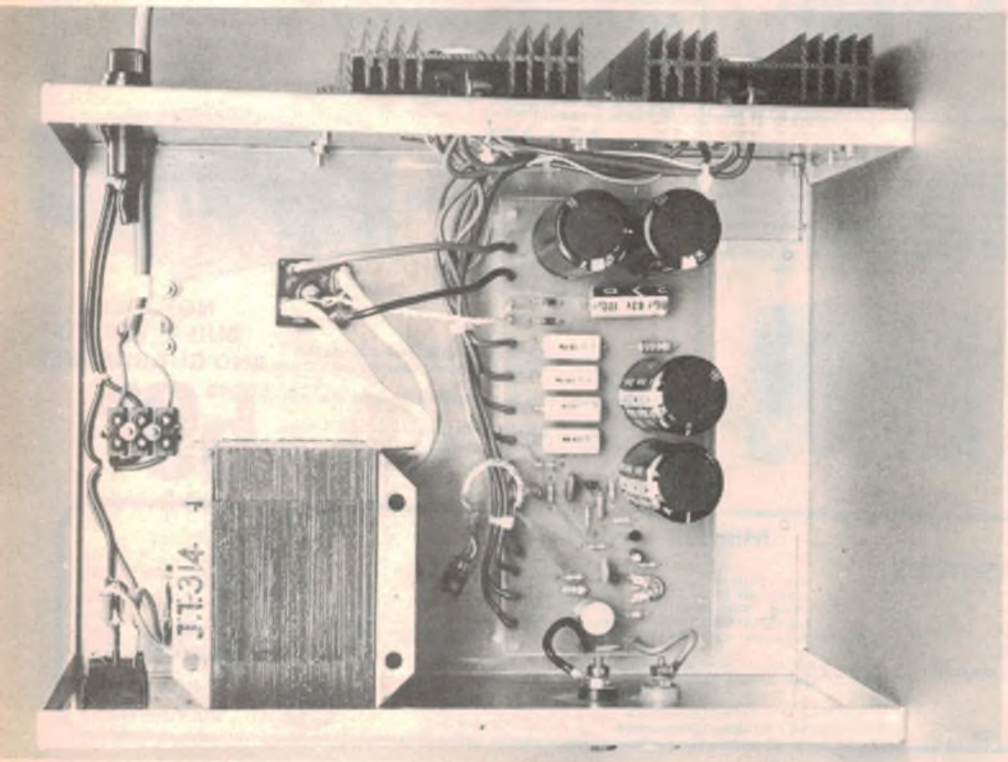
At first sight, the Powermaster design looks conventional enough. There they are, the four output transistors sharing the load by means of small resistors in series with their emitters. But wait a minute. The emitters are not connected to the load. The transistors look to be back to front. In fact the whole design is upside down with the negative rail being controlled by the regulator element instead of the positive . . . Hmm.

Well now. We haven't really made a dreadful mistake. There is a reason for the upside-down approach and it has to do with the short-circuit protection which we will come to later. For the moment, let us go through the circuit, seeing where it is in fact quite conventional and then seeing where it departs from normal practice.

The front part of the circuit is certainly conventional with a transformer secondary winding feeding a 25-amp bridge rectifier and four 10,000μF electrolytic filter capacitors. Note though that the capacitors on the circuit are "upside down" so that the positive rail is the reference or GND rail for the whole circuit.

When rectified and filtered, the 18VAC from the transformer secondary becomes around 25 to 27 volts DC. This is then fed to the regulator circuit which employs five transistors, one zener diode and one Darlington transistor for the basic regulator configuration, and an additional transistor and SCR for the short-circuit protection.

Trying to understand the circuitry in its



Left: view inside the prototype. Take care with mains wiring.

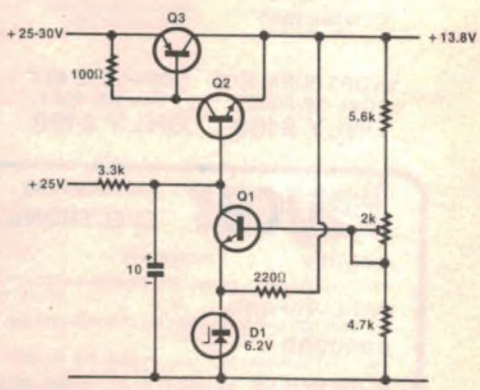
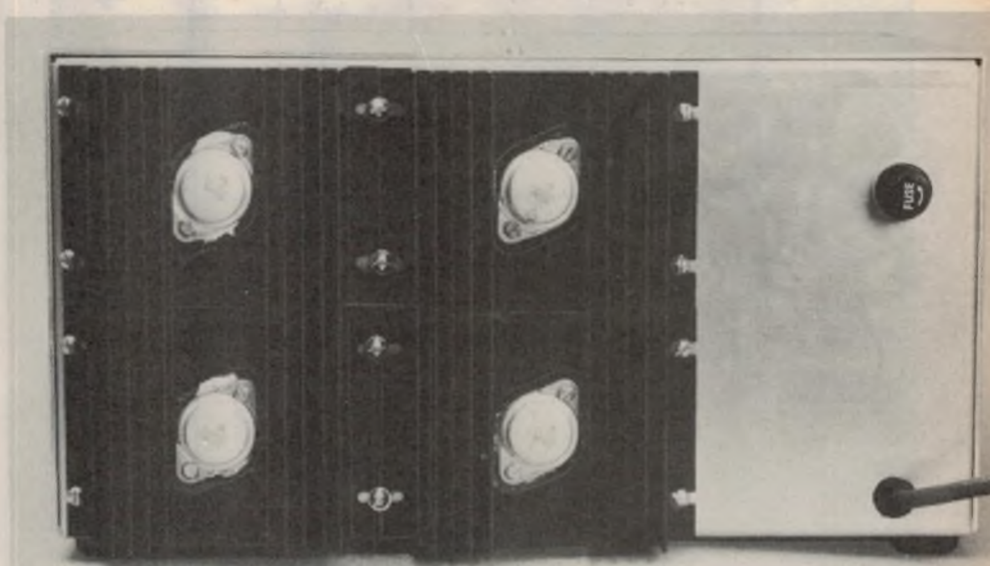


Fig. 1



The louvred top cover aids heat dissipation while the output transistors are mounted on substantial heatsinks.

entirety is a bit much though, especially as it is "upside down" to normal practice.

To make it easier to understand (and easier for the writer to describe), we have reproduced the same regulator configuration in Fig. 1 but with a conventional positive supply arrangement. This means that all transistor polarities in Fig. 1 are reversed to that of the actual circuit.

So Fig. 1 is a more-or-less conventional regulator circuit. Q3 is the main series pass transistor, Q2 is the driver transistor and Q1 is the error amplifier. It works like this: D1 provides a constant 6.2V DC reference at the emitter of Q1. Q1 compares this reference voltage with the sample of the 13.8V output voltage at its base and adjusts its collector current accordingly, thereby diverting base current for Q2 which is supplied via the 3.3kΩ resistor.

For example, if the output voltage tends to rise slightly it will raise the base voltage of Q1 by a proportional amount and so cause it to conduct more heavily. This will tend to turn Q2 off slightly and the same thing applies to Q3 and so the output voltage tends to fall back slightly.

The voltage divider feeding the base of Q1, comprising a 5.6kΩ and 4.7kΩ resistor plus 2kΩ trimpot, can be thought of as the DC gain control of the circuit. With a 6.2V reference and 13.8V output, the DC gain of the circuit is just over two. Since the ratio of the closed loop gain to the open loop gain (several thousand) is very large, the resultant regulation and ripple performance of the circuit is very good.

In fact it is every bit as good as could be expected from an integrated three-terminal regulator, if there was such a thing as a 25-amp three-terminal regulator.

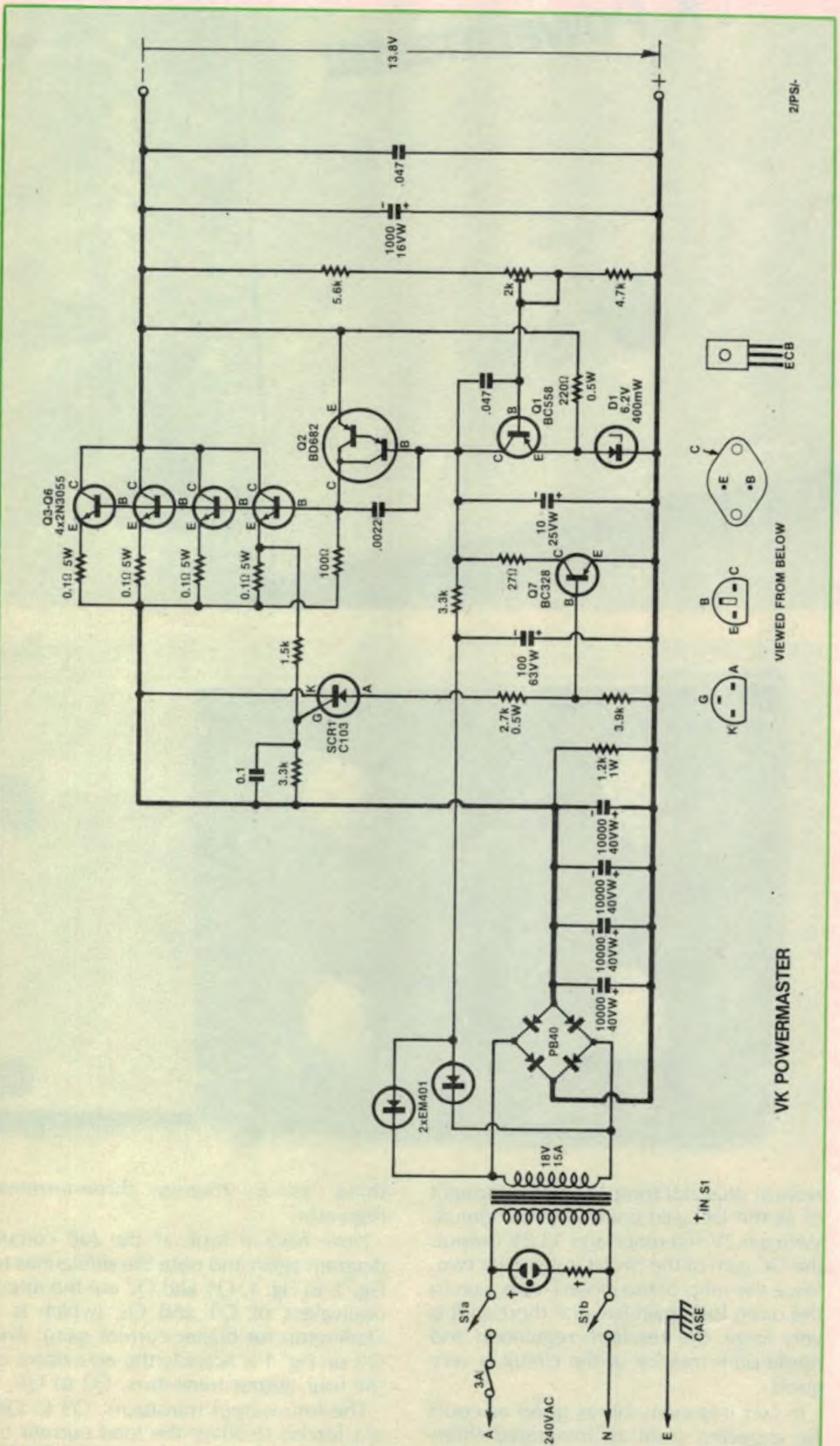
Now have a look at the full curcuit diagram again and note the similarities to Fig. 1. In Fig. 1, Q1 and Q2 are the direct equivalent of Q1 and Q2 (which is a Darlington for higher current gain). And Q3 on Fig. 1 is actually the equivalent of the four output transistors, Q3 to Q6.

The four output transistors, Q3 to Q6, are forced to share the load current by the following mechanism. First, all their

VK Powermaster

bases are tied together while the emitters are also commoned via individual 0.1Ω 5W resistors.

If one of the Q3 to Q6 transistors starts to conduct more heavily than the others, due to a higher value of inherent current gain, its associated 0.1Ω emitter resistor will also carry more current and will have a higher voltage developed across it than the 0.1Ω resistor for the other three transistors. The higher voltage across the 0.1Ω current sharing resistor will then effectively reduce the base-emitter voltage of the associated transistor and so it will be forced to conduct less current.



Note that the DC input for the error amplifier (Q1) and the bias drive for the Darlington (Q2) is not derived from the 40,000μF filter capacitor bank but is supplied via the 3.3kΩ resistor from a 100μF electrolytic capacitor which is fed from two separate diodes. This separate supply is better regulated and filtered than the main heavy current circuit because it is not required to feed the main load.

Both Q1 and Q2 have capacitors connected between collector and base to reduce the high frequency loop gain of the circuit. This reduces the possibility of instability or other "cranky" behaviour which may occur in the vicinity of a transmitter.

Good pulse output response is assured by virtue of the 1000μF and .047μF capacitors connected directly across the output circuit.

Short-circuit protection

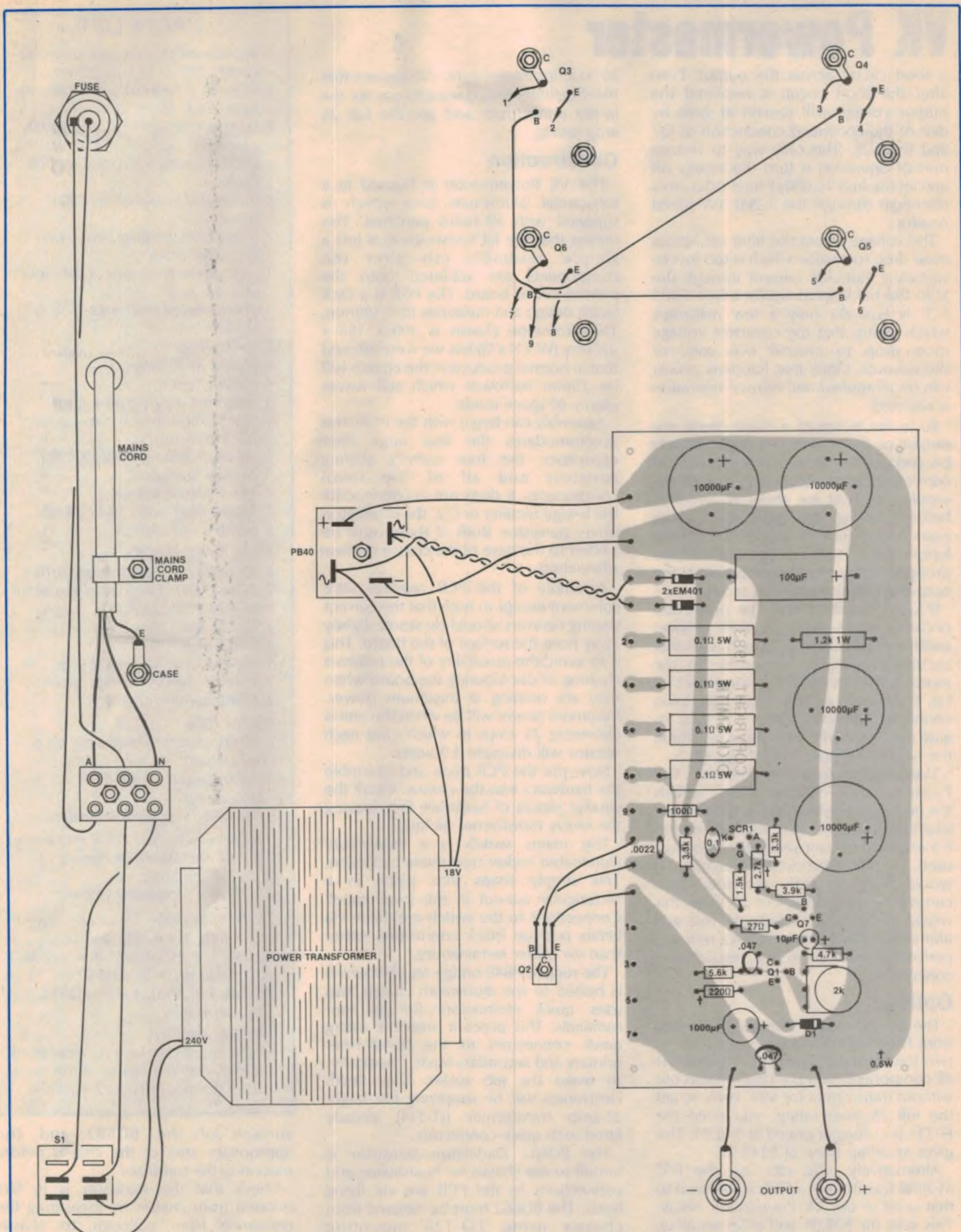
We now come to the essential reason why this circuit is unconventional. Because there are four 0.1Ω resistors which are used to share the current equally among the four output transistors we have the means for sensing the total output current: just monitor the voltage across one of those four resistors and multiply the relevant value by 40 to obtain the actual current in amps.

The short circuit protection components rely on this mechanism. The SCR has its cathode tied to the common connection of the four 0.1Ω sensing resistors while its gate is connected to the emitter of Q3 via the 1.5kΩ resistor. Thus the gate of the SCR senses the voltage across one of the 0.1Ω resistors and thereby monitors the total load current from the supply.

The voltage at the gate of the SCR is reduced slightly by dint of the 3.3kΩ connected to the 0V line. A 0.1μF capacitor is also connected to the gate to remove any small transient pulses which might otherwise trigger the SCR into conduction.

Once the current through the monitored 0.1Ω resistor exeeds seven amps or so the voltage at the gate of the SCR is enough to trigger it into conduction. This supplies a bias current to the base of Q7 which also turns on and effectively shorts the collector of Q1 to the positive line. This means that the base voltage to Q2 via the 3.3kΩ resistor is shunted away. Thus Q2 and the associated transistors, Q3 to Q6, are turned off.

Thus the output current is very suddenly reduced to zero in the event of


FUSE
MAINS CORD
MAINS CORD CLAMP
E
CASE
A
N
POWER TRANSFORMER
18V
240V
S1
PB40
Q3
Q4
Q5
Q6
Q2
2xEM401
10000µF
100µF
0.1Ω 5W
1.2k 1W
100Ω
.0022
SCR1
3.3k
2.7k
1.5k
3.9k
27Ω
Q7
10µF
4.7k
.047
Q1
5.6k
220Ω
2k
1000µF
D1
0.5W
OUTPUT

VK Powermaster

a short circuit across the output. Even after the short circuit is removed the output voltage will remain at zero by dint of the continued conduction of Q7 and the SCR. The only way to restore normal operation is turn the supply off and let the four 10,000μF filter capacitors discharge through the 1.2kΩ 1W bleed resistor.

The voltage across the filter capacitors must drop to a value which is too low to sustain a "holding" current through the SCR. The holding current for a type C103 SCR is typically only a few milliamps which means that the capacitor voltage must drop to around five volts or thereabouts. Once that happens power can be re-applied and normal operation is restored.

So in the event of a short circuit the output of the circuit will automatically be reduced to zero. After the fault is corrected it is necessary to switch off the supply and wait for about 60 seconds before turning on again to restore normal operation. If power is restored before the current through the SCR has dropped below the "holding" value, the output voltage will remain at zero.

Having described how the protection circuitry works we can now answer another question: why was this overall circuit configuration preferable to the more "understandable" arrangement of Fig. 1? After all, an SCR could have been connected directly across Q1 and its gate used to monitor a sensing resistor in the negative supply line (of Fig. 1).

The question almost answers itself. The Powermaster protection circuit avoids the need for an extra sensing resistor and its attendant power loss. Remember that if a separate current sensing resistor was used for the short-circuit protection it would have to carry the total load current. At a maximum of 25 amps this would amount to a substantial loss and ultimately would also result in a reduced performance as far as line regulation is concerned.

Options

The power supply may be purchased from Dick Smith Electronics with one of two transformers. The basic kit includes all components and punched chassis but without transformer for $99. Then, to get the full 25 amp rating, you need the JT-314 transformer priced at $49.95. This gives an all-up price of $148.95.

Alternatively, you can use the DSE M-2000 transformer which is identical to that used in our VK Powermate circuit. This sells for $24.95 and gives an all-up price of $123.95. As such, it would have the same current ratings as the VK Powermate, ie, 6 amps continuous or up to 10 amps intermittent. We assume that most builders would want to pay for the larger transformer and get the full 25 amp rating.

Construction

The VK Powermaster is housed in a substantial aluminium case which is supplied with all holes punched. This means that the kit construction is just a simple assembly job after the components are soldered onto the printed circuit board. The PCB is a Dick Smith design and measures 88 x 189mm. The prototype chassis is 300 x 155 x 220mm (W x H x D) but we were advised that in normal production the chassis will be 25mm narrower which still leaves plenty of space inside.

Assembly can begin with the PCB. This accommodates the four large filter capacitors, the four current sharing resistors and all of the small components. It does not accommodate the bridge rectifier or Q2, the Darlington driver transistor. Both of these must be bolted to the base of the chassis for heat dissipation.

Assembly of the PCB requires little comment except to note that the current sharing resistors should be stood slightly away from the surface of the board. This is to avoid the possibility of the resistors charring or discolouring the board when they are running at maximum power. Maximum power will be when the unit is delivering 25 amps in which case each resistor will dissipate 3.9 watts.

Now put the PCB aside and assemble the hardware into the chassis. Install the smaller pieces of hardware first, leaving the heavy transformer till last.

The mains switch is a heavy-duty illuminated rocker type made by Swann. This simply snaps into place in a rectangular cut-out in the front panel. Connections to the switch are made via Utilux push-on quick connectors rather than via solder terminations.

The rugged PB40 bridge rectifier which is bolted to the aluminium chassis also uses quick connectors for its four terminals. This poses a problem: fitting quick connectors to the transformer primary and secondary leads. Thankfully, to make the job easier, Dick Smith Electronics will be supplying the larger 25-amp transformer (JT-314) already fitted with quick connectors.

The BD682 Darlington transistor is bolted to the chassis for heatsinking and connections to the PCB are via flying leads. The BD682 must be isolated from chassis using TO-126 mounting hardware; ie, mica washer, insulating bush plus screw and nut. Smear a little heatsink compound onto the metal surface of the BD682 and the appropriate area of the chassis before mounting the transistor.

Check that the transistor is in fact isolated from chassis by measuring the resistance from collector to chassis (before any connections are made) with a multimeter switched to a high "Ohms" range.

PARTS LIST

1 aluminium chassis and louvred cover, 275 x 155 x 220mm
1 PCB, 88 x 189mm, available only from Dick Smith Electronics
1 transformer with 18V secondary (see text)
1 DPST illuminated rocker switch (Swann)
1 three-way insulated terminal block
2 heavy-duty binding posts, one red, one black
1 3AG panel mounting fuseholder and 3A fuse
4 double-sided heatsinks, DSE cat. H-3470
5 solder lugs
4 plastic PCB supports
4 rubber feet
1 grommet to fit mains cord
4 sets of mounting hardware for TO-3 transistors
1 set of mounting hardware for TO-126 transistor
4 TO-3 plastic covers
1 mains cord with 3-pin plug
1 mains cord clamp

SEMICONDUCTORS
4 2N3055 NPN power transistors
1 BD682 PNP Darlington transistor
1 BC558 PNP transistor
1 BC328 PNP transistor
1 C103 SCR
1 6.2V 400mW zener diode
2 EM401, IN4002 silicon diodes
1 PB40 bridge rectifier

CAPACITORS
4 10,000μF/40V electrolytic (PCB mounting)
1 1000μF electrolytic (PCB mounting)
1 100μF/63V pigtail electrolytic
1 10μF electrolytic (PCB mounting)
1 0.1μF metallised polyester
2 .047μF ceramic
1 .0022μF metallised polyester

RESISTORS (¼W, 5% unless noted)
1 × 5.6kΩ, 1 × 4.7kΩ, 1 × 3.9kΩ, 2 × 3.3kΩ, 1 × 2.7kΩ/½W, 1 × 1.5kΩ, 1 × 1.2kΩ/1W, 1 × 220kΩ/½W, 1 × 100kΩ, 1 × 27kΩ, 4 × 0.1kΩ/5W, 1 × 2kΩ trimpot.

MISCELLANEOUS
Utilux quick-connectors, heatshrink tubing, hookup wire, 4mm auto cable, screws, nuts, lockwashers.

A NEW ALTRONICS RESELLER IN SYDNEY!!!

SUPER PRICE SAVINGS

PLUS A FREE "LEATHER LOOK" CARRY CASE WITH EVERY Q1001 OR Q1002 PURCHASED THIS MONTH

UNIVERSAL MULTIMETER
PORTABLE WITH BENCH STAND
★ 23 RANGES ★

★ 20,000 OHMS/Volt DC ★ 10,000 OHMS/Volt AC ★ Mirror backed scale ★ Overload protected ★ Unique carry handle doubles as a bench stand ★ High-impact resistant case ★ Uses 1 AA Penlight battery (incl.) ★ Comes complete with battery, test leads and instructions. **RANGES: DC Voltage** 0-.25, 1, 2.5, 10, 25, 100, 250, 1000. **AC Voltage** 0-10, 25, 100, 250, 1000. **Decibels** 20 to + 22 db. **DC Current** 0-50, 500 UA, 0-5, 50, 500MA. **OHM Meter** 0-6 megohms in 4 ranges, 30 ohms centre scale. Sizes 135 × 91 × 39.

Q1002 .... **$19.50**
was **$24.50**

ECONOMY TESTER

OVERLOAD PROTECTED
High 2000 OHMS/Volt sensitivity overload protected. Dimensions 90 x 60 x 30. Mirror back scale prevents Parallax error. **Complete with test leads and instructions.** Uses 1 AA Penlight batt. (incl.) **Ranges:** DC and AC 0-10, 50, 250, 1000V. **Decibels:** 10 to + 22 db. DCA 0-100MA. OHMS 0-1 meg. OHM in 2 ranges.

Q1001 ... **$11.00**
was **$14.50**

MICRON 30 WATT

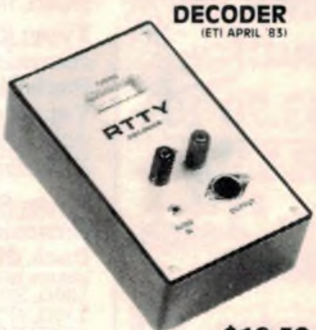
This brilliant little 30 watt iron is just the "bee's knees" for the electronics hobbyist, electrician or home handyman. We searched the world for a low cost yet quality iron which met the criteria of ★ light-weight ★ screw in interchangeable tips ★ efficient thermal transfer from element to tip ★ tip temperature maintains within the limits suitable for electronic work and also small household jobs ★ and of course, fully S.E.C. tested and approved.

Comes fitted with T 2435 Tip

WAS **$12.95**

NOW. . . **$7.50**

RADIOTELETYPE DECODER
(ETI APRIL '83)



K9733 .... **$19.50**

Display RTTY encoded messages on your video Monitor. Receive up to date weather information. International News before the Papers, all sorts of coded military info. Simple circuit uses PLL techniques. Single PCB Construction. Kit includes DB15 Plug and backshell for connection to micro-bee. Shielded pretinned PCB.

MICROBEE LIGHT PEN

NEW

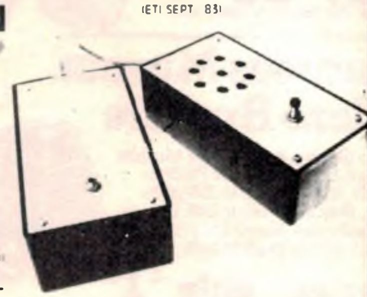
(ETI AUGUST '83)

PROVIDES DIRECT PERSONAL CONTACT WITH YOUR BEE!

K9649 .... **$19.95**

AT LAST — a light pen for the Bee. This pen works in the low-resolution graphics mode and connects directly to the I/O port. • Complete kit including DB15 2m CORD • Fully documented with software example

FAX-DECODER
(ETI SEPT '83)



K9733 .... **$24.50**

This project allows you to decode the signals of shortwave stations transmitting radio facsimile weather maps, satellite pictures etc and then reproduce them on your dot-matrix printer.
• Complete kit of parts includes DB15 Ribbon Cable
• SOFTWARE LISTING

YOU CAN NOW BUY ALTRONICS PRODUCTS

7 Days AT

BIRKENHEAD ELECTRONICS

Where you'll find the most comprehensive range of ALTRONICS products outside of Perth.

81 4077

SHOP 71 BIRKENHEAD POINT, Harbourside, Drummoyne 2047

VK Powermaster

Much the same procedure should be followed when mounting the four power transistors which each have separate double-sided heatsinks. The transistor should be mounted on the heatsink before the heatsink itself is mounted on the chassis. It is also a good idea to fit each of the 2N3055 power transistors with a TO-3 plastic cover to prevent accidental shorts.

Fig. 2 shows how the power transistors are mounted. If a resistance check reveals a short between the transistor case and the heatsink, the transistor must be removed and the fault located. In particular, check for metal swarf around the mounting holes drilled through the heatsinks.

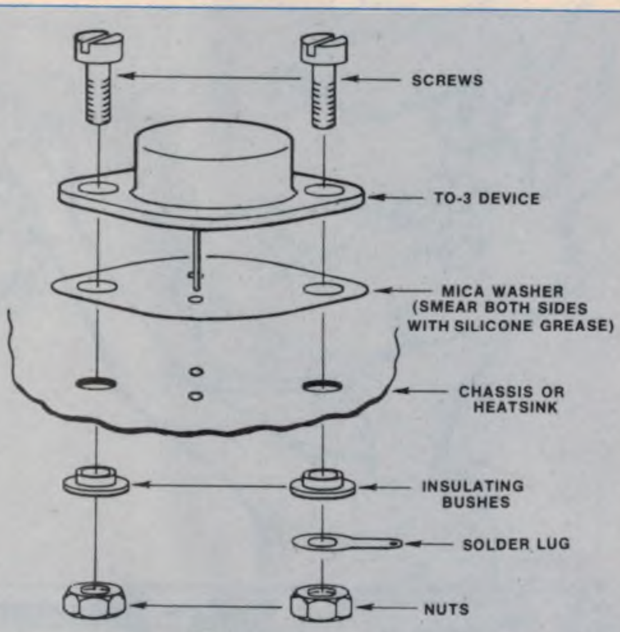


Fig. 2

This diagram shows how the 2N3055 power transistors are mounted. Note that each transistor must be isolated from chassis.

Heavy duty wiring

Rainbow cable or light duty hookup wire can be used for the connections to the following: between the PCB and BD682; the two wires between the transformer secondary and the PCB (to the two diodes), and the common base lead to the four output transistors. All other wiring, with the exception of the two short output leads from the PCB, must use heavy duty 32 x 0.2mm stranded hookup wire rated at 10A.

The two short output leads to the front panel terminals have to carry currents of up to 25 amps so they should use 4mm auto cable.

To simplify the wiring procedure it is probably best to attach all the leads to the PCB and cut them to a suitable length before installing the PCB on its plastic supports. If you do it the other way around and attach all the leads to the power transistors and so on first, there will inevitably be quite a lot of flexing of the PCB connections during the wiring procedure with the result that some connections may break.

The connections to the four power transistors are made via four large diameter cutouts in the rear of the chassis.

All the wiring should be bound into neat cable forms to make the job look workmanlike and also to simplify any troubleshooting which may be necessary in the event of a fault.

Take care to make sure the mains wiring is safe. The mains cord passes through a grommeted hole in the rear of the chassis and is anchored with a cord clamp. Terminate the mains active (brown) and neutral (blue) leads to the insulated terminal block and solder the earth lead (green/yellow) to a solder lug bolted to chassis near the transformer. By the way, all screws and nuts should have shakeproof washers.

When wiring the mains fuseholder make sure you follow the wiring diagram and connect the incoming active lead from the terminal strip to the end terminal on the fuseholder. This reduces the possibility of shock when you are changing a live fuse (if you have not had the sense to unplug the unit from the mains). When the fuseholder wiring is complete, a length of heatshrink tubing should be slipped over it to shroud the mains terminations.

When the connections are made to the power switch, the quick connect terminals should also have plastic boots to shroud them and prevent accidental contact. These are not shown in the photograph of the prototype but should be fitted nevertheless.

Testing

When construction is complete, check all wiring carefully. Check that the complete circuit is isolated from chassis, apart from the mains earth connection.

Now apply power and with no load connected, set the trimpot to give 13.8V DC at the output. Ideally then, the regulation performance should be checked using a dummy load but that is not going to be easy. For a steady state test the required 0.55Ω resistor has to dissipate 345 watts when passing 25 amps.

If you are really keen to check the regulation one method would be to make up a 0.6Ω resistor using six 0.1Ω/5W resistors in series. Such a dummy load would only have a steady-state rating of 30 watts so it could only be used for a brief test lasting for a few seconds. If you do make this test the output voltage of the supply should not fall by more than 200mV between the loaded and unloaded conditions.

Such a test is likely to be more valid than one performed with a transmitter as a load. This is because your multimeter is likely to be upset by the transmitter signal.

In this regard, analog meters are usually less effected than digital types. We have found a digital meter to have an error of 1V during transmit, a cheap analog to have an error of 0.5V (probably due to a rectification effect of the protection diodes) and an expensive analog type to have no error.

Finding out whether your meter is likely to be affected is easy. Just short the meter leads and transmit. Any reading on the meter is obviously an induced error.

You can also check the operation of the short-circuit protection circuitry. Just short the output and check that the output does immediately go to zero and stays off until the mains is removed and then restored, one minute later. Incidentally, if the above load regulation test indicates that the SCR is too sensitive to allow a 25 amp current to be delivered, the sensitivity can be reduced by reducing the value of the 3.3kΩ resistor associated with the SCR.

During normal operation the output transistors will become very hot if high currents are being delivered. The supply is rated to deliver up to 14 amps continuously or up to 25 amps on an intermittent basis, for transmitter use.

It's the March Hare and Dick's

BELOW COST!
THUMPING GREAT VALUE!

ONLY $135 WHILE STOCKS LAST!

FUNVISION Video Games Console

Our loss . . . your gain! We bought a huge shipment of these fantastic Funvision games consoles but now have to clear our warehouse (there's nowhere left to store the carrots for winter). Electrically identical to the famous Dick Smith Wizzard, same great range of cartridges available. But look at the difference in price. Hurry in and save over $160.00!!! Cat. Y-2600

Save on tune ups!

Engine Analyser

SAVE $5

If your widdle wed waggon wuns woughly, it could need a tune-up. Do it yourself with this deluxe engine analyser and Save! Cat. A-8514

WAS $29.95 $24.95

Radar Detector

Tiny size – but what a performer!

Find out if they're shooting microwaves at your car before they start taking your carrots. Suits both X & K band, latest superheterodyne circuitry for fantastic sensitivity. Cat. A-8502

GREAT VALUE! $225

Xenon Timing Light

SAVE $5

Much more light than a neon type – almost enough to light a whole burrow. Set engine timing easily, save fuel and money. Cat. A-8508

$24.95 WAS $29.95

Remote Communications Speaker $11.95

Even with rabbit's ears, it's hard to hear the tiny speakers used in most radios. This quality 10cm speaker will normally give much clearer sound (particularly in mobile use!); comes with cable & 3.5mm plug. Cat. A-2451

30W Mini Brutes

You'll be amazed at the quality sound from such tiny speakers: and they handle a huge 30W each! Absolutely superb in 4wd's, vans, cars, etc. And bunny burrows. Cat. A-2380

only $44.95

Low Cost

Ultralight Headphones

Very difficult to fit on a hare's ears – but they fit great on humans. And the sound is really great! Suits virtually all modern stereos, comes with 3.5/6.5mm adaptor plug. Cat. C-4106

$8.98

$125

Two in one! FM/AM RADIO CASSETTE

Not much room in the old jallopy, eh? But you want great sound? Get it from the superb AM/FM stereo cassette. Not one of the cheapies you find anywhere: this one is real quality with auto reverse, huge 8W max/ch power output and locking fwd/rew. Cat. A-6482

Super Thin

Door Mount Speakers

Some cars are so crowded the only room left for speakers is in the doors. No worries: these ones fit in the doors! Super thin, but don't sacrifice anything in sound quality. Handle 15W, 100mm size. Cat. A-7050

$19.95 pr.

Inductive pick-up

Suction cap sticks to intercom so no electrical connection needed. Ideal for amplifiers, tapes, etc (recording of phone conversations may not be permissible).

Cat. C-7300

only $1.80

2 Station Intercom

Yelling through the burrow isn't easy – so use a two station intercom. Battery operated, cable included. Also use as a baby-sitter for the little bunnies. Cat. F-1020

$16.80 pr

SAVE $5

FM 2 station intercom

It's hard putting cable onto the burrow wall – the nails keep pulling out of the earth. Use the deluxe mains FM intercom – just plug it into the power point. And it's two channel, so you can have three intercoms! Cat. F-1012

$29.95 ea

27MHz Helical Whip Antenna

Be quick for this bargain! 27MHz helical whip complete with base & coax for $$$ off normal price! Ideal for all 27MHz CB's: takes full 40 channels. Cat. D-4076

$29

The one and only GENUINE Dick Smith Catalogue . . .
FREE in the April issue of Electronics Aust. & E.T.I.
BEWARE OF IMITATIONS!

mad month of March!

prices are crazier than ever!

Famous Ampex Cassettes

Hurry! Only two types left.

C90 LN Cat C-3082 **$2.24** — 10 up $2.00

C90 EDR Cat. C-3088 **$2.69** — 10 up $2.30

PARKING IS EASY Ultrasonic Back-up Sensor

Don't be a bunny! Park safely and easily with the back-up sensor. As you reverse it squeaks to you letting you know how close you're getting. No more crunches, no more bills. And no more grey hares. Cat. A-8520

ONLY **$59.00**

Don't take chances with Modems..

Why build a Modem which may be impossible to have Telecom permitted (and if it could would cost you a fortune!!!) The Dick Smith Dataphone II is already Telecom permitted – so you can legally plug it in to any telephone socket. And even more: latest improved model has a push-button phone ... at no extra cost! Cat X-3272

$199.00

IMPROVE RECEPTION! Metropolitan UHF/VHF Antenna

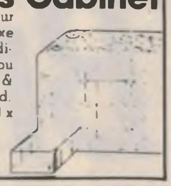
What's better than rabbit's ears? Nothing if you're a rabbit. But for good VHF/UHF TV you need a good antenna. This one has both in one – no need for separate antenna or feed ins. Suits 300 ohm ribbon.

$59.95 Cat L-4020

16 Drawer Parts Cabinet

Store away all your goodies in this deluxe parts cabinet. Individual drawers so you can keep the celery & carrots separated. Measures 300 x 180 x 140. Cat. H-2588

$19.95



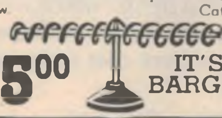
Ignition Killer

Watch your tails! No worries – this one's a new kit to protect your car. It disables it so the crook thinks something's wrong and pinches someone else's! Easy to build, easy to fit. Cat. K-3255

STALLS CAR THIEVES! ONLY **$12.95**

Economy Indoor Antenna

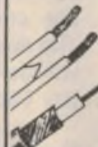
And even this is better than rabbit's ears! Spiral indoor TV antenna is great in primary signal areas. And it doesn't take up much room in the burrow. Cat. L-4010



$5.00 IT'S A BARGAIN!

TV & FM Cable

New video for Christmas? But the pic's too crook? You could need new cable!



300 Ohm Flat Ribbon
Cat W-2070 — 20¢ per m. — 100m .... 17¢

75 Ohm Coax
Cat W-2080 — 45¢ per m. — 100m .... 32¢

Printed Stripboard

Fantastic for mocking up circuits or building the real thing. No more birds nests – or even rabbit warrens

2.5mm spacing 75mm x 153mm Cat. H-5612 .... $3.15

2.54mm spacing 76mm x 76mm Cat. H-5614 .... $1.65

Versa Stripboard

2.54mm spacing 76mm x 153mm Cat. H-5616 .... $3.55

SCOOP PURCHASE! Mini hi-torque carbon brush motor

Wow! Huge scoop purchase – ideal for modellers, etc. You'll be amazed at the torque from such a tiny motor. And it operates from 6-15V DC. And our low low price? Cat. M-9950

24 CARROT BARGAIN! **95¢**

IT'S HARE! THE INCREDIBLE BICYCLE COMPUTER

Now you can find out exactly how well you're doing on your bike. Just like the latest cars with their car computers, you can tell how fast you're going, time, distance, etc etc. Real easy to fit, complete with sensor ring for wheel and removable computer head so some other wascally little gwey wabbit won't pinch it! Cat Y-3010

$49.50

Etching Kit

Make your own PCB's at home or in the lab. No need to send them out (costs a fortune). Mock them up yourself: kit has ferric chloride, resin, Dalo PC pen and a sample piece of PC board – plus instructions. Cat H-5650

$6.99

Ferric Chloride

Super strength ferric for fast PCB etching. 600 ml bottle. Cat. H-5652

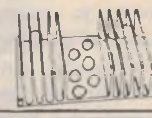
$3.99

Power Heatsink

Massive boo-boo! We had hundreds of heatsinks drilled at great cost for our kits and found the holes too close! You reap the benefit – Drilled heatsinks only 20¢ dearer than undrilled!!!

Undrilled H-3460 **$5.75** — 10 up ... $5.45

Drilled H-3461 **$5.95** — 10 up ... $5.50



Multi-tap TRANSFORMERS

DSE 2155 Our most popular tranny – with 6 taps between 6.3 & 15V @ 1A, giving up to 21 voltage combinations! Cat M-2155

$5.90 — 10 up $5.10

DSE 6672

Our second most popular – taps between 15 and 30V @ 1A, giving you every voltage you could ever want (except a few million). Cat M-6672

MULTIPLY YOUR SAVINGS! **$6.75** — 10 up ... $6.10

NiCad AA Batteries

Re-charge hundreds of times save money! 10 up ... $2.47 Cat. S-3300 **$2.95**

GE NiCad Charger

Plug-pack charger with snazzy snap-on adaptor set to suit most nicads. Cat. M-9520 **$10.95**

NEW! 12V 2.6Ah Gel Battery

Ideal for burglar alarms (see our new Security Centre elsewhere!) but also ideal for other high current 12V applications. Leak-proof Gel type, huge 2.6Ah capacity. Cat. S-3320

ONLY **$24.50**

AMAZING!

The new Dick Smith Multimeter with Logic Probe

This is the very first analog multimeter ever with its own built-in Logic Tester! Built-in LED's give instant recognition of 'HIGH', 'LOW' and 'PULSE' states of logic circuits. 18 voltage, current and resistance ranges, with 20K ohm/V sensitivity DC and 8K ohm/V AC. Complete with instructions, batteries and probes. Cat Q-1026

GREAT VALUE! **$32.50**

DICK SMITH Electronics

See page 107 for full address details.

A708/LL

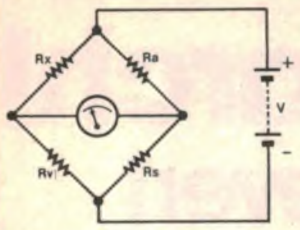


Fig. 1a

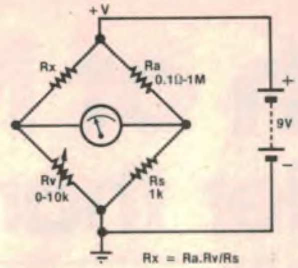


Fig. 1b

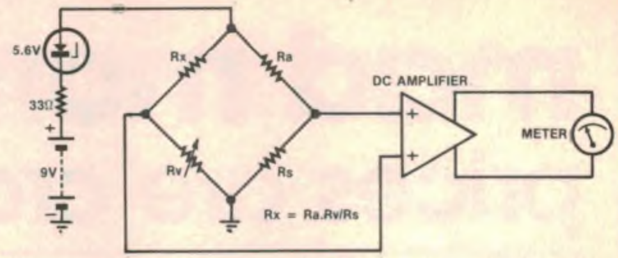


Fig. 1c

by JEFF SKEEN & LEO SIMPSON

A versatile LCR Bridge

– for laboratory & workshop

When it comes to measuring resistors, capacitors and inductors nothing can beat a good all-round LCR bridge, especially if it can cope with electrolytics and high and low-Q inductors.

So who needs an LCR bridge? The answer is everyone who is really interested in electronics, whether they be hobbyists, amateur radio operators, technicians or design engineers. Sure, if you only put one kit together in a year, you probably don't need a good LCR bridge but once you decide to become a little more venturesome, an LCR bridge becomes indispensable.

Once you acquire a good LCR bridge such as this new EA design you will wonder how you ever managed without it. It is very reassuring to be able to quickly check the value of any passive component before you solder it into circuit – at least you know that particular component won't give any trouble! And capacitors and other components with their values rubbed off cease to be a problem. Just whack 'em across the bridge, twiddle the dials and there's the value. Easy.

To a certain extent other instruments have encroached upon the need for a comprehensive LCR bridge. For example, most digital multimeters can measure resistance over a wide range of values with a high order of accuracy. And digital capacitance meters, two of which have been described in EA (March 1980 and March 1982), bring precise and convenient measurement to capacitors although the range of measurement is not as wide as it might be.

Paradoxically, resistors are probably the one component we have the least need to measure since their value is clearly marked (once you know the colour codes) and they are a readily available in close tolerances (1% or better). Still, it is often desirable to know the precise value of a resistor, regardless of its specified tolerance.

And even though digital capacitance meters can be very handy, they are usually unable to cope with large value electrolytics and do not have any facility for measuring dissipation factor of capacitors.

And of course, there is no instrument, other than that rare creation, the Q-meter, which can really do the job of an LCR bridge for quick and convenient measurement of inductors. If you have to work with inductors it is important to have a bridge that can measure them because they are rarely marked – once they're out of the packet you have no idea of their value.

So even though there are a number of alternatives to an LCR bridge which can measure resistors and capacitors, they are only a partial substitute for a good bridge.

In fact we have put a great deal of development into this new bridge, to the point where it puts any other bridge we have designed in the past well into the shade. If you presently have an elderly EA LCR bridge amongst your test equipment line-up now is the time to replace it with a high performance design which will cost much less than an equivalent imported commercial unit.

That is not to say the new design will be cheap to put together. We have not cut corners in this design and some of the components are quite expensive. The end result is a design which we think will be popular for many years and will pay back its purchase cost many times.

Features

The new EA LCR bridge will measure AC and DC resistance from one milliohm to 11 megohms; inductance from 0.1 microhenries to 1100 henries; and capacitance from one picofarad to 11,000 microfarads. In other words, for resistance, capacitance and inductance the overall measurement range is 1.1×10^{10}. No other measuring instrument can match that!

Minimum resolution is one milliohm for resistance measurements, 0.1 microhenry for inductance and one picofarad for capacitance although for any measurement range the resolution will be limited to four digits.

Basic accuracy is about ±1% for AC resistance, inductance and capacitance ranges and about ±0.3% for DC resistance measurements.

In addition, the quality factor, Q, of inductors and the dissipation factor, D, of capacitors under test is indicated for values lying in the range .01 to 31.

AC measurements (inductance, capacitance and AC resistance) are performed at a frequency of 1kHz which is supplied by an internal sinewave oscillator. A socket has been provided to allow connection of external AC signals in the range 20Hz to 20kHz so that measurement of component values may be done at frequencies other than 1kHz. This feature is useful for components which have values specified at particular frequencies.

A further useful feature is provision for applying a polarising voltage to electrolytic and tantalum capacitors under test. This is done via a front panel socket. In addition, the power supply may be derived from either a set of internal batteries or an external 12V AC plugpack. This means that the instrument is fully portable and that measurements can be made in places remote from mains power.

Controls

Perhaps the most important control on the new EA LCR Bridge is the main nulling control. Unlike previous EA designs this is not a single-turn pot with an attached dial. Instead it is a precision 10-turn potentiometer with a three-digit vernier readout. This, combined with the close tolerance internal standard capacitor and multiplier resistors, determines the high performance of the design.

The nulling indicator is a centre-reading meter which is electronically driven so that it provides very high sensitivity while still indicating the null "direction", even when the bridge is a long way from the null setting; ie, when the multiplier settings are quite wrong.

Two rotary switches are used to select the measurement mode (and whether DC or AC resistance measurement) and the range multiplier. Since the control settings may not be self-evident, an explanatory table is displayed on the front panel.

Other features will be explained in the next article.

Circuit concepts

For the remainder of this article we shall discuss the circuit methods used in the new EA LCR Bridge while next month's article will be devoted to the full circuit presentation and construction details.

The basic bridge circuit used in the instrument is shown in Fig. 1a. To most readers this will be familiar as the Wheatstone Bridge. While this was first developed for resistance measurements there are many variations on the basic theme and several are used in this new EA design.

The principle of operation of the Wheatstone Bridge is quite simple, the bridge basically consisting of two voltage dividers placed across a common power source. The first voltage divider consists of Rx and Rv while the second voltage divider consists of Ra and Rs.

If a centre zero meter is placed between the junctions of the two resistive dividers as shown, and Rv is varied, a point will be found where no current flows through the meter and the bridge is said to be "nulled". At this point the voltages on either side of the meter are equal and so:

$V.Rv/(Rv + Rx) = V.Rs/(Ra + Rs)$

Cancelling the "V" terms and cross multiplying gives:

$Rv.Ra + Rv.Rs = Rv.Rs + Rs.Rx$

Subtracting Rv.Rs from both sides leaves:

$Rv.Ra = Rs.Rx$

This expression may be rewritten as a ratio of the divider resistors to give:

$Rx/Rv = Ra/Rs$

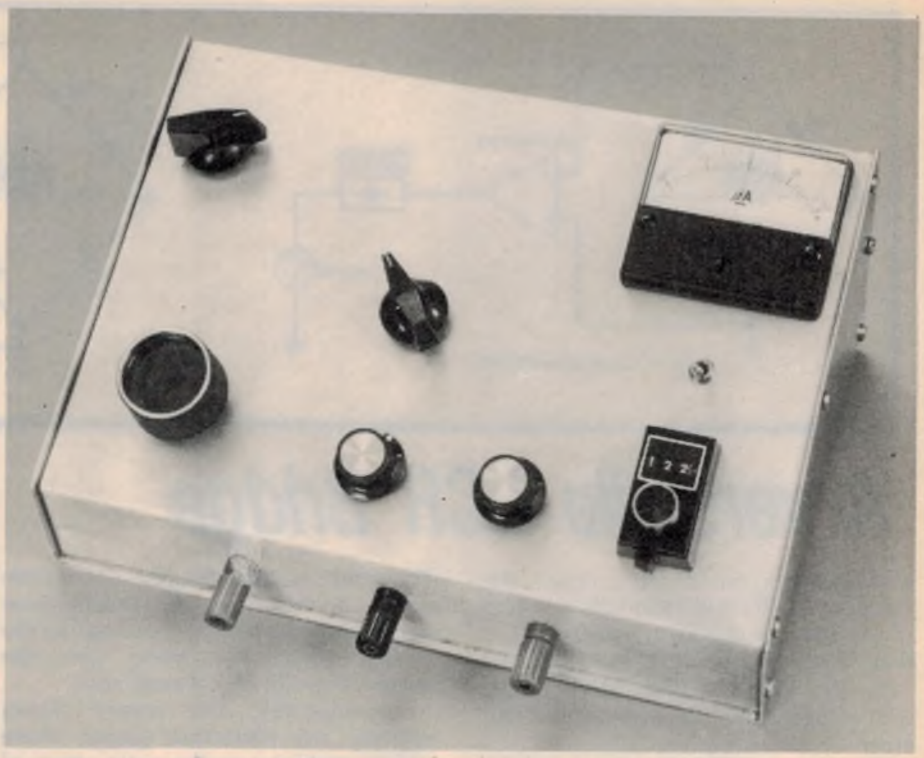
which could have been written down by inspection directly from Fig. 1a.

We can now express Rx in terms of the other resistors by writing:

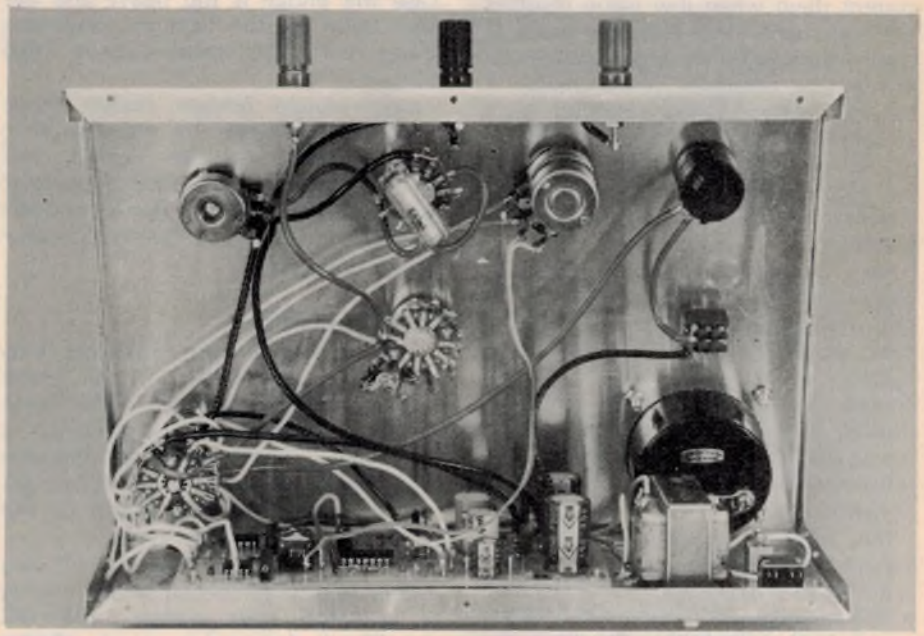
$Rx = Rv.Ra/Rs$

So providing we know the values of Ra, Rv and Rs, we can find out the value of our unknown resistor, Rx.

In our bridge, Ra and Rs are fixed resistors of known value, while Rv is a 10-turn variable resistor with a matching vernier drive attached. A "digital" readout on the vernier drive indicates the resistance of Rv and so the three resistors on the right hand side of the expression for Rx are known. Therefore



Above is a view of the new LCR Bridge in early prototype stage, with the front panel layout still to be finalised. Below is an interior view showing the PCB and general wiring details.



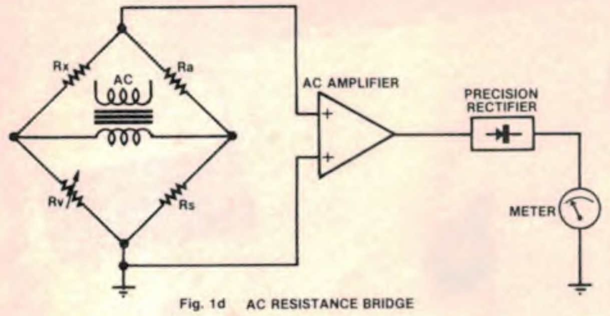


Fig. 1d AC RESISTANCE BRIDGE

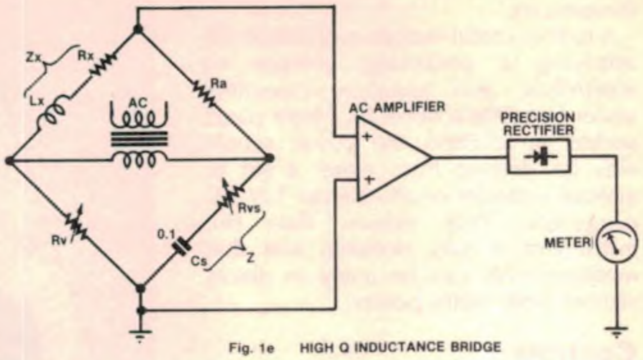


Fig. 1e HIGH Q INDUCTANCE BRIDGE

A versatile LCR Bridge

we can work out Rx. In practice, the values of Ra, Rv and Rs are all multiples of 10 and the unknown value may be read directly from the vernier scale.

Fig. 1b shows the Wheatstone Bridge with values shown for three of the four arms.

There are several practical problems associated with this form of bridge. The first and most obvious is the excessive current drain when low value resistors are measured. The extreme practical case occurs when we wish to measure the residual resistance of the bridge. In this instance we have a value for Rx of around 3mΩ and a corresponding value for Rv of around 3Ω. This calls for a current of 3A from the power supply which is not really possible using small batteries.

Also, if the short circuit used in measuring the residual resistance is removed, about 3A will pass through the 0.1Ω range resistor, Ra. The range resistors are rated at ¼W, 0.1% and should not be overloaded otherwise their value may change. Since passing 3A would dissipate 0.9W in the resistor, it is obvious some form of current limiting is necessary.

This problem is overcome by the variant shown in Fig. 1c. Current limiting is achieved by placing a 33Ω resistor and a 5.6V zener diode in series in the power supply lead of the bridge. This limits the maximum current which can flow through the bridge to around 100mA. The 5.6V zener diode is not really necessary for current limiting, since increasing the 33Ω resistor to 100Ω would achieve the same result. However, it helps solve another problem that we will discuss shortly.

If you examine the component values in each leg of Fig. 1b on the 0.1Ω and 1Ω ranges, you can see that the bridge is "bottom heavy"; ie, the component values on the bottom arms of the bridge are many times those on the top arms. The effect is that the two connection points for the meter are virtually short circuited to the supply point and so the voltage across the meter (and the current through it) is almost zero.

Consequently, the meter shows virtually no deflection (about three pointer-widths) over the entire range of Rv adjustment. The same situation applies to the 1MΩ range except in this case the bridge is top heavy and the high value resistors limit the maximum meter current (for resistors above 1MΩ) to 9μA.

Most simple bridges dodge these sensitivity problems by requiring that measurements on the highest and lowest ranges be done using an external power supply which can deliver enough voltage or current to obtain a usable meter deflection.

DC amplifier

Our solution to these problems is to include a DC amplifier in the meter circuit so that the sensivitity of the meter is increased. Maximum amplification is 290 times which ensures adequate meter sensitivity even on the 0.1Ω range. Fig. 1c shows the connection of the amplifier to the bridge circuit.

The DC amplifier consists of two operational amplifiers (op amps) sharing a common gain control. The DC amplifier is designed to reject voltages common to both corners of the bridge (called the common mode voltage) and amplify only the voltage difference between the corners (called the differential voltage).

The common mode range of the op amps does not extend to the positive supply rail so some form of voltage limiting is necessary on low resistance ranges so that the measurement points remain within the common mode range of the DC amplifier. This is the reason for the 5.6V zener diode mentioned earlier. It limits the maximum input voltage on the lower resistance ranges to 3.4V.

On the highest resistance ranges, very little current flows through the zener and it comes out of regulation, the voltage drop across it reducing to around 3V. This makes more voltage available to the bridge resistors, increasing the sensitivity by a factor of nearly two.

AC energisation

For the DC resistance method just discussed it was necessary to arrange for the detector circuitry to "float" so that a single power supply could power both the detector circuitry and the bridge itself. For AC measurements, however, it is desirable to swap the bridge around so that the null detector can use an unbalanced input amplifier. This means that the bridge source must "float". This condition is met by using a transformer, as in Fig. 1d.

Surprisingly, swapping the position of the power source and null detector does not alter the mathematical relationship given earlier, even though the circuit has now been turned on its side, as it were. You can prove this to your own satisfaction by starting with the basic relationship,

V. Ra/(Ra + Rx) = V. Rs/(Rv + Rs)

which reduces to

Rx = Ra.Rv/Rs

as before.

In fact, compared to the previous configuration, Fig. 1d produces a greater difference in measurement point potential for a given change in Rv, meaning that the bridge is more sensitive.

The amplifier circuit is changed slightly, an extra stage of amplification being added followed by a precision rectifier. The extra stage of amplification, together with the increased bridge sensitivity, compensates for the lower drive voltage produced by the transformer. The precision rectifier is necessary since the meter cannot respond to AC.

Fig. 1e shows the bridge connected to measure high-Q inductors. This configuration is sometimes referred to as a Hay bridge.

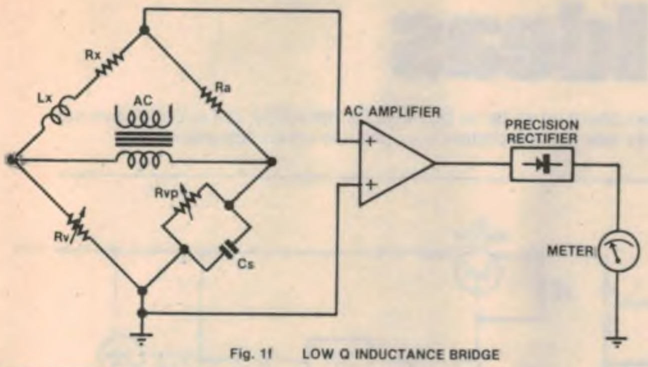


Fig. 1f LOW Q INDUCTANCE BRIDGE

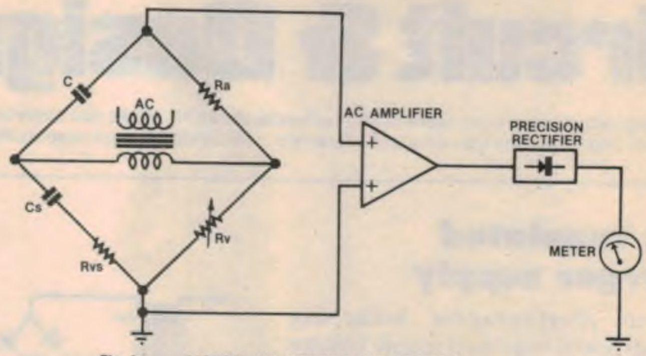


Fig. 1g CAPACITANCE BRIDGE CONFIGURATION

The "Q" or "quality factor" of an inductor is defined as the ratio of its imaginary component of impedance to its real component. Or, in other words, $2\pi fL/R$. The high-Q bridge functions in much the same manner as the AC resistance bridge except that Rs is replaced by a capacitor Cs with a variable resistor Rvs in series.

Rvs is used to balance out the series resistance which is found in all practical inductors. An understanding of the bridge operation can be obtained by considering the measurement of an ideal inductor. Since an ideal inductor has zero series resistance, the variable resistor, Rvs, has nothing to balance out and so will be set to zero ohms. This corresponds to an inductor with infinite Q.

The ratio of the impedances in the arms of the bridge can be written by inspection as:

$Z_L/Ra = Rv/Zc$

By substituting $Z_L = jwL$ and $Zc = 1/jwCs$ and rearranging we obtain:

$jwL = Rv.Ra.jwCs$

which simplifies to

$L = Rv.Ra.Cs$

When the inductor being measured is not ideal and has some series resistance, the expression for inductance becomes more complicated and is given by:

$L = Rv.Ra.Cs/(1 + 1/Q^2)$

where $Q = 1/w.Cs.Rvs$

Our bridge uses this measurement configuration for inductors with a Q greater than 30 so less than 0.11% error will be introduced if the inductance is approximated as $L = Rv.Ra.Cs$.

Low Q inductors (ie inductors with a Q under 30) are measured using the bridge configuration shown in Fig. 1f. This configuration is sometimes called a Maxwell bridge. The bridge is essentially the same as the high Q bridge but this time the inductor losses are balanced via a resistor in parallel with the standard capacitor.

Expressions for the inductance and Q of the unknown inductor are:

$L = Rv.Ra.Cs$ and

$Q = w.Cs.Rvp$

Note that the expressions for the high and low Q inductances are the same over the respective measurement ranges and therefore one scale can be used to read both.

Capacitance measurement is very similar to inductance measurement except that the arm containing the standard capacitor and its loss balancing resistor is swapped with the arm containing Rv. The swap corrects for the fact that capacitor impedances are the inverse of resistor and inductor impedances, ie a large value capacitor has a small impedance while a large value resistor or inductor has a large impedance.

The term "Q" is not used for capacitors; instead the term "D" or dissipation factor is used as an indication of the capacitor quality. D is the ratio of the real component of capacitor impedance to the imaginary part and is written as:

$D = w.R.C$

Typically, D is almost zero for high quality polystyrene and polycarbonate capacitors, while electrolytic capacitors often have D values of around 0.2 to 0.3.

In Fig. 1g the bridge configuration used in the measurement of capacitance is shown. This form of the bridge circuit is known as a De Sauty configuration.

In the usual manner we can write down the expression for the bridge impedance ratios (assuming the unknown capacitor, C is ideal) as:

$$\frac{Ra}{\frac{1}{jwC}} = \frac{Rv}{\frac{1}{jwCs}}$$

or, $$C = \frac{Rv.Cs}{Ra}$$

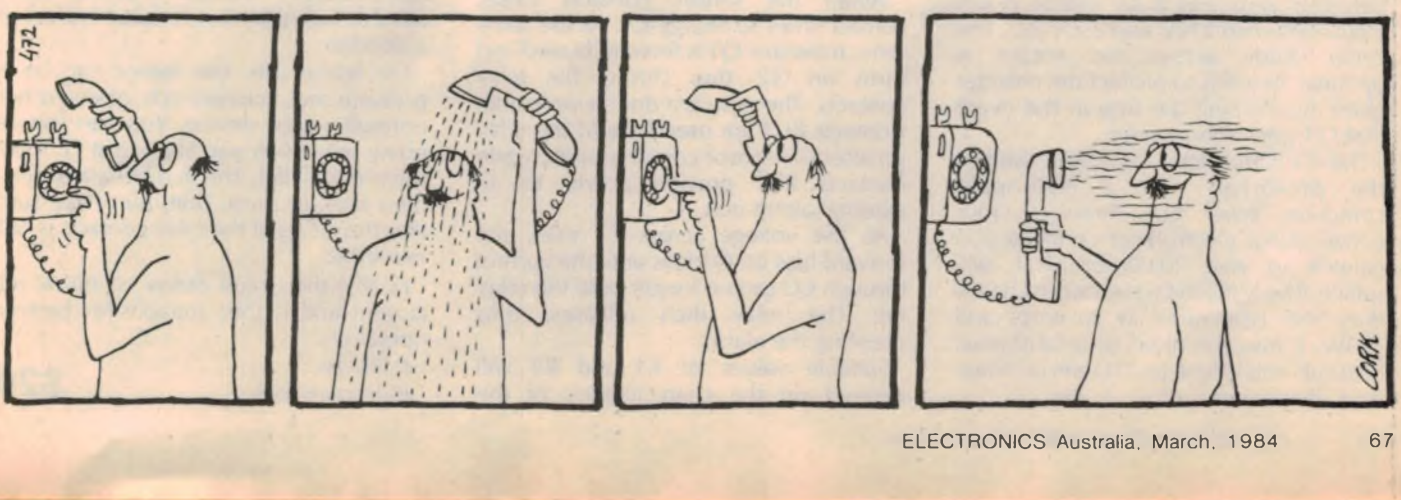
and, $D = w.Rvs.Cs$ from before.

The normal range of capacitor D values is covered quite well by the De Sauty bridge configuration and there is no real need to switch to a parallel loss resistor. It can be done, if required, by switching the Q ranges and finding the values of C and D from the expressions:

$C = Rv.Cs/Ra(1 + 1/Q^2)$

$D = 1/w.Rvp.Cs$

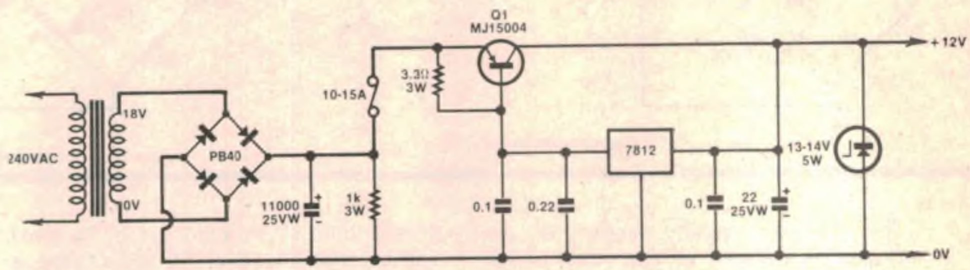
This completes our article on basic theory of LCR bridge operation. In the following article we will provide the circuit diagram and full details of the bridge construction.



Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. As a consequence, we cannot accept responsibility, enter into correspondence or provide constructional details.

10A regulated enlarger supply



Colour photographic enlarging demands a well-regulated supply voltage for the enlarger lamp to produce a stable light output. Unfortunately, commercial AC stabilisers are very expensive. This DC voltage regulator circuit provides a stable 12V output at currents up to 10A and is suitable for powering 12V lamps with ratings up to 100W.

The circuit is quite conventional, with the low voltage transformer secondary being rectified by a 25A bridge rectifier and fed to an 11,000µF filter capacitor. From there, the DC is applied to the emitter of series pass transistor Q1 which is controlled by a 12V three-terminal voltage regulator.

There are two current paths, one through transistor Q1 and one through the 3.3Ω resistor and the regulator IC. The current drawn by the regulator IC produces a voltage drop across the 3.3Ω resistor, thus forward biasing Q1 which supplies the bulk of the load current. This arrangement makes it possible for the regulator IC to closely control the voltage applied to the load, at currents far above its normal rating.

It works like this. If the voltage across the load tends to rise above the nominal 12V output, the regulator tends to shut down slightly; ie, it draws less current. This reduces the voltage across the 3.3Ω resistor and thus Q1 shuts down by the appropriate amount.

Similarly, if the voltage applied to the load tends to drop below the nominal 12V, the regulator tends to draw more current and Q1 is driven just a little harder.

On test, the regulated voltage output showed no variation for currents between zero and 8.3A and/or mains inputs between 216V and 250V AC. The zener diode across the output is optional. Its job is to protect the enlarger globe by blowing the fuse in the event that Q1 goes short circuit.

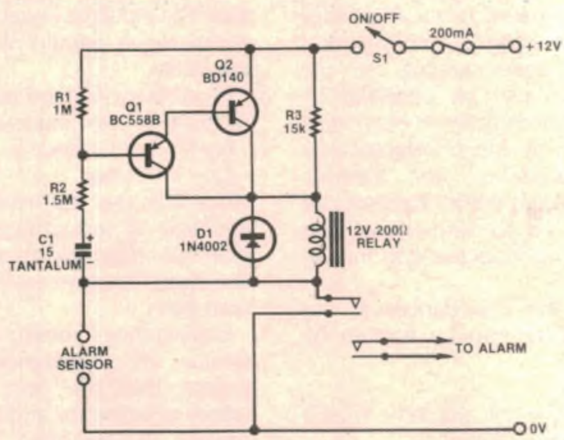
The 11,000µF filter capacitor used in the prototype was a high-ripple computer type, but three or four conventional electrolytics connected in parallel to give 10,000-20,000µF will suffice. The MJ15004 transistor is a heavy duty PNP type rated at 20 amps and 250W. It must be fitted to a substantial heatsink equivalent to 350cm² of 3mm-thick aluminium.

Finally, the transformer should be rated to produce 18V AC at a minimum 8.5A. Either the Jones JT314 (as used in the VK Powermaster published in this issue) or the Fergusson PF4244 (16V, 18A) will be suitable.

B. Hunt,
(Address supplied.)

$20

Simple, low-cost burglar alarm



With suitable values of R1, R2 and C1, this alarm unit will operate for 30s or more when the sensor contacts are momentarily closed; eg, when an intruder steps on a pressure mat. The alarm automatically resets at the end of the timing period.

When the sensor contacts close, current flows to charge C1. At the same time, transistor Q1 is forward biased and turns on Q2, thus closing the relay contacts. The relay is a double-pole unit. Contacts RL/1 are used to hold the relay on after the sensor contacts open, while contacts RL/2 provide power to an external alarm unit.

As the voltage across C1 rises, the forward bias on Q1 falls until the current through Q2 can no longer hold the relay on. The relay then releases, thus silencing the alarm.

Suitable values of R1 and R2 will depend on the characteristics of the relay and the two transistors used. For reliable operation, the relay should operate at supply voltages down to about 9V and should release when the voltage across C1 reaches 65-75% of the supply voltage.

Transistors Q1 and Q2 in the prototype had gains of 300 and 100 respectively. Using 1MΩ for R1 and 1.5MΩ for R2 allowed the relay to release when C1 reached 8.5V. Note that a BC558 with a suitably high gain may be used instead of a BC558B.

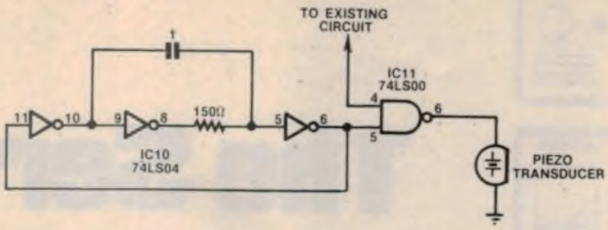
For home use, the sensor can be a pressure mat, microswitch, or any other normally open device. You can use as many sensors as you like – just connect them in parallel. The audible alarm may be a siren or piezo unit, but make sure that the rating of the relay contacts is not exceeded.

Finally, the circuit draws no quiescent current and is thus suitable for battery operation.

J. Emery,
Bull creek, WA.

$20

EPROM Programmer beeper



Readers who have constructed the EPROM Programmer (EA, January 1982) will be well aware of reliability problems with the pushbutton switches in the hex keypad. The alternative "Digitran" keypad is the obvious way to go, but it is rather expensive.

Yet another option is to use a "Utilux" type H12231/1 membrane switch. This permits reliable data entry, but without "feel" or "sound". This simple circuit provides "beep" to indicate that data has been entered whenever a key is pressed.

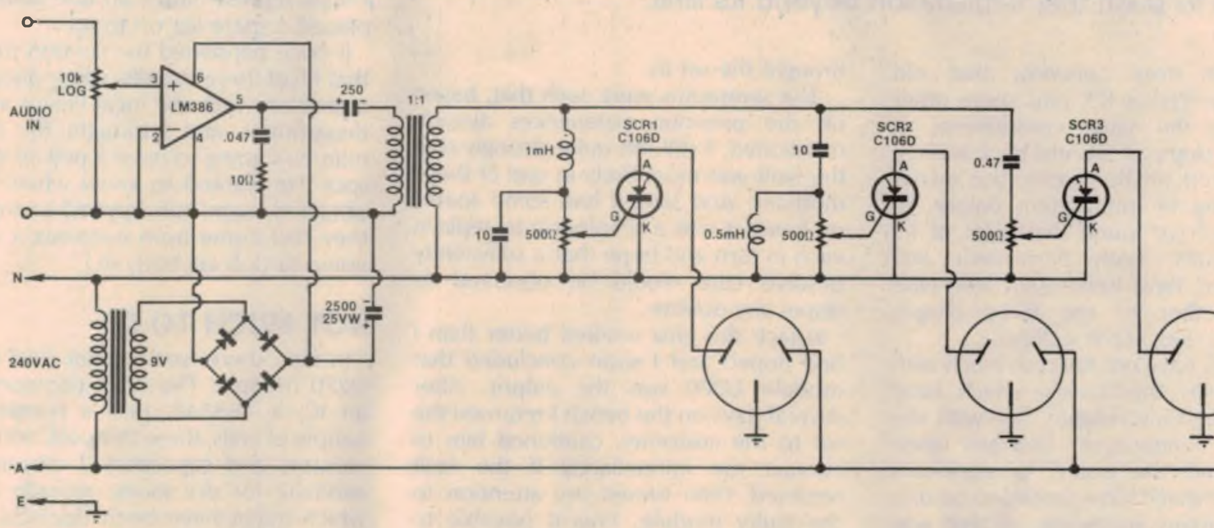
Fortunately, due to an abundance of unused gates in the circuit (not shown on the circuit diagram), all it takes to get a beep from the keypad is one 150Ω resistor, one 1μF capacitor, and a piezo transducer. Here's how it's done:

- locate IC10 74LS04 and cut the PCB tracks to free the unused inverters. Note that you will have to use a wire link to rejoin pin 3 of IC10 to pin 4 of IC6;
- using the free inverters, connect up the oscillator shown in the accompanying circuit diagram;
- locate IC11 (74LS00) and free pin 5 for connection to pin 6 of IC10;
- connect the piezo transducer between pin 6 of IC11 and supply ground.

And that's it — from now on you will have no doubt when data has been entered into your EPROM Programmer.

C. Wilton,
Redland Bay, Qld.

$15



Throbotron light show

Christened the "Throbotron", this simple circuit will modulate coloured 240V lamps in time with the music from your hifi. It can be plugged into the record output socket of your hifi or you can use a microphone pick-up instead.

Basically, the circuit splits the incoming audio signal into three bands or channels. Each channel is used to control an SCR which, in turn, switches the mains to the lamps.

The incoming audio signal is first of all fed to an LM386 audio amplifier (IC1) and thence to a 1:1 line isolation transformer. From there, the signal is split by a 3-way filter network which sends the bass frequencies to SCR1, the midrange frequencies to SCR2 and the high frequencies to SCR3. Trimpots VR1, VR2 and VR3 adjust the sensitivity.

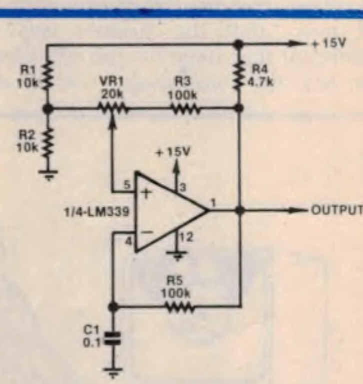
Editor's note: this circuit must be housed in an earthed metal case. Readers are warned that, depending upon your house wiring, the SCR and filter circuitry can all float at 240V AC. Heatsinks will be required for the SCRs and these must NOT be earthed.

Finally, the isolation transformer must comply with the insulation requirements of Australian standard ASC126. The Fergusson MT627 line isolation transformer, as used in the Multi Modem (EA, January 1984), is suitable.

S. Somers,
Magill, SA.

$15

Variable-frequency oscillator



Based on a single op amp comparator (¼LM339), this circuit forms a simple variable-frequency oscillator with a fixed duty cycle of approximately 50%.

R1, R2 and VR3 set the upper threshold voltage on the non-inverting input (pin 5). When power is initially applied, the voltage across C1 is zero and thus the output is high. C1 then charges via R4 and R5 until it reaches the upper threshold voltage. At this point, the output of IC1 switches low and C1 discharges through R5 until the voltage across it reaches the lower threshold. The output now switches high again and the cycle repeats.

The output frequency is varied by means of VR1 which simply varies the circuit's hysteresis. Using the values shown, the output can be smoothly adjusted anywhere between about 750Hz and 2.7kHz.

From "Electronics", November, 1983.

The Serviceman

Is this stretching coincidence too far?

On previous occasions I have related various instances of the same, or similar, faults, occurring in the same model set, two or three times in fairly rapid succession. At the time, I wrote these events off as coincidences. But a recent sequence of events seemed to push that explanation beyond its limit.

The first story concerns that old faithful, the Philips K9, plus some other sets using the same components. It started a couple of months back when a K9 appeared on the scene, the owner complaining of intermittent colour. In the past I have found that a lot of K9 colour faults, both permanent and intermittent, have been associated with one or other of the three plug-in modules, U260, U270, U280.

The faults have not been so much with the modules themselves, which have been remarkably reliable, but with the soldered connections between their sockets and the board, a significant number of which have proved to be dry. Thus, on many occasions, all that was needed was a few minutes work with a hot iron, going over these joints, and the trouble vanished.

So that was my first approach to this job and, initially at least, it seemed to work. But not for long. Within a week the owner was on the phone with the bad news that the trouble was still evident. At that stage the job was clearly one for the workshop, and I duly brought the set in.

The symptoms were such that, based on the previous experiences already mentioned, I still felt quite strongly that the fault was most likely in one of these modules. And since I had some spares on hand, it was a simple job to replace each in turn and hope that a sufficiently positive cure would be observed to dispel any doubts.

In fact, the idea worked better than I had hoped and I soon concluded that module U270 was the culprit. After several days on the bench I returned the set to the customer, cautioned him to contact me immediately if the fault returned, then turned my attention to the faulty module. Was it possible to repair it?

I don't know how many others have tackled repairing these units, but it would appear that the makers are none too keen on this idea. As far as I know, the circuits for these modules have never been officially released to Australian servicemen, being apparently classified as "top secret".

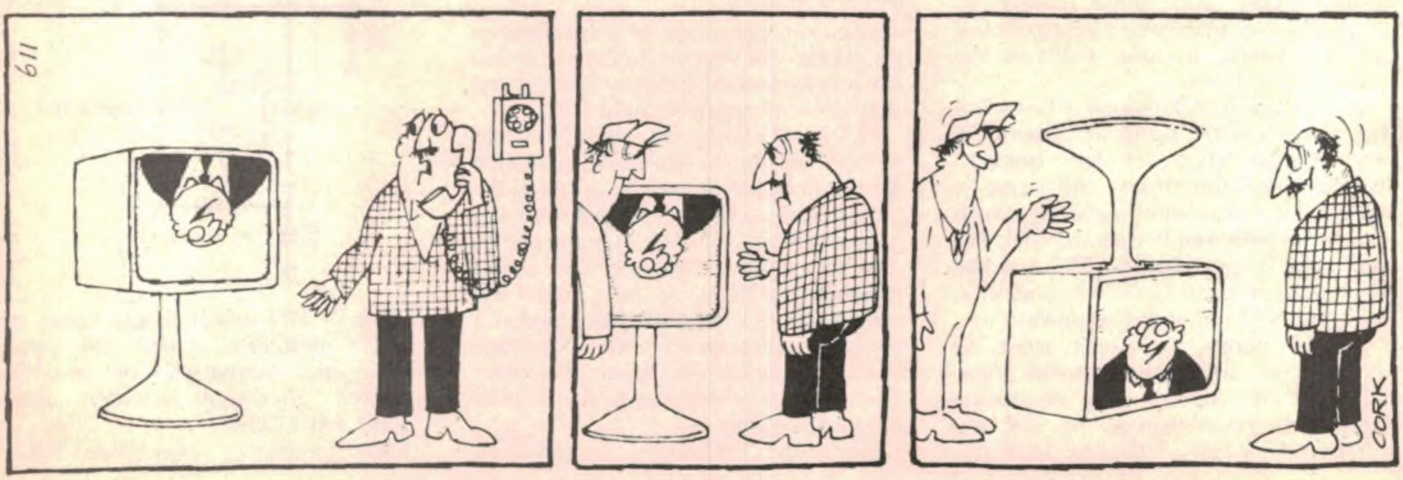
Strangely enough, this classification does not appear to be universal worldwide, and a colleague who was overseas at the time that the K9 first appeared had no trouble in obtaining copies of the circuits, quite legitimately, from the local Philips representative. In due course he passed a spare set on to me.

(I once happened to mention the fact that I had these circuits, when discussing a problem with the local Philips service department, and I thought the Philips man was going to have a pink fit on the spot. He wanted to know where I had obtained them but, beyond saying that they had come from overseas, I wasn't going to dob anybody in.)

NOT MUCH TO IT!

In fact, there isn't a great deal in the U270 module. The main component is an IC, a TBA540, plus a transistor, a couple of coils, three trimpots, and a few resistors and capacitors. I examined it carefully for dry joints, remade a few which might have been doubtful, then checked the transistor and other minor components as well as I could in-circuit. I found nothing wrong.

Of course it was only a rough check, and I could have missed something, but I decided to take a punt on the TBA540. So, armed with the solder sucker and an illuminated magnifier, I carefully removed the suspect IC and fitted a new one.



I finished up with what I hoped would be a good replacement module, the only snag being that I had no way of testing it, since I had no K9 chassis on the bench. So I put it aside until, about a week later, another K9 came in for a quite different fault. Having fixed it, I took the opportunity to substitute the rebuilt module.

It worked perfectly, and I was able to let it run on the bench for several days, since the owner was in no great hurry for his set. At the end of that time I felt the point had been proved and put the module into stock, but taking care to mark it clearly. I put the original module back into the customer's set and returned it to him.

And that was more or less that, or so I imagined. Apart from the satisfaction of repairing the module, I regarded it as a fairly routine operation. So I was mildly surprised when, a couple of weeks later, another K9 appeared with the same symptoms, though constant rather than intermittent.

I plugged in the repaired module and, presto, the fault was cured. I swapped the two modules back and forth a couple of times, in case it was a socket fault, but this proved negative. So, after a couple of days run on the bench, I considered the point proved. This time, however, I fitted a new TBA540 to the faulty module and tested it in the set before returning the latter to the customer. And, once again, it was the IC which was faulty.

All that happened a couple of months ago and since then I have been averaging a K9 about every two weeks, always with the same symptom and always with the same faulty TBA540. While I normally buy these ICs one at a time I am now ordering them in lots of six. So far I have had about seven such cases, mostly K9s but one model K11 and one K2, which both use the same module.

So why did these ICs decide to fail now, all at virtually the same time, and almost exclusively in the K9s. This IC is also used in some Kriesler models, but there has been no run of these sets.

And, as if the K9s did not provide coincidence enough, I had another sequence of events, over approximately the same time period, involving a quite different fault in a different brand receiver. In this case the receiver was the Australian made HMV model 221; a more or less second generation set under this brand, the first one being the model 211.

In most respects these two models were almost identical, but the 221 was a much tidied up version of the 211; the latter having developed more than its fair share of faults, particularly in the line board and power supply module. These problems were largely overcome in the 221, which has become known as an extremely reliable set.

Over the years that these sets have been in the field, the only serious faults I have encountered in them have been a couple of cases of line transformer failure which, in one case at least, took out the tripler as well. (Or maybe it was a tripler failure which took out the line transformer; I can't be sure which).

Anyway, the present sequence started a couple of months ago when a customer phoned to say that his set had failed completely. I established that it was an HMV set and, with a little careful questioning, that it was probably a model 221. So I packed a set of replacement boards, just in case it was a serious failure.

When I arrived at his house the customer volunteered the information that, ". . . there was a smell of burning from it. I think it's caught fire, sort of." Thus alerted, I pulled the back off the set, removed the covers from the line stage, and turned the set on.

It was almost immediately obvious that there was no EHT being generated, although the main power supply was running normally and there were no immediate signs of distress. I let the set run for about a minute then felt the line transformer. It was quite hot and closer inspection showed that it was also slightly discoloured.

REPLACEMENT BOARD

The cure was simple. I fitted a replacement board, whereupon the set came good without any other problems being evident. I made the appropriate charge, pocketed the old board, and went on my way. Back at the shop I ordered a replacement transformer and, when it arrived, fitted it to the board. Tested in the jig it proved to be working correctly, and was put into stock.

On past experience I confidently expected that it would be many months, at least, before I would need it; probably a good deal longer. In fact, it was only about 10 days later that I received a call from another model 221 owner who had much the same story; a smell of burning, loss of picture, etc. Naturally, they had turned it off immediately.

Again I packed a full set of boards, although I couldn't help speculating that it might be the same fault over again. Sure enough, it was. So once again I went through the routine; replace the board, salvage the old one, fit a new transformer, and put it into stock.

In less than a week I had a third call and, to add coincidence to coincidence, it was from a house only about 100 metres from the house in which the first set had failed. However, I doubt whether

Telephones:
211 0744
211 0816

Radio Despatch Service

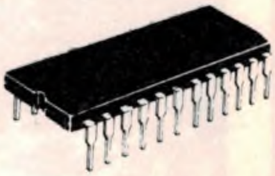
Est 1934

869 GEORGE STREET, SYDNEY 2000

WE STOCK A LARGE RANGE OF SEMICONDUCTORS

	1.24	25up
LM13600	1.61	1.53
DX1488N	1.02	.96
DS1489N	1.30	1.23
MM210IN	5.50	5.22
MM2102N	2.10	1.99
MM2114	3.14	2.98
LM555	51	.48
LM741-5	40	.37

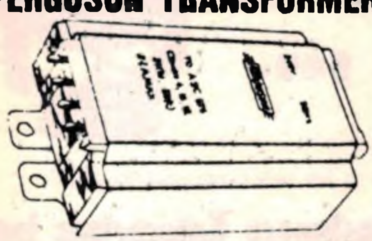
400 SERIES
7400 SERIES
74LS SERIES
74000 SERIES
74S SERIES



	1.24	25up
74S	.65	.52
74S02	.72	.58
74S03	.65	.52
74S04	.72	.58
74S05	.72	.58
74S08	.68	.54
74S09	.72	.58
74S10	.72	.58
74S11	.82	.66
74S15	.72	.58
74S20	.65	.52
74S22	.72	.58
74S30	.72	.58
74S32	.74	.60
74S51	.68	.54
74S74	1.07	.85
74S85	3.22	2.57
74S86	.96	.88

TOO MANY TO LIST

FERGUSON TRANSFORMERS



PL-/2-5VA SERIES	7.75
PL-/5VA SERIES	8.25
PL-/20VA SERIES	14.75
PL-/40VA SERIES	16.25
PL-/60VA SERIES	21.25
TS115/30VA	40.00
TS115/60VA	40.00
TS115/200VA	42.00
TS115/300VA	60.00

PLEASE NOTE NEW TELEPHONE NUMBERS

TRADING HOURS:

MONDAY TO FRIDAY 8.30am to 5.30pm

SATURDAY 8.30am to 12pm

MULTIMETERS

UNIVERSITY MVA-22
20,000 ohm's per volt
10a AC/DC!

$36.60

UNIVERSITY YF-1100
DIGITAL MULTIMETER
TRANSISTOR TESTER BUILT IN

$78

PARAMETERS 7040 DIGITAL
0.1% ACCURACY
28 RANGES
10A AC/DC

$94

FLUKE 73-75-77
ANALOG/DIGITAL DISPLAY

73	75	77
126.60	148.40	189.80

MICROPROFFESSOR I.B.

Z80, 2K RAM
2K ROM,
2K MONITOR
6 DIGIT DISPLAY

$165.60

CALCULATORS

CASIO

FC 550	33.73
FX 82	24.95
FX 910	39.95
FX 990	49.95
FX 450	58.12
PF 100	79.95
FX 602P	109.95
FX 702P	169.16
FX 700	124.95
FX 802P	189.95
FX 3600P	49.95

TEXAS INSTRUMENTS

TI 30-ii	22.00
TI 35	26.00
TI 54	48.00
TI 55 ii	67.00
TI LCD Prog	76.00
BA ii	55.00
BA 55	76.00

HEWLETT-PACKARD

HP 10 C	109.86
HP 11 C	141.25
HP 12 C	188.34
HP 15 C	188.34
HP 16 C	188.34
HP 41 C	306.06
HP 41 CV	431.63
HP 41 CX	486.56

NEW MODELS

Just released

CASIO FX-370, FX-570

70 Functions **79** Functions.
Inc Base Conv + Permutations.

PB 700 Computer
up to 16K — many features

SPECIAL OF THE MONTH

AARON BS601 20 MHz Dual Trace with b/in Comp Tester Oscilloscope with two free probes **$620.60**

ALL PRICES INCL SALES TAX

The Serviceman

there was really anything significant in that fact. Once again, it was the line transformer.

The fourth call didn't happen for about another two weeks and it wasn't quite the same. It was obvious that the line transformer had failed, and I duly replaced the board, but that didn't fix it. This time the tripler had failed as well, so I can't be sure which had destroyed what.

MORE TO COME

But that wasn't the end of the sequence. Over the ensuing weeks I had another three cases, making seven in all. And take my word for it; when you have encountered the same fault seven times over a period of about three months you really begin to wonder what is going on. Is it coincidence, or is there some definite pattern emerging?

Could it be, for example, that a whole batch of line transformers contained an inherent weakness, such that they all began to fail at the same time? But, if so, I would not be the only one to encounter the fault. Yet I have been unable to find any similar stories among my colleagues or in any service literature. I even questioned a salesman who supplies replacement boards, but he had no indication of any upsurge in demand for these boards.

Much the same reasoning might be applied to the sequence of K9 failures; a batch of faulty TBA540s which all reach the end of their tether at the same time. But, again, why only in my stamping ground? Why haven't we heard of the same fault occurring in batches all over the country?

So the whole thing remains a mystery. If any readers have had any similar experience, they may be able to throw some light on it.

To change the subject, here is a letter from a fellow serviceman, one D.M. of Rochester, Victoria. He writes: This letter was prompted by the Serviceman's December 1983 notes — "More on TV fires" and the letter from J.M. of Warwick, Q.

About five years ago a burnt Philips K9A/2 TV set arrived at the workshop, via the local insurance office, who had written it off. Later, I purchased the set for $25. The picture tube mask and control panel was one molten mass, while the back had a large "U" shaped channel melted into it. Inside, the control panel and convergence board wiring loom, plus the wiring loom and plastic fittings at the top of the cabinet were in a similar condition.

The fire apparently had started on the mains input filter printed board, tracked across the board, set fire to a thin sheet of plastic underneath it, set fire to the speaker cone, just above the filter board, and proceeded up the control panel.

The fire had started at the instant the customer turned the set on. With commendable presence of mind she turned the set off, threw a blanket over it, and dragged it outside. She did not use water on it, for fear that the picture tube might implode.

Five years later the set sits in our lounge room, fitted in a mahogany cabinet from an old 63cm monochrome TV set. (D.M. goes on to detail the various tricks he used to salvage the set, using parts mostly salvaged from old monochrome sets. Unfortunately, space does not permit presenting this in detail).

He goes on: About three months ago a Philips K11 came into the shop with blown fuses on the mains filter board. Subsequent investigation revealed a burnt track between active and neutral copper tracks on this board. This set and others of later production appear to have a piece of cardboard under this board.

Well, that's DM.'s story, and I am sure others will find it interesting and informative. It would be useful to know whether any other readers have had any similar experiences or can support D.M.'s theory as to the cause of fires in these type sets.

And, in lighter vein, here is another letter, this time from a Queensland reader, K.H. of Bundaberg. K.H. is an amateur and his story concerns a conversation overheard on the Bundaberg two-metre repeater. However, it is of interest here because it concerns a local TV serviceman, who is also an amateur. Here's how he tells it.

Call sign One, a prominent amateur who has a TV service business here, was telling call signs Two and Three about a demonstration of a new stretcher he had seen at the local ambulance brigade. He commented that a similar product had all the possibilities of being adapted to carrying a TV set from the customer's home to the van, and from the van into the workshop, thus making life a lot easier.

At this point, call sign Four broke in to cap the story off by saying, "And I bet you are going to tell us now that, when the sets are returned to the owners, they will be well enough to get out of the van and walk into the houses on their own."

Oh well.

Oh well, indeed, K.H., and I hope the local amateurs imposed some kind of ban on call sign Four, for a crack like that.

Microbee-No.1 for computers Jaycar-No.1 for Microbee

microbee

Jaycar Electronic Agencies is proud to announce the 1984 range of microbee computers – at new low prices!! The microbee Series 2 machines are ALL supplied with built-in communications capability, dual font 80 character by 24 line & 65 character by 16 line displays. Remember, your microbee is obsolete-proof with g'teed upward expandability.

microbee Series 2 EXPERIMENTER

By popular request, the low cost microbee Series 2 Experimenter has been designed for those who are starting out in the fascinating world of computers or those who want to share the fascination of exploring the exciting developments in the fast moving MICRO WORLD.

Demand for projects using the microbee is so great that 'Electronics Today' are now planning to run a microbee project every month during 1984. So far ETI has described the light pen, EPROM programmer, a radio TTY printer, the world's first home facsimile receiver and ROM expander board for the microbee. Virtually every local computer magazine has run reviews and/or columns devoted entirely to the microbee. If you want to be part of the MICROCOMPUTER GENERATION in 1984 then microbee Series 2 Experimenter is the ideal starting point. Of course you can expand your microbee Series 2 Experimenter as your need grows.

$399 Cat. XE-4000

Note: the software that is supplied with each machine – at no extra charge!!

microbee Series 2 EDUCATOR

The microbee Series 2 was specifically designed to serve the needs of the EDUCATION MARKET. Let's face it, the primary non business use for most personal microcomputers is to increase our learning capabilities either about computers (computer awareness) or about life itself. microbee Series 2 has now been officially approved by Education Departments in NSW, WA and Queensland and is being carefully considered in virtually all other states and by the National Schools Commission at the time this ad was going to press.

The microbee Educator uses BATTERY BACKED NON VOLATILE CMOS RAM so your programs are saved in the microbee Series 2 after the power is switched off. Students can bring the microbee Series 2 Educator home from school to complete assignments ready for class the next day. With the optional BEEMODEM you can use your microbee Series 2 Educator to talk to other computers or information networks.

$449 Cat. XE-4050

microbee Series 2 PERSONAL COMMUNICATOR

With the BUILT-IN WORDBEE in ROM as well as MICROWORLD BASIC and NETWORKING, the Personal Communicator is a powerful home computer ideal for virtually any home use from wordprocessing, spreadsheet analysis, eduction and even experimentation with the computer concepts as they evolve during the year. With the optional BEEMODEM you can send WORDBEE files across any telephone line to another computer. Bee the first on your block to have home telex!

$499 Cat. XE-4100

microbee Series 2 ADVANCED PERSONAL COMPUTER

Now for the first time in Australia: the microbee Series 2 Advanced Personal Computer with 400K disk drive. Then add bundled world class software such as CP/M, MICROSOFT BASIC, MULTIPLAN, WORDSTAR and a powerful library of support programs and you will have some idea as to why the microbee Series 2 Advanced Personal Computer is the most powerful and best price/performance computer in its class. What's more any existing microbee owner can convert his microbee to the Series 2 APC at any time.

The microbee Series 2 APC uses the popular Z80 microprocessor and runs standard CP/M so that users have access to the vast library of CP/M software available world wide. MICROSOFT BASIC is now supplied on disk. WORDSTAR, according to independent surveys now accounts for 50% of ALL word processing software now in use so the designers of the Series 2 APC decided to purchase the OEM rights for your benefit. MULTIPLAN is considered by many to be one of the most powerful spreadsheets yet produced for the microcomputer.

$1495 Cat. XE-4200 SINGLE 400K DISK DRIVE

$1795 DUAL 400K DISK DRIVE Cat. XE-4300

MICROBEE

KITS—KITS—KITS—KITS—KITS—KITS—KITS

ETI 733 RTTY Convertor. Ref: ETI April 1983. This simple project allows you to hook up your MicroBee to a HF receiver and print radio teletype messages on a monitor screen. Listen to world news for FREE!!
Cat. KE-4654 — ONLY $17.95

ETI 649 MicroBee Light Pen. Ref: ETI August 1983. This simple, low cost device plugs into the Bee's 8 bit port. The "pen" gives you an entry into the world of light pens and interactive software.
Cat. KE-4656 — SHORTFORM $19.50
SPECIAL PROBE CASE TO SUIT (as specified in ETI article) Cat. HB-6400 — $19.95

ETI 668 MicroBee EPROM Programmer. Ref: ETI February 1983. This simple, low cost EPROM programmer just plugs into the Bee's I/O port and enables you to save programs in any of the 5 different common EPROMs available (2716, 2532, 2732, 2732A, 2764). Kit comes complete with 'Personality' plug and all IC sockets.
Cat. KE-4650 — $39.95

Parallel Interface Kit for the MicroBee. Includes 15 pin 'D' plug – add $15.00 if Centronics plug required.
Cat. KE-7017 — $15.00

BRILLIANT!

$399

DIRECT CONNECT MODEM

KEY FEATURES
- DIRECT ATTACH AUTO ANSWER MODEM
- 300 BPS FULL DUPLEX (CCITT V21)
- 1200 BPS HALF DUPLEX (CCITT V23)
- 75 BPS BACK CHANNEL (FULL V23)
- AUTO DIAL
- BELL FREQUENCIES INCLUDED
- TELECOM APPROVED
- 1 YEAR WARRANTY
- NO ADJUSTABLE CIRCUITRY
- DESIGNED IN AUSTRALIA
- MADE IN AUSTRALIA

THIS IS NOT A "TOY"

Includes 1 years subscription to the Australian Beginning

Jaycar has made a bulk purchase to bring them to you at the incredibly low price of $399. Amazing value for a FULL DUPLEX unit.
Cat. YC-1350

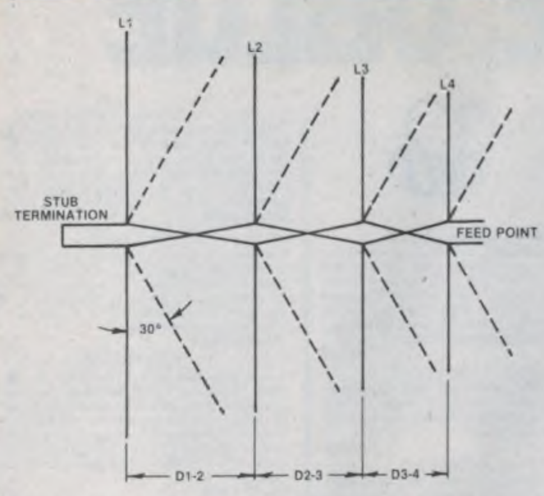


Fig. 1

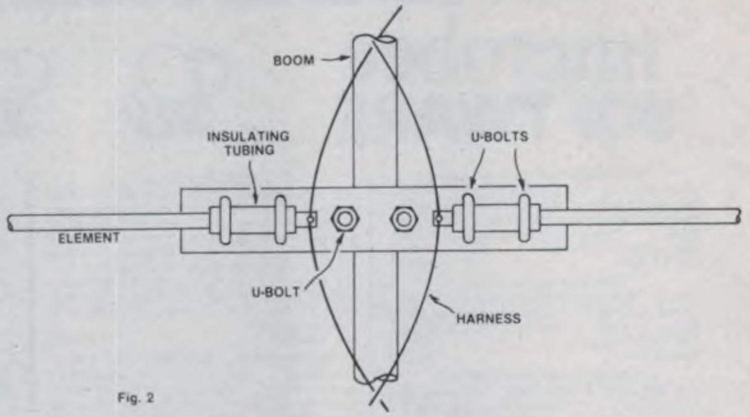


Fig. 2

Fig. 1 (left): general layout of a log period dipole antenna.

Fig. 2: method of mounting elements and running connecting harness.

How to obtain better

Design and build your own log periodic antenna to suit TV or FM reception. The job is made easy with a Basic program to run on a personal computer.

Most of the information on which this article is based was originally published by Robert Carrell of the Electrical Engineering Research Laboratory, in a paper entitled "The Analysis and Design of the Log-Periodic Dipole Antenna", and which was the subject of two articles in "Electronics Australia" in December 1965 and January 1966.

Since those articles were published the popularity of log periodic dipole antennas (LPDA) has grown considerably to the point where most new antenna installations are of the log periodic configuration. As indicated in the fourth article in this series, in October 1983, most commercial LPDA antennas could be referred to as hybrid designs since they combine parasitic elements (directors) with the basic array.

The attraction of adding directors instead of log periodic dipole elements is that it increases the gain while keeping the array to a reasonable size. Another way of reducing the size of the overall array is to interleave high frequency (short) and low-frequency (long) elements on the one boom.

There are two other ways of reducing the size of a log periodic array. One is to take advantage of its ability to operate with a broken frequency progression. In other words it is possible to design the first few elements to cover a bandwidth of frequencies, jump the next 30 or 40MHz and then continue on to cover another band of frequencies. This property allows the size of the antenna to be reduced when separate channels only are required.

The second method involves angling the elements towards the apex so that they all take on a "V" configuration. This enables the array to operate in higher resonance modes with a consequent increase in gain while exhibiting a polar response pattern with negligible side lobes. Australian antenna manufacturers have yet to exploit this characteristic but some overseas designs have used it.

A higher resonance mode is defined as a frequency that is an odd multiple of the fundamental frequency of the array. The fundamental mode is called the half-wavelength mode, and each odd multiple is thus three half-wavelengths, five half-wavelengths, seven half-wavelengths and so on. The usefulness of such an array becomes obvious when one considers that an LPDA "V" with a fundamental frequency range of 60-75MHz will also operate in the three half-wavelength mode at 180-225MHz. Thus one antenna can cover a low band VHF TV channel and several high-band TV channels with increased gain.

In a normal LPDA, approximately four elements are active at any one frequency. To ensure that an array operates at its peak efficiency, over the desired frequency range, it is good design practice to add 10% to the lowest frequency and 25-40% to the highest frequency involved. For example an antenna to cover 60 to 80MHz would be designed using the frequencies of 54 and 112MHz. This precaution will prevent reduction of gain at high frequencies and retain good front-to-back ratios at the lower frequencies. However, the antenna design examples given later, in the interests of reduced physical size, are based on frequencies closer to the frequency coverage required.

Design parameters

Before you can design a log periodic array, you must be familiar with the design parameters. Let us run through these briefly. The first is the Tau factor which is the common ratio between the lengths of any two successive pairs of elements. The second is Alpha which is the angle subtended by lines drawn through the ends of the dipole elements to meet at the virtual apex of the array.

The ratio of the distance between two adjacent elements to twice the length of the larger element is a constant for a given antenna. This is known as the spacing factor, Sigma. The geometry of the antenna relates all three factors, Sigma, Tau and Alpha as stated in the following equation:

$$S = \tfrac{1}{4}(1-T)\cot \alpha$$

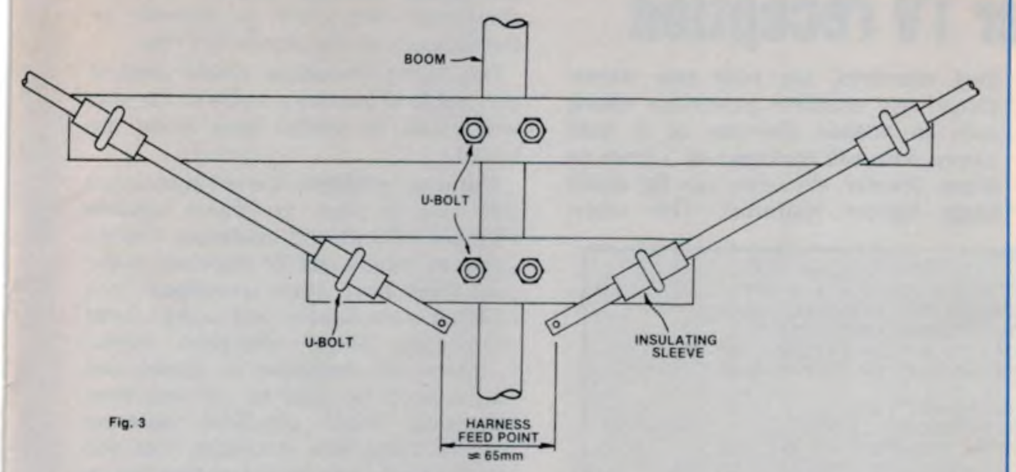


Fig. 3: construction method for a V-shaped antenna array.

TV reception

Part 6

by M. TAYLOR

where T is the Tau factor, S is the Sigma factor and ∝ is the angle Alpha.

To determine the number of elements required in an array the operating bandwidth factor (Bs) must be known. To calculate the operating bandwidth of the antenna another factor, bandwidth of the active region (Bar), must first be determined. Bar is directly related to Tau and may be determined by the following equation:

$$Bar = 1.1 + 7.7(1-T)^2 \cot\alpha$$

Once Bar has been ascertained then Bs may be obtained from the next equation where "B" equals the ratio between the highest and lowest operating frequencies:

$$Bs = B \times Bar$$

Finally the number of elements required is determined by:

$$N = 1 + \frac{\log Bs}{\log \frac{1}{T}}$$

The relative length of the antenna can be determined by adding the spacings between elements or ascertained in terms of wavelength by the next equation:

$$L/\lambda \max = \tfrac{1}{4}\left(1 - \frac{1}{Bx}\right)\cot\alpha$$

With the above information, a scientific calculator and a lot of patience, you could proceed to design LPDAs. Remember that the antenna gain increases as Tau increases (resulting in more elements for a given frequency), while the subtended angle decreases (wider element spacing).

However, to ease the furrowed brow and sore finger tips a Basic computer program has been written. This program should run without alteration on TRS-80 Level II and System-80 computers. It requires under 4K to load and run successfully. It should be easy to modify for most computers and has been run after minor modifications on the author's Commodore 64.

The computer program

When entered, the program will request inputs of lowest and highest operating frequencies, scale factor and subtended angle. Higher values of scale factor will give higher gain, as will smaller values of subtended angle. On your first run, try an angle of about 20°. By varying the angle, the number of elements and boom length can be changed.

The first read-out will give a definite number of elements, followed by a fractional number in brackets. By varying the angle, it is possible to bring the fractional number just below the integer value. Use this integer value and select the number of elements, having in mind the compromise between overall gain as compared to economy and size of the array.

When the first read-out is acceptable, entering "C" on the keyboard will complete the calculation and print out up to 15 elements and 14 spacings as well as the length of the feeder termination (stub). Only use the number of elements first selected.

There are two ERROR routines, lines 110 and 115, which will not allow the antenna parameters to deviate outside acceptable performance characteristics.

When you have become familiar with the use of the LPDA program, the following changes may be made to make it run faster:

```
2015 FOR XX=1 TO 1000:NEXT XX:
CLS: GOTO 65
2035 FOR XX=1 TO 1000:NEXT XX:
CLS: GOTO 65
```

There is an optimum value for Sigma which will give best directivity, good front-to-back ratio and minimum side lobes. It will not necessarily give the smallest number of elements or shortest boom length. To display this information and help with design decisions add the following lines to the program:

```
270 TT=T*0.185185
1015 PRINT:PRINT"OPTIMUM SIGMA
APPROX.";TT;", ACTUAL SIGMA";S;"."
```

Theoretical gain for the fundamental frequency mode of LPDAs in this article, at optimum Sigma and for ascending values of Tau, are given below. These are approximate values and depend on care in construction, especially at the higher frequencies.

TAU	GAIN
0.78	6.0–8.0dB
0.82	6.5–8.5dB
0.87	7.0–9.0dB
0.9	7.5–9.5dB
0.92	8.0–10.0dB
0.93	8.5–10.5dB
0.945	9.0–11.0dB
0.955	9.5–11.5dB
0.965	10.0–12.0dB

Higher gains may be obtained at Sigma values below optimum but some sacrifice of the other features of the antenna will then have to be accepted.

When the program is used to design an LPDA for fundamental operation, a 6 or 7 element antenna will have an approximate impedance of 200Ω. When the antenna elements are angled forward, to an included angle of 120°, the LPDA "V" will operate successfully in third harmonic mode. The impedance will be different to the LPDA fundamental frequency antenna, using straight elements, but will still give good performance using 300Ω ribbon feeder.

For readers without computers, Table 1 gives some typical antenna designs covering popular frequencies. These antennas have been calculated using the computer program, but not actually constructed due to time and cost. As these designs adhere strictly to theoretical parameters they should, if carefully constructed, give good results.

Construction method

When constructing these antennas, the long elements, say over one meter, should use seamless aluminium tubing with an outside diameter of at least 12mm and wall thickness of 1.2mm or more. Shorter elements can be made from lighter material. The inter-connecting harness should be soft aluminium wire, 3mm in diameter or thereabouts, or flat aluminium strip.

The stub termination, where used, is also made of aluminium wire or flat strip which can be folded back along the boom.

The main problem home constructors will face is how to obtain suitable element mounts and insulators. First to come to mind is old TV antennas; in the past these have been scrounged from building demolishers and scrap metal merchants. Some television manufacturers sell insulators as spares and may indeed be glad to sell insulators left over from obsolete antenna manufacturing runs. Insulators may also be fashioned from fibreglass sheeting or tubing, or moulded from an epoxy base such as Plasti-Bond.

Another possibility is to use metal support brackets with the elements insulated from the brackets using nylon nuts and bolts. Small sections of plastic water hose or plastic conduit may be slipped over the ends of the elements and then clamped to the metal support brackets using "U" type muffler clamps or conduit clamps. If wood or tempered Masonite, is used it must be painted at regular intervals to provide protection against the weather.

Normally 25mm aluminium tubing, or larger for really big antennas, is used for the boom. Do not neglect the possibility of square section material for the boom; it is simpler to line up the elements with this material. Finally, 25mm or larger dowel (rake handles, etc), if protected from weathering, may also be pressed into service for a boom.

The fundamental LPDA using straight elements presents no further problems in supporting the elements. The "V" version requires more thought. One approach is to use the straight type insulator and bend the element, at the extremity of the insulator, forward by 30°.

If you haven't bent tubing before then there are some precautions worth noting. To stop creasing of the tube it is common to fill the tubing with some material which can be removed after bending to the final shape. Materials used include sand, low melting point metals, coiled springs and rope of a suitable diameter. You may also wish to leave something like nylon rope in the element to help reduce ringing and fatigue.

Fig. 1 shows the general layout of a log periodic dipole antenna. Note that with any array shown in Table 1, the overall length of elements is the same regardless of whether they are straight (for the fundamental mode) or angled for the harmonic mode. Note that the spacing between each dipole

```
15 CLS
20 PRINT"   *** L O G   P E R I O D I C   D I P O L E S ***"
25 PRINT:PRINT"THIS PROGRAM WILL DETERMINE THE PHYSICAL PARAMETERS"
30 PRINT"OF LOG PERIODIC DIPOLES WITH EXTENDED BANDWIDTH."
35 PRINT:PRINT"THE ANTENNA WILL BE LIMITED AT LOW FREQUENCIES BY"
40 PRINT"PHYSICAL SIZE AND AT HIGH FREQUENCIES BY MECHANICAL"
45 PRINT"PRECISION IN CONSTRUCTION."
47 PRINT:PRINT:INPUT"PRESS ENTER TO CONTINUE.";B$
50 CLS:INPUT"WHAT IS LOWEST OPERATING FREQUENCY IN MHZ";FL
55 PRINT:INPUT"WHAT IS HIGHEST OPERATING FREQUENCY IN MHZ";FH
60 CLS:INPUT"WHAT IS SCALE FACTOR,0.7 TO 0.98,(ASCENDING GAIN)";T
65 PRINT:INPUT"WHAT IS SUBTENDED ANGLE,2.5 TO 45 DEGREES";A
100 REM CALCULATE SIGMA
105 YY=A*0.01745329:XX=TAN(YY):CO=1/XX
110 WW=1-T:S=WW*0.25*CO:IF S<0.05 GOTO2000
115 QQ=T/S:IF QQ<5.4 GOTO2020
150 REM CALCULATE BAR
155 X=1-T:Y=X*X:BA=(Y*CO*7.7)+1.1
200 REM CALCULATE BOOM SIZE RELATIVE TO WAVELENGTH
205 B=FH/FL:BS=B*BA
210 Z=1/BS:L=CO*.25*(1-Z)
250 REM CALCULATE NUMBER OF ELEMENTS
255 FF=LOG(BS):GG=LOG(10):Q=FF/GG
260 R=1/T:UU=LOG(R):TT=LOG(10):U=UU/TT
265 N=(Q/U)+1:M=FIX(N)+1
1000 CLS:PRINT"THIS ANTENNA COVERS FROM";FL;"MHZ TO";FH;"MHZ."
1010 PRINT:PRINT"THE SCALE FACTOR IS";T;"AND SUBTENDED ANGLE";A;"."
1020 PRINT:PRINT"THE BOOM SIZE RELATIVE TO A WAVELENGTH IS";L;"."
1030 PRINT:PRINT"THE MINIMUM NUMBER OF ELEMENTS IS";M;" (";N;")."
1034 PRINT:PRINT
1040 INPUT"PRESS 'F' TO FINISH,'C' TO CONTINUE ,'H' TO RE-START";A$
1050 IFA$="F"THEN5000ELSE1060
1060 IFA$="C"THEN1500ELSE1070
1070 IF A$="H" THEN 50 ELSE 1040
1500 PRINT:REM CALCULATE LENGTH OF FIRST ELEMENT
1505 LET RE=149962/FL
1510 REM CALCULATE LENGTH OF OTHER ELEMENTS
1520 RF=RE*T:RG=RF*T:RH=RG*T:RI=RH*T
1530 RJ=RI*T:RK=RJ*T:RL=RK*T:RM=RL*T
1540 RN=RM*T:RO=RN*T:RP=RO*T:RQ=RP*T
1550 RR=RQ*T:RS=RR*T
1560 REM CALCULATE FIRST ELEMENT SPACING
1570 SA=S*2*RE
1590 REM CALCULATE OTHER ELEMENT SPACINGS
1600 SB=SA*T:SC=SB*T:SD=SC*T:SE=SD*T
1610 SF=SE*T:SG=SF*T:SH=SG*T:SI=SH*T
1620 SJ=SI*T:SK=SJ*T:SL=SK*T:SM=SL*T
1630 SN=SM*T
1650 REM CALCULATE FEEDER TERMINATION
1660 FT=37490.5/FL
1800 CLS
1810 PRINT"REAR ELEMENT LENGTH";RE;"MM,FIRST SPACING";SA;"MM."
1820 PRINT"NEXT ELEMENT LENGTH";RF;"MM, NEXT SPACING";SB;"MM."
1830 PRINT:PRINT"NEXT ELEMENT LENGTH"RG;"MM, NEXT SPACING";SC;"MM."
1840 PRINT"NEXT ELEMENT LENGTH";RH;"MM, NEXT SPACING";SD;"MM."
1850 PRINT:PRINT"NEXT ELEMENT LENGTH";RI;"MM, NEXT SPACING";SE;"MM."
1860 PRINT"NEXT ELEMENT LENGTH";RJ;"MM, NEXT SPACING";SF;"MM."
1870 PRINT:PRINT"NEXT ELEMENT LENGTH";RK;"MM, NEXT SPACING ";SG;"MM."
1880 PRINT"NEXT ELEMENT LENGTH";RL;"MM, NEXT SPACING";SH;"MM."
1890 PRINT:INPUT"PRESS ENTER TO CONTINUE";B$
1900 CLS:PRINT"NEXT ELEMENT LENGTH";RM;"MM, NEXT SPACING";SI;"MM."
1910 PRINT"NEXT ELEMENT LENGTH";RN;"MM, NEXT SPACING";SJ;"MM."
1920 PRINT:PRINT"NEXT ELEMENT LENGTH";RO;"MM, NEXT SPACING";SK;"MM."
1930 PRINT"NEXT ELEMENT LENGTH";RP;"MM, NEXT SPACING";SL;"MM."
1940 PRINT:PRINT"NEXT ELEMENT LENGTH";RQ;"MM, NEXT SPACING";SM;"MM."
1950 PRINT"NEXT ELEMENT LENGTH";RR;"MM, NEXT SPACING";SN;"MM."
1960 PRINT"NEXT ELEMENT LENGTH";RS;"MM."
1970 PRINT:PRINT"FEEDER TERMINATION IS";FT;"MM BEHIND REAR ELEMENT."
1975 PRINT:INPUT"DO YOU WISH TO SEE FIGURES AGAIN YES(Y) OR NO(N)";XX$
1976 IFXX$="Y"THEN1000ELSE1977
1977 IFXX$="N"THEN1980ELSE1975
1980 GOTO 1040
2000 CLS:PRINT"SIGMA (";S;") IS LESS THAN 0.05,THIS WILL DECREASE"
2010 PRINT"DIRECTIVITY AND F/B RATIO,TRY DIFFERENT ANGLE."
2015 FOR XX=1TO3000:NEXTXX:GOTO50
2020 CLS:PRINT"SIGMA IS GREATER THAN OPTIMUM,THIS WILL DECREASE"
2025 PRINT"DIRECTIVITY, SIDE LOBES WILL APPEAR AND ANTENNA LENGTH"
2030 PRINT"WILL BE EXCESSIVE. TRY DIFFERENT ANGLE."
2035 FOR XX=1TO3000:NEXTXX:GOTO50
5000 CLS:PRINT"PROGRAM TERMINATED AS REQUESTED.":END
```

TABLE 1: PRACTICAL ANTENNA DESIGNS

		1	2	3	4	5	6
ANTENNA DESIGN No.		1	2	3	4	5	6
FUNDAMENTAL FREQ		45-108	88-108	88-108	170-222	170-280	143-160
HARMONIC FREQ		135-324				510-840	429-480
ELEMENT LENGTH	L1	3333	1704	1704	882	882	1049
	L2	2666	1278	1568	812	794	996
	L3	2133	959	1442	747	715	946
	L4	1706	719	1327	687	643	899
	L5	1365	—	1221	632	579	854
	L6	1092	—	1123	581	521	812
	L7	874	—	1033	535	469	771
	L8	—	—	—	492	422	—
ELEMENT SPACING	D1-2	523	362	335	194	96	157
	D2-3	419	271	308	179	86	149
	D3-4	335	203	284	164	78	141
	D4-5	268	—	261	151	70	134
	D5-6	214	—	240	139	63	128
	D6-7	171	—	221	128	57	121
	D7-8	—	—	—	118	51	—
FEEDER TERMINATION LENGTH		833	—	426	221	221	262
APPLICATION		LOCAL VHF TV & FM	LOCAL FM	FRINGE FM	FRINGE TV. CH6-11	LOCAL TV VHF & UHF	RECEIVING 2METRE, 70cm & UHF CB

connection (to the harness) is not critical provided that the overall dipole length is as specified in the table.

Note that the stub termination does not protrude from the end of the boom as depicted schematically in Fig. 1 but is folded back along the boom, as noted above.

The antenna feeder connections, ie, to the cable down to the set, are made at the apex, as shown in Fig. 1. As it stands, any of these antennas will drive 300Ω TV ribbon satisfactorily or preferably, if 75Ω coax cable is used, a balun should be employed. Weatherproof baluns which may be fastened to the terminals of most TV antennas are readily available from most electronics parts suppliers for a few dollars.

Fig. 2 shows a practical method of mounting elements to a boom and using aluminium wire for the interconnecting harness. Fig. 3 shows an alternative method to bending for a V-shaped array. The double-clamp support system would only be necessary for the longer elements.

Most antenna manufacturers use aluminium screws and nuts or pop rivets to fasten and terminate the antenna elements. This is desirable to minimise corrosion. Aluminium screws and nuts can be obtained from the better hardware stores. If pop rivets are used, make sure you use the type with an aluminium stem. Those with a steel stem will rust out in short order.

Even so, it is a good idea to paint the finished antenna with a metal etch primer and then add a couple of coats of British Paints "Silvar" or other aluminium loaded paint. Make sure you don't short out the insulating connections with this paint!

Finally, it is good practice to seal the ends of all elements and the boom. The smaller diameter elements can be just pinched off while larger elements can be plugged with a blob of epoxy adhesive or silicone caulking compound.

TAX TIME SELLOUT

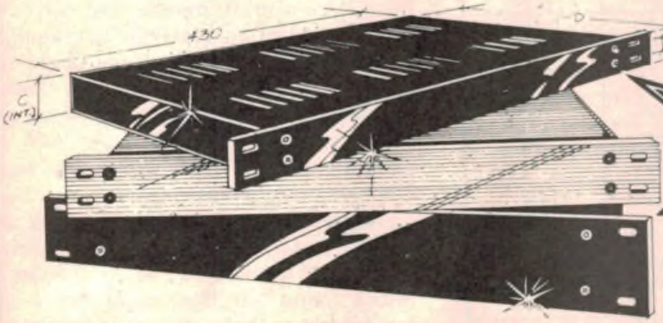
Yes it's that dreaded time of the year where we have to shell out 1000's of $ of our hard earned cash to the taxman! **So here's your chance to save a fortune** we're clearing $50,000 of these top selling products at never to be repeated prices to overcome our present dilemma

— Regards, *Jack O'Donnell*

Sale continued from pages 22-25.

YOUR BUDGET PROBABLY ~~WON'T~~ WILL STRETCH TO AFFORD OUR PROFESSIONAL SERIES ALL ALUMINIUM RACK CABINETS

NOW YOUR PREAMPS, AMPS, CONTROL MODULES MONITOR PANELS ETC. CAN LOOK EVERY BIT AS GOOD AS TECHNICS, NAKAMICHI AND OTHER TOP MANUFACTURERS



HUGE SAVINGS THIS MONTH

* These beautifully crafted rack cabinet boxes will give your equipment a real 1st class appearance. * All aluminium construction. * REMOVABLE TOP AND BOTTOM PANELS. * All dimensioning conforms to the International Standard. * Natural or Black finish. * Ventilated lid. * Deluxe brushed finish anodised front panel. * Individually cartoned. * Supplied in Flat Pack Form — Easily assembled in minutes.

Side Elevation:
D = 254mm C (Internal Chassis Height)
B (Mounting Bolt Centres)

Cat. No.	Finish	A	B	C	Was	NOW
H 0401	Natural	44	34	38	$45.00	$39.00
H 0402	Natural	88	57	82	55.00	49.00
H 0403	Natural	132	89	126	59.95	54.00
H 0411	Black	44	34	38	45.00	39.00
H 0412	Black	88	57	82	55.00	49.00
H 0413	Black	132	89	126	59.95	54.00

Beware of other rack boxes that do not conform to International Rack Sizing.

INTERNATIONAL STD SIZING BLANK RACK PLANELS

(Elongated mounting holes provided only)

	Height	Finish	ea.	10+
H0421	44mm	Nat. Anod.	6.50	5.90
H0422	88mm	Nat. Anod.	11.50	10.50
H0423	132mm	Nat. Anod.	14.95	13.95
H0426	44mm	Blk. Anod.	7.50	6.90
H0427	88mm	Blk. Anod.	12.95	12.15
H0428	132mm	Blk. Anod.	16.95	15.95

TECHNICIAN'S UTILITY PARTS CASE

H 0449
Now
~~$6.50~~
$6

**Lightweight and durable
This Parts Case is a MUST!**

Featuring:— Clear lid (tell contents at a glance); Positive action snap lock; 30 partition combinations.

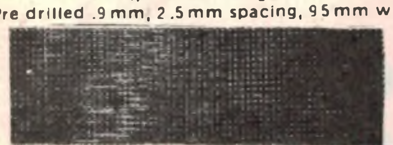
FUSE HOLDER 3AG

32 x 6.3mm Fuse

S 6000 . . . ~~.95~~
NOW .60c

VERO TYPE STRIP BOARD

Alpha numeric grid
Pre drilled .9 mm, 2.5 mm spacing, 95 mm wide

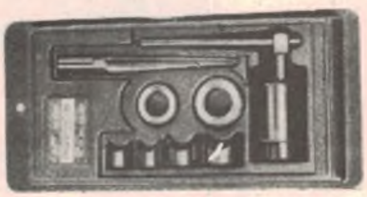


H 0712 95 x 152........... **$2.50**

HOLE PUNCH SET Fantastic Value

A must for every enthusiast or serviceman. Cuts holes in metal up to 1.6 mm (16 gauge). Set of 5 punches and tapered reamer.

Punch sizes:
16mm
18mm
20mm
25mm
30mm

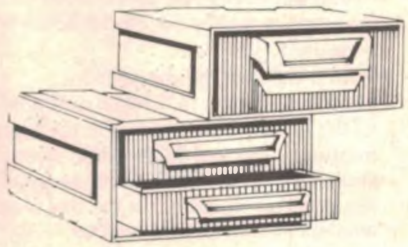


T2360.................... **$18.50**

INTERLOCKING PARTS DRAWER

Unique side and top/bottom keying system allows you to use just a few or build a whole wall of drawers as your parts expansion dictates. Quality designed drawer slides will not "stick" or seize. Slide handle also takes ident. cards. Single or double drawers available

H0435 Single Was ~~$2.95~~ . . **$2.20**
H0436 Double Was ~~$2.95~~ . **$2.20**



A SINGLE BOARD CP/M COMPUTER

"THE LITTLE BIG BOARD"

64K on board RAM, Z80A based running at 4mHz (Top speed) Floppy disk controller, Real time clock.

That's right! A fully configured Z80 computer running at maximum capacity, on a single **PCB**. **On board disk controller** drives up to four double sided, double density drives either 8" or 5". **2 by RS232 I/O Ports**, both may be software configured, use one for a terminal the other for a printer or modem etc. **Battery backed real time clock** software accessible for automatic dating of documents, timing during games. Fully **STD buss compatible** — choose from thousands of ready available plug in card options. **Bootstrap Monitor** on board — boots to **CP/M**. Choose from the world's **largest range of software.**

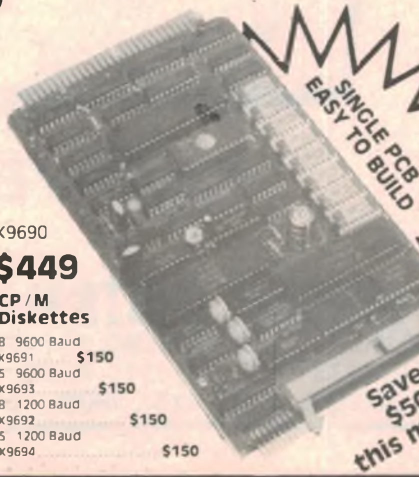
ALTRONIC KIT FEATURES

- Two versions of the bootstrap monitor supplied. One set **for 1200 baud operation** enables connection to **MICROBEE 16 & 32K IC'S** utilizing their terminal emulation facilities. The other set for **9600 baud** operation.
- Complete set of **IC** sockets
- Double sided plated through **PCB** — solder masked and pretinned
- 56 Pin **STD** connector
- **2 x DB25P's** and ribbon cable for peripheral connections
- Quality components used throughout including solder and full documentation

K9690
$449

CP/M Diskettes

8" 9600 Baud
K9691 **$150**
5" 9600 Baud
K9693 **$150**
8" 1200 Baud
K9692 **$150**
5" 1200 Baud
K9694 **$150**



SINGLE PCB EASY TO BUILD

Save $50 this month

COMPUMUSE

YOUR GAMES WILL NEVER BE THE SAME

A computer music synthesizer that is **easy to build** and **easy to use,** connects to any computer with a Centronics-style parallel port and provdes music over a five octave range and a wide variety of sound effects

* EXPERIMENTAL KIT - PCB, COMPONENTS & SOFTWARE

K9834.................... **$26.50**

ALTRONICS • ALTRONICS • ALTRONICS • BANKCARD JETSERVICE DELIVERY NEXT DAY

ALTRONICS • ALTRONICS • ALTRONICS • BANKCARD JETSERVICE DELIVERY NEXT DAY

BANKCARD HOLDERS — PHONE ALTRONICS TOLL FREE 008-999-007 FOR NEXT DAY JETSERVICE DELIVERY

QUALITY VIDEO KITS

Video has been booming for quite a while, finally a range of video accessories in kit form.
Two **video amplifiers** for both VCR and Computer use, a brand new **Video Enhancer** and our popular **VCR Stereo Synthesizer**. All four represent outstanding value for money and all are assembled with **Altronic's Extra Care**.

VIDEO AMPLIFIERS

DISTRIBUTION TYPE
Simple, low-cost project will allow you to drive five video monitors from one source, such as a video cassette recorder or a computer. Great for piping video around the house, or for clubs meetings when screening lectures etd. or for computer demonstrations.

★ **THE ALTRONICS KIT** includes all components as specified by ETI **plus all** power supply components

K5830....... Only....... **$45.00**

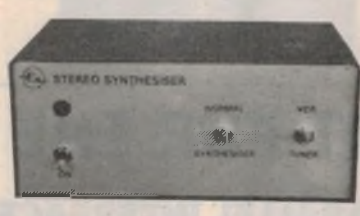
VIDEO ENHANCER

Here's a **simple** but **effective** Video Enhancer that is super **easy to build** at a fraction of the cost of commercial models.
Unit sharpens picture detail, and can actually improve the quality of a copy by amplifying the top end of the video signal.

AT LAST A VIDEO ENHANCER KIT

K5825.................. **$35.00**

ENJOY THE PLEASURES OF STEREO SOUND
(See EA Sept. 1982)



SINGLE OUTPUT

INVERSE AND NORMAL OUTPUT
Brilliant new kit from EA. **Super cheap** and **Super Effective.** Whilst our K5830 is suitable primarily for VCR use this video amplifier is best suited to use with computers. The EA documentation supplied is extremely well written and provides details for installation into television sets.

NO MORE SMEARY COLOURS, SIGNAL BEATS OR RF INTERFERENCE

NOTE ★ NOT SUITABLE FOR USE WITH LIVE CHASSIS TV SETS.

K5850..................... **$14.95**

STEREO SYNTHESIZER FOR VCR'S AND TUNERS

Synthesize realistic stereo from virtually any monophomic source by simply connecting this unit between the source and your stereo amplifier.
- ★ Quality Phillips MN3001 (not second source dropout)
- ★ Provision for 2 different signal sources.
- ★ Selection of either source via front panel switch.
- ★ Normal or stereo sound selection.
- ★ Complete kit includes all hardwear, cables etc., even solar.

Important ★ beware of Kitset suppliers who sell this kit for **less** ★ you get **less**!

K5810................... **$55.00**

FUNCTION GENERATOR

The most essential piece of test gear (second only to a good multimeter) on any hobbyist's bench is some kind of audio signal generator. This design utilizes the latest circuit techniques to produce stable, low distortion waveforms.

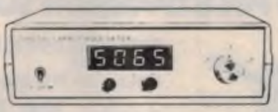
A truly versatile unit at a bargain price

★ 4 digit frequency readout (eliminates tiresome dial calibration) — typical accuracy ± 2% ★ 3 overlapping ranges x1, x10, x100 ★ 600 OHM Nominal Output — continuously variable 3MV — 2.5V P-P ★ Distortion — sinewave less than 0.7% @ 1KHz ★ Linearity — triangle wave better than 1% @ 1KHz ★ Squarewave rise time — 6V/uS maximum output ★ Amplitude stability — better than 0.1dB on all ranges

With the exception of the display all components mount on a single PCB making this kit suitable for all constructors

K2505......................... **$85.00**

DIGITAL CAPACITANCE METER



with Deluxe Instrument Case

NEW DELUXE FINISH
We are pleased to announce the release of the Digital Capacitance Kit housed in our Deluxe H0480 ABS Instrument Case.
This superb Test instrument kit now compliments our top selling Digital Frequency Counter and Function Generator Project Kit. Electronics Australia Project. Measures capacitance of both polarized and non polarized capacitors from 1 picofarad to 99.99 microfarads in 3 ranges.
Check values of unmarked capacitors especially those little trimmers that are never coded.
Select precise values for filters and timing networks within ease.

EXCLUSIVE TO ALTRONICS
Each kit includes precision measured capacitors for accurate calibration of each range.

K2521........................ **$55.00**

7 DIGIT FREQUENCY COUNTER

UNBELIEVABLE 0.005% ACCURACY

★ **Frequency and Period measurement to 500 MHz (with optional prescaler) ★ High input sensitivity. Professional unit at a fraction of the cost of built up units.**
★ IC sockets provided throughout ★ Low age rate 10.000 MHz XTAL ★ Quality ABS plastic case with deluxe Front panel ★ Specified LSI

K2500....................... **$119.50**

PRESCALER
K2501....................... **$26.00**

DECIMAL POINT
K2502....................... **$7.50**

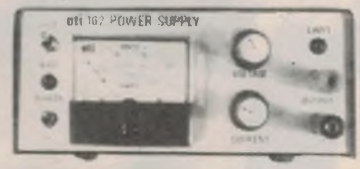
THE EVER POPULAR MUSICOLOUR IV EA PROJECT

K5800...................... **$89.50**

Combination Colour Organ and Light Chaser. Four channel colour organ. Internal microphone or connect to speakers for colour organ operation. (The lights connected to each channel pulse in beat to the music proportional to portion of frequency spectrum concerned.) Four chaser modes forward and reverse. Output lamp load capacity a massive 2400 watts — that's 100 party globes. Full instructions and every last nut and bolt included. Great for parties, shop signs, display windows etc.

POWER SUPPLIES

If you're thinking of buying a power supply then buy from us, we are the experts on power supply kits and carry a supply to suit most enthusiast and professional requirements.............................READ ON.



BENCH STANDARD
- ★ 3-30v Output @ 1 Amp
- ★ Fully Regulated, Fully Protected from Thermal Overload and Short Circuits
- ★ Based on EA Design

K3200.................. **$42.50**

- ★ All the features of above PLUS Current Limit
- ★ ETI Design

K3205..... (PICTURED)..... **$49.50**

DUAL TRACKING
- ★ ± 1.3 to ± 22v Output @ 2 Amps : + 5v @ 0.9 Amps
- ★ Fully protected
- ★ 10 turn pot enables Voltage adj. to within 10mV
- ★ EA Design (March '82)

K3220.................. **$89.50**

HIGH CURRENT

MICROCOMPUTER PS
★ + 5 Volts @ 3 Amps ★ + 12 Volts @ 2 Amps − 12 Volts @ 200 milliamps.
This universal design has enough grunt to power most disk drives.

K3350.................. **$59.50**

13.8 VOLTS @ 10 AMPS HAM'S & CBER'S
Save the expense of a Mains Powered Rig.

K3250.................. **$8950**

HIGH CURRENT — DUAL METERING

EA SWITCH MODE DESIGN
- ★ 2-50 Volts at massive 175 Watts.
- ★ CLEVER DESIGN — a fully mains isolated supply with a "Switchmode" low voltage circuit.
- ★ Easy to build

K3300. . (EA MAY, JUNE '83). . **$139.00**
K3301... (10 TURN VOLTAGE CONTROL OPTION)... **$10.00**
K3302..... (± 12V OPTION) EA JULY '83..... **$12.50**

ETI SERIES REGULATOR DESIGN
- ★ 0-40 Volts @ 5 Amps — **thats 200 Watts.**
- ★ Current limiting 0-5 Amps variable.
- ★ Specifications Second to None.
- ★ Free from the hum and noise sometimes associated with other techniques.

A PROFESSIONAL SUPPLY

K3325.... (PICTURED).... **$175.00**

BANKCARD HOLDERS — PHONE ALTRONICS TOLL FREE 008-999-007 FOR NEXT DAY JETSERVICE DELIVERY

GO ANYWHERE 12-240V POWER

MASSIVE 300 WATTS

These great Inverter kits enable you to power 240V appliances from a 12V DC power source. Tremendous for camping, fishing etc. Install into your Car, Boat or Caravan.

A fully regulated and overload protected design, featuring XTAL locked frequency. Use to power hi-fi, TV sets, even electric drills for short time periods.
MANY OF THESE KITS ARE NOW IN USE FOR EMERGENCY LIGHTING PURPOSES.
ALTRONICS' KIT features ☆ Gold plated edge connector and PCB huss ☆ Low age rate XTAL ☆ Sockets for all IC's ☆ High Efficiency Transformer.

K6750..... (EA JUNE '82) ... **$199.50**

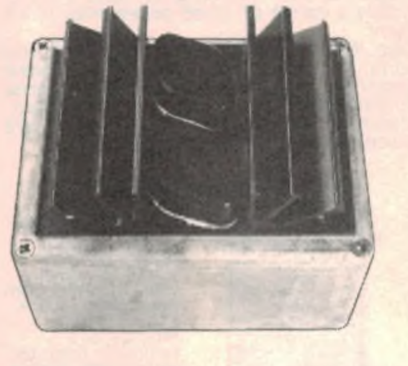
($10 DELIVERY AUSTRALIA WIDE)

40 WATT MODELS

Suits small appliances, ie. Turntables, Tape Decks, Shavers etc. Variable frequency adjustment enables speed control of turntables. Works as a trickle charger when mains power is available.
EASY CONSTRUCTION ☆ VALUE PLUS

K6700..................... **$55.00**

TRANSISTOR ASSISTED IGNITION WITH DWELL EXTENSION



The Altronics Kit includes all components for the modifications, detailed by Electronics Australia Feb. 1983.
Yes, it's bad enough paying $2.00 a gallon for petrol without wasting a fortune on an out of tune engine. Fit this transistor assisted ignition kit in minutes and start saving money from the very next petrol stop. Easy to build!

K4010..................... **$35.00**

★ KIT SUPPORT FOR THE MICROBEE ★

MULTIPROM INTERFACE

44K OF PROGRAM STORAGE

A sensational new kit for the MICROBEE, requires no modification to the computer except for the fitting of a 50 pin expansion socket. This project is easy to build and will allow you to store and software select up to 44K of eprom storage — acts like a mini disk drive system with the speed of RAM. Extra units may be added to further increase storage.

The Altronics Kit comes complete in every way
★ Full set of IC sockets
★ Double sided, plated through board.
★ Assembled connection lead to Microbee.
★ Fully documented.
★ Cassette monitor included (plus sourcefile)

THE MICROBEE KIT OF 1983

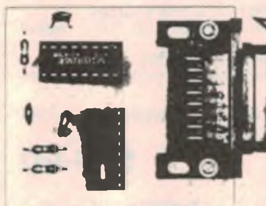
K9673..................... **$99.50**

PARALLEL INTERFACE

BUILD YOUR OWN INTERFACE AND SAVE $$$

A simple kit to build — takes about 20 minutes, save on the cost of a built interface and save the cost of a serial printer

K9671........ **$29.95**



INCLUDES CENTRONICS PLUG AND CABLE

PROPORTIONAL JOYSTICK

K9674
$32.50
(ETI DEC '83)

AT LAST AN ANALOGUE JOYSTICK
Plot X-Y co-ordinates on the screen, sign your name. A great graphics aid. Complete kit **including case,** software example.

50 PIN EXPANSION SOCKETS

PRICE BREAK-THROUGH

Right angle type to suit Microbee, floppy disk controllers etc
Mounts on PCB and mates with IDC sockets.

P 0932.... **$6.50**ea 10 up.... **$6.00**

EPROM PROGRAMMER

(ETI JAN '83)

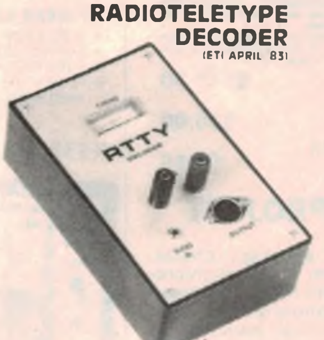
K9668..................... **$55.00**

Versatile, low cost and easy to build. Plugs straight into the microbee I/O port. Suitable for 2716 2732 2532 2732A and 2764 Eproms. Burn your games programmes and eliminate cassette loading time.
KIT FEATURES Sockets for all other IC's 1 x 2716 supplied — get started straight away Front Panel and Mains (SEC approved) transformer 28 pin and 16 pin wire wrap sockets to flush mount personality plugs (2 included) and ZIF socket (included) DB15 Plug Complete to last nut and bolt

(See Review ETI AUGUST 1983)

RADIOTELETYPE DECODER

(ETI APRIL '83)



K9733..................... **$19.50**

Display RTTY encoded messages on your Video Monitor. Receive up to date weather information, International News before the Papers, all sorts of coded military info. Simple circuit uses PLL techniques. Single PCB Construction. Kit includes DB15 Plug and backshell for connection to microbee. Shielded pretinned PCB

MICROBEE LIGHT PEN

NEW

(ETI AUGUST '83)

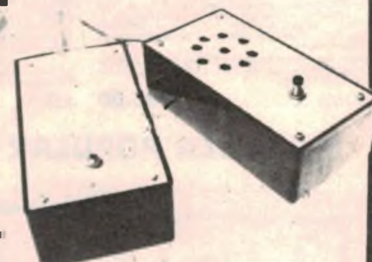
PROVIDES DIRECT PERSONAL CONTACT WITH YOUR BEE!

K9649..................... **$19.95**

AT LAST — a light pen for the Bee. This pen works in the low-resolution graphics mode and connects directly to the I/O port • Complete kit including DB15 2m CORD • Fully documented with software example

FAX-DECODER

(ETI SEPT '83)



K9733..................... **$24.50**

This project allows you to decode the signals of shortwave stations transmitting radio facsimile weather maps, satellite pictures etc and then reproduce them on your dot-matrix printer
• Complete kit of parts includes DB15, Ribbon Cable
• SOFTWARE LISTING

BANKCARD HOLDERS — PHONE ALTRONICS TOLL FREE 008-999-007 FOR NEXT DAY JETSERVICE DELIVERY

PHONE YOUR ORDER — ALTRONICS TOLL FREE 008-999-007

ALTRONICS • ALTRONICS • ALTRONICS • ALTRONICS

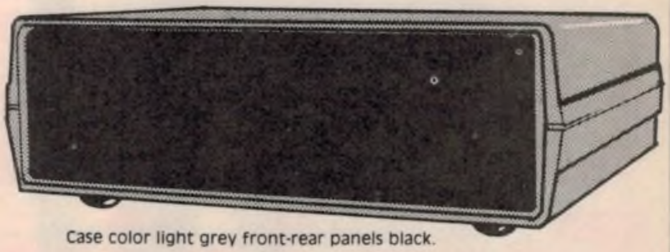
KAISE DIGITAL MULTIMETER SK 6100

WAS $89.95

Now $59.95
Cat Q1100

Check the specifications/features of this superb Digital Multimeter. **Autoranging** with manual override **Auto Polarity** displays — sign when probes reversed **overange indication** "Blink" and Buzzer warning **Low Battery Warning** BATT Sign shows. **Sampling Rate** 2 times SEC **Power Supply** 2 x A penlight batteries (300 hour continuous operation). **Fuse Protected,** spare fuse provided. **Zero Adjustment,** zero adjust button — a must if you change test probes. **LCD Display,** magnificent clear readout. **Inbuilt Buzzer,** available for continuity test, overload warning and switch warning. **Ranges** + / − 1000 V DC/600 V AC, AC and DC current, resistance 200 (Resolution .1 OHM) to 2000K OHM (resolution 1K OHM) in 5 ranges autoranging. **ACCURACY** ·5% DC, ·8% AC.

DELUXE ABS INSTRUMENT CASE



Case color light grey front-rear panels black.

Our superb new instrument case will give your projects the professional appearance they deserve.

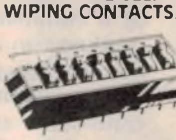
- Internal mounting posts enable a wide combination of PCB's, Transformers, etc. to be accommodated (screws supplied).
- PCB guide rails provided internally allow vertical PCB positioning to several locations.
- Removable front and rear panels. Attractive textured finish one side and plain the reverse side. (Enables direct engraving, silk screen printing etc. to plain side.)
- Great for test instruments and other high grade projects.

Overall Size: 200W x 160D x 70mmH

	WAS	NOW	10 +	50 +
H0480	$13.50	$10.00	$9.00	$8.50

DIL SWITCHES

GOLD PLATE SELF-WIPING CONTACTS.



	WAS	NOW
S 3050 4 Way	~~$1.50~~	$1.35
S 3060 8 Way	~~$2.00~~	$1.75

LAST MONTH AT THIS PRICE

ALTRONICS

105 STIRLING ST. PERTH — FOR INSTANT SERVICE

008 999 007 TOLL FREE

(09) 328 1599 PERTH METRO AREA & AFTER HOURS RECORDED SERVICE

All Mail Orders: Box 8280, Stirling St, Perth, WA 6000.

Phone toll free 6am - 8pm (EST) for personal service, or take advantage of our 24 Hour 7 day p/week Bankcard phone order service. Give your name address with postcode, phone number, bankcard number and expiry date then your order — and presto your order will be processed and back to you in a flash. — Please nominate Jetservice if you want overnight delivery.

$2.50 DELIVERY AUSTRALIA WIDE We process your order the day received and despatch via Australia Post. Allow approx. 7 days from day you post order to when you receive goods. Weight limited 10kgs.

$4.50 DELIVERY AUSTRALIA WIDE We process your order day received and despatch via Jetservice for delivery next day.

BANKCARD HOLDERS CAN PHONE ORDERS UP TO 8PM (EST) FOR NEXT DAY DELIVERY — SOUNDS INCREDIBLE DOESN'T IT? Alright you cynics just try us! Weight limit 3.3kgs. Jetservice cannot deliver to P.O. box numbers (Australia Post would have a fit).

$10.00 HEAVY HEAVY SERVICE — AUSTRALIA WIDE All orders over 10kgs must travel on the heavy service, that is — road express. Delivery time 7 days average.

ALTRONICS RESELLERS

Please note that resellers may not have all the items advertised in stock, and as resellers have to bear the cost of freight, prices may be slightly higher than advertised. ALTRONICS reseller prices should however represent a considerable saving over our competitors' prices.

VICTORIA

CITY
All Electronic Components 662 3506
Ellistronics 602 3499
MaGraths Electronics 347 1122

SUBURBAN
BENTLEIGH
Absolute Electronics. 557 3971
BOX HILL SOUTH
Eastern Communications ... 288 3107
CHELTENHAM
Talking Electronics .. 550 2386
FOOTSCRAY
Acron Electronics ... 689 1911
SOUTH CROYDEN
Truscott Electronics .. 723 3860

COUNTRY
BENDIGO
Lindrea & Johnson ... 41 1411
MILDURA
Electronic and Digital Services ... 23 3380
SHEPPARTON
GV Electronics...... 21 8866
WODUNGA
A & M Electronics 24 4588

QUEENSLAND

CITY
Delsound P/L 229 6155
SUBURBAN
BIRKDALE
Wholesale Sound Accessories...... 207 2502
FORTITUDE VALLEY
St. Lucia Electronics. . 52 3547
PADDINGTON
ECQ Technics...... 369 1474
SALISBURY
Colourview Wholesale 275 3188
SLACKS CREEK
David Hall Electronics. 208 8808
COUNTRY
CAIRNS
Thompson Instrument Services 51 2404
GLADSTONE
Purley Electronics 72 4321
IPSWICH
P & P Electronics ... 281 8001
NAMBOUR
Nambour Electronics . 41 1604
PALM BEACH
The Electronics Centre. 34 1248
ROCKHAMPTON
Purley Electronics 2 1058
TOOWOOMBA
Hunts Electronics 32 9677
TOWNSVILLE
Solex 72 2015

WESTERN AUSTRALIA

COUNTRY
ALBANY
BP Electronics...... 41 2681
ESPERANCE
Esperance Communications 71 3344
GERALDTON
Geraldton TV and Radio 21 2777
KALGOORLIE
Todays Electronics ... 21 5212
MANDURAH
Kentronics 35 3227
WYALKATCHEM
D & J Pease 81 1132

NT

DARWIN
Radio Parts Darwin ... 81 8508
Ventronics 81 3491
ALICE SPRINGS
Ascom Electronics 52 1713
Farmer Electronics 52 2967

ACT

CITY
Electronic Components 80 4654
Scientronics 54 8334

SOUTH AUSTRALIA

CITY
ADN Electronics 212 5505
Protronics 212 3111

SUBURBAN
BRIGHTON
Brighton Electronics. . 296 3531
CHRISTIES BEACH
Force Electronics 382 3366
ELIZABETH GROVE
A.E. Cooling....... 255 2249
KESWICK
Freeway Electric Wholesalers...... 297 2033
PROSPECT
Jensen Electronics ... 269 4744

COUNTRY
PORT PIRIE
G.F. & J.A. Pointon ... 32 5141

TASMANIA

CITY
D & I Agencies...... 23 2842
GEORGE HARVEY
Hobart 34 2233
Launceston 31 6533

NEW SOUTH WALES

CITY
Avtek Electronics ... 267 8777
David Reid Electronics 267 1385
Jaycar 264 6688
Radio Despatch 211 0191

SUBURBAN
BIRKENHEAD
Birkenhead Electronics. 81 4077
CARLINGFORD
Jaycar 872 4444
CONCORD
Jaycar 745 3077
DEE WHY
David Ryall Electronics 982 7500
ENFIELD
Avtek 745 2122
HURSTVILLE
Jaycar 570 7000
LEWISHAM
PrePak Electronics ... 569 9770
MATTRAVILLE
Creative Electronics . 666 4000

COUNTRY
ALBURY
Webb's Electronics ... 25 4066
BATHURST
Sound of Music..... 31 4421
BROKEN HILL
Crystal TV......... 4803
COFFS HARBOUR
Coffs Harbour Electronics 52 5684
GOSFORD
Tomorrows Electronics 24 7246
KURRI KURRI
Kurri Electronics..... 37 2141
NEWCASTLE
D.G.E. Systems...... 69 1625
George Brown & Co. . 69 6399
NOWRA
Vimcom Electronics .. 21 4011
PENRITH
Acorn Electronics ... 21 2409
PORT MACQUARIE
Hall of Electronics 83 7440
RICHMOND
Vector Electronics 78 4277
TOUKLEY
TES Electronics...... 96 4144
WINDANG
Madjenk Electronics .. 96 5066
WINDSOR
M & E Electronic Communications 77 5935

RESELLERS WANTED IN ALL AREAS (Including WA). **Phone: STEVE WROBLEWSKI (09) 381 7233 for details.**

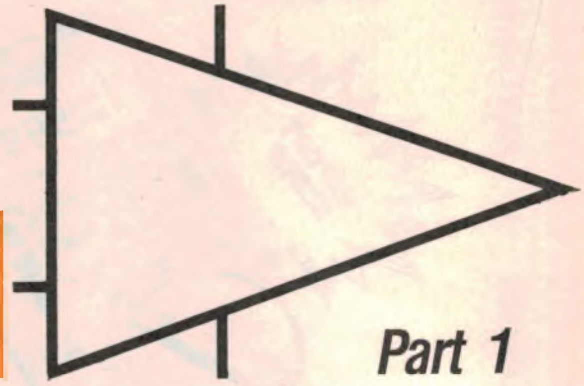
ALTRONICS • ALTRONICS • ALTRONICS • ALTRONICS

ALTRONICS • BANKCARD JETSERVICE DELIVERY NEXT DAY • ALTRONICS • ALTRONICS

ALTRONICS • BANKCARD JETSERVICE DELIVERY NEXT DAY • ALTRONICS • ALTRONICS

BRYAN MAHER

OP AMPS Explained



Part 1

Negative feedback is a method of reducing the output or gain of a system in order to improve the accuracy of performance. The use of feedback implies that the system is not operating flat-out but had "something in reserve".

Operational amplifiers form a large class of very useful circuits but are in fact only a part of a much larger class of circuits and systems – the negative feedback systems. Man cannot claim credit for inventing negative feedback systems as they were effectively invented by nature millions of years ago, being in quite good control of suns, planets, animals, and man.

Man's body contains many negative feedback systems, and quite complex they are too. One example is the way the body regulates its temperature, keeping the whole body at 37°C; heating the body if necessary by food energy consumption or shivering; cooling the body when required by sweat evaporation. Furthermore, if the external conditions are too severe such that the body cannot be kept at 37°C (say, if you fell into a frozen river) then the body temperature control negative feedback system will switch to a preferential system aimed at keeping the "vital core" (essential organs, spinal column and brain) at 37°C and sacrificing the less essential parts such as hands and feet. (The human body is limited to producing about 90 watts of heat continually when in the heating mode.)

Man invented his first versions of negative feedback perhaps 5000 years ago. It is believed that the king of Babylonia authorised the construction of an irrigation water controller which was effectively a negative feedback system. The general outline of a simple control system, shown in Fig. 1, shows what we might call a "hope for the best" system wherein some input, a voltage, a request or a command, applied to the system produces an output which "we hope" is the desired result.

One example can be a simple transistor amplifier stage, another example perhaps a remote controlled milling machine. In either case inadequacies in the system can produce output different from that desired. With the simple system that's just too bad! The simple transistor amplifier gives us distorted music, the simple controlled milling machine produces an inaccurate job. The system (the transistor or machine) does not know about the errors in its output and goes happily on its way while we suffer the consequences. We call this an open loop system.

Some person who was "not satisfied" with this state of affairs thought of the brilliant idea that the front end of the system should be "told" about the output errors in such a way that the system may be able to correct them. Thus man (thought he had) invented the negative feedback system as in the basic block diagram Fig. 2. The operation of all negative feedback systems is simply that a sample of the output is "fed back" to the front end of the system to be compared with the input signal or command. This comparison is done by subtracting the fed-back output sample from the input, ie, forming the difference: (input-feedback).

This difference represents the error of the system so we re-draw Fig. 2 in slightly expanded form as Fig. 3 to show the comparison stage. Two different symbolisms having the same meaning are commonly used so we show them both as Figs. 3(a) and 3(b).

Because the negative feedback path closes the system upon itself, the circuit shown in Figs. 2 and 3 is called a closed loop system.

In this series of articles we will usually bypass the mathematics of the subject, but for those interested the mathematical ideas used today in feedback analysis began to appear around 1750 to 1790 in the work of such men as D'Alembert and the Marquis Jean Pierre De La Place, both in France, and in

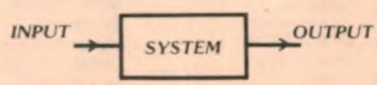


Fig. 1: A simple open loop system.

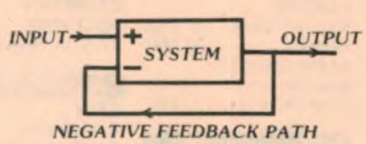


Fig. 2: Basic negative feedback system.

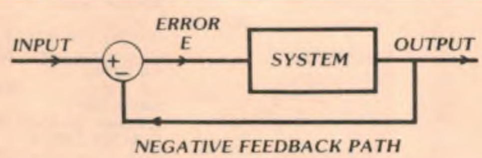


Fig. 3(a): The circle represents the difference stage. Error E = Input − Feedback

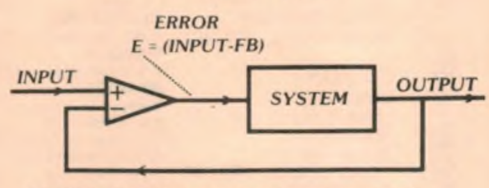


Fig. 3(b): Alternatively, a triangle can be used to represent the difference stage.

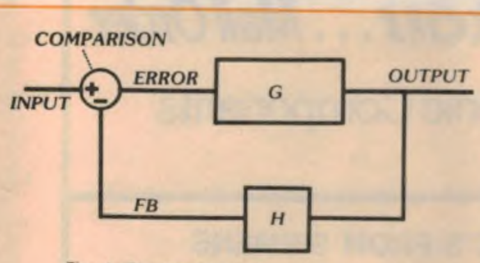


Fig. 4: The general in-phase (non-reversing) feedback system.

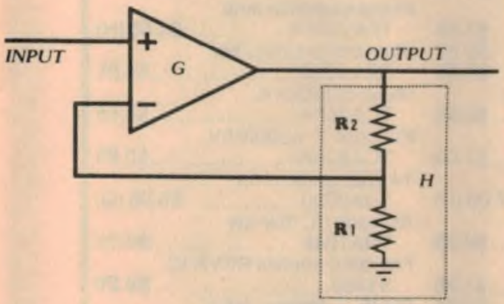


Fig. 5: An implementation of Fig. 4. Results are in Table 1 (page 91).

the powerful book "Mecanique Analytique" by Joseph Louis Marquis De La Grange at Turin in 1788. Such men of genius (La Grange was appointed Professor of Mathematics at age 16) were ably followed by Kalman, the Russian Lyapunov; Pontryagin, Bode and Nyquist.

It was the latter, working on the analysis of telephone repeater amplifiers, who in 1930 awakened the then sleepy electronics world to the powers and dangers of negative feedback ideas. Power, in that accurate output could be obtained, danger, in that an unstable amplifier system might result if not properly designed. As Nyquist's amplifiers were to be built into the Trans-Atlantic telephone cable and buried deep in mid-ocean, guesswork was inadmissable. His name is enshrined forever, as all students of negative feedback sooner or later meet the Nyquist contour as a stability design method. And all this without computers!

Although in this series we are primarily interested in the application of negative feedback to electronic operational amplifiers, it is interesting to observe that only one theory is necessary to design ALL negative feedback systems: electrical, mechanical, rotational, pneumatic, hydraulic, chemical, biological or whatever. Inputs, outputs, and system details are different but block diagrams and generalised theory are identical.

The block diagram Fig. 3 is somewhat too simple in that it implies that all the output is used as the feedback signal. This is "full feedback", giving the "unity gain" or "gain = 1" case (some textbooks use this figure without accentuating the fact, confusing readers). To enable us to achieve any desired system we add the extra block H in Fig. 4 where H means what kind of sample of the output we will use as feedback.

For a simple electronic amplifier using, say, half the output as feedback then H is simply a voltage divider having ratio equal to one half. In the wider sense of the more general feedback system, say that automatically controlled milling machine, the output is the milling cutter position and H is a more complex "cutter-position-to-voltage" conversion instrument or "transducer".

The system block we have now called G and, in the simple case of the electronic amplifier, G means the forward gain of the block marked G, that is the gain from the error E to the output, also known as the open loop gain. This is quite different from the overall gain from input to output. In the wider sense of general feedback systems, the block G may mean some combination of electronic amplifiers, electric motors, electro-hydraulics, almost anything. In our automatic milling machine case it would be the electric or hydraulic motors used to put that milling cutter into correct position, together with the electronic controls necessary.

The circle symbol in Fig. 4 is preferred for the comparator as we want the symbol to mean the action of comparison or substraction rather than the circuit method used.

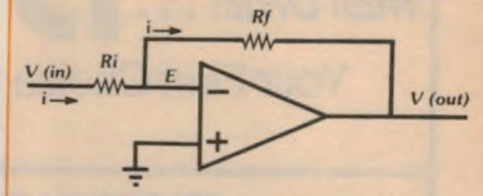
Condensing the negative feedback theory (well some of it anyway) into a few lines of simple equations we observe in Fig. 4 that:

Output = G × Error E
FB = Output × H
E = Input – FB
E = Input – Output × H
Output = G (Input-output × H)
Output = G × Input – GH × Output
Output + GH × Output = G × Input
Output (1 + GH) = G × Input

$$\frac{\text{Output}}{\text{Input}} = \frac{G}{1 + GH}$$

We call this output/input the "overall gain" of "closed loop gain" of the electronic circuit but, for the more general case of any feedback system, such as our milling machine, it is more than a gain. So in general we will call it the "Transfer Function T" so

$$T = \frac{\text{Output}}{\text{input}} = \frac{G}{1 + GH} \quad \text{Eqn. 1}$$



	i	=	$\frac{Vin - E}{Ri}$	
also	i	=	$\frac{E - Vout}{Ri}$	Facts
and	Vo	=	$-GE$	We
so	E	=	$\frac{-Vo}{G}$	Know

As there is only one current i we have:

$$\frac{Vin - E}{Ri} = \frac{E - Vout}{Rf}$$

$$Rf\,Vin + \frac{Vout\,Rf}{G} = -\frac{Ri\,Vout}{G} - Ri\,Vout$$

$$\frac{Vout\,Rf}{G} + \frac{Vout\,Ri}{G} + Vout + Ri = -Rf\,Vin$$

$$Vout\left(\frac{Rf}{G} + \frac{Ri}{G} + \frac{RiG}{G}\right) = -Rf\,Vin$$

$$\frac{Vout}{Vin} = \frac{-Rf}{\left(\frac{Rf}{G} + \frac{Ri}{G} + \frac{RiG}{G}\right)}$$

$$\frac{Vout}{Vin} = \frac{-RfG}{\left(\frac{RfRi}{Ri} + Ri + RiG\right)}$$

$$T = \frac{Vout}{Vin} = \left(\frac{-Rf}{Ri}\right)\frac{G}{\left(1 + G + \frac{Rf}{Ri}\right)}$$

Fig. 6: Exact gain equation for the phase reversing operational amplifier.

Consider the units used, often called the dimensions of the quantities and blocks, in Fig. 4. For the electronic amplifier that is easy: input and output are in volts, G and T are dimensionless numbers and H is a dimensionless fraction. In the case of the milling machine: input is in volts but output is the position of the milling cutter, probably measured in meters. Thus T and G have dimensions "meters per volt" and the dimensions of the position transducer H are "volts per meter".

Gain accuracy

The circuit Fig. 4 and the corresponding equation 1 are useful over a wide range of open loop gain G. Observe in equation 1 that if the open loop gain G is made a very large number, say 100,000, and if H is some ordinary

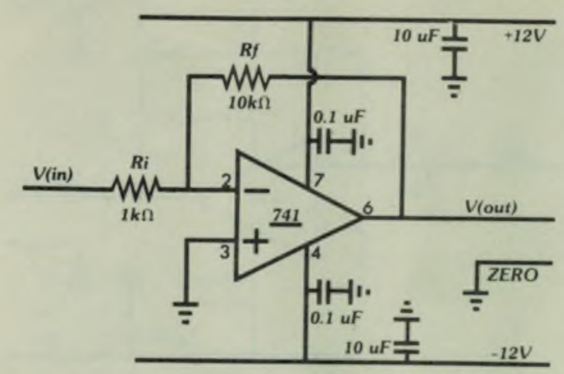


Fig. 7: Practical use of the 741. Circuit gain T = −10, input impedance = 1kΩ.

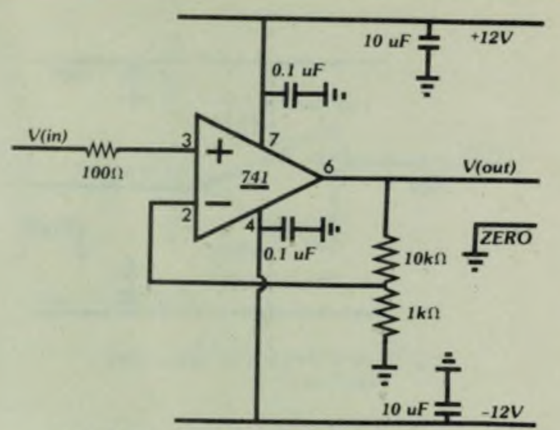


Fig. 8: Practical use of the 741. Circuit gain T = +11, input impedance approx. 100kΩ.

OP AMPS Explained

fraction say 1/10, then GH is 10,000, still a very large number (compared to one) so that (1 + GH) is about the same as GH and T is approximately equal to G/GH or simply 1/H. If the open loop gain is made large enough we have a simple equation for the closed loop gain T:

$$T = 1/H \qquad \text{Eqn. 2}$$

The accuracy of this statement decreases if G is not so large or if we try to make T very big. To express this, some people talk of the gain accuracy being decided by the "open loop to closed loop" ratio which should be a large number for accurate gain. Errors in gain for the circuit Fig. 4 are shown in Table 1 for two values of H and a range of values of G. An example of a system using only a moderate value for G would be the "Playmaster" series of hi-fi amplifiers featured in EA in the 1960s and 1970s.

In playing records many conflicting factors must be balanced and a moderate value of G giving approximate gain accuracy may be a first class choice. But in a different application, for example a preamplifier for a five figure digital voltmeter, Fig. 5, for all figures to be meaningful, and to remain meaningful, a high open loop gain is essential.

The advantages of a high open loop gain or, more correctly, a high ratio between open loop and closed loop gain, may be summarised as follows.

(1) The actual closed loop gain will remain more nearly constant, regardless of variations in the actual open loop gain, whether these be due to temperature changes within a given amplifier, or to typical manufacturing tolerances ("spread") between individual amplifiers.

(2) As the output is almost independent of G, it is also independent of the non-linearity distortion of G. Such an amplifier can produce an output voltage swing almost up to the supply rail voltage with excellent linearity which is something a non-feedback system could never do.

(3) As a bonus, it becomes easier to nominate a required closed loop gain, by calculation, within an acceptable tolerance, remembering that the calculation, as given in equation 1, will always introduce some error. If the open to closed loop ratio is not large enough, calculation alone may not be accurate enough, and the final feedback component values may have to be determined experimentally. Other problems, such as temperature sensitivity, may also occur.

Terminology

Amplifiers having only moderate values of open loop to closed loop gain ratio are simply called negative feedback circuits. But amplifiers whose open loop to closed loop gain ratio is high are known as "operational amplifiers" a name which we see strictly means the amplifier block G and the associated components H. However the name and its abbreviation "op amp" is also loosely applied to the amplifier block G alone.

The practical IC high gain amplifier around which typical operational amplifiers are built was originally evolved to serve the needs of early analog type computers, in which amplifiers having very precise and stable orders of gain formed the basis of the analog concept. Even though the analog computer was rapidly replaced by the digital type, except in a few specialised applications, these ICs lived on to become an extremely useful component in their own right.

Thus, to construct an operational amplifier we may either make ourselves a high gain amplifier G using discrete transistors and resistors or, more realistically, go out and buy an integrated circuit which will become G, add the few necessary components around it to make H, plus a few capacitors. Most constructors buy the integrated circuit as, unless they have some special application, there is no need to make a high gain amplifier.

By using a very high value for G we can build a moderate gain amplifier wherein gain is decided simply by a ratio of resistors H = R1/(R1 + R2) as in Fig. 5. At quite a reasonable cost we could buy two high stability metal film or wire wound resistors of 1% tolerance or better for R1 and R2 and our closed loop gain, being dependent only on resistors, would be stable. Furthermore it we are sensible we will buy R1 and R2 of the same type and brand and mount them close together to encourage equal temperature. Then, even if they increase in value due to temperature rise, their ratio will change very little.

So far we have ignored side effects due to imperfections in the amplifier block G. We have assumed that the input impedance Z(ig) of G is very high. We define Z(ig) as the ratio of a small change in input voltage to the small change in input current so produced. In the in-phase amplifier, Figs. 4 and 5, the circuit input impedance Zi is simply equal to Z(ig). Because common integrated circuits like the LM301AH, AD308 and many others have input impedances in the megohm range, the in-phase circuits, Figs. 4 and 5 are referred to as the high impedance configuration.

The output impedance Zo of any circuit is defined as the ratio of a small change in output voltage to that small change in output current necessary to cause it. Common integrated circuits may have an output impedance up to hundreds of ohms (for the bare amplifier

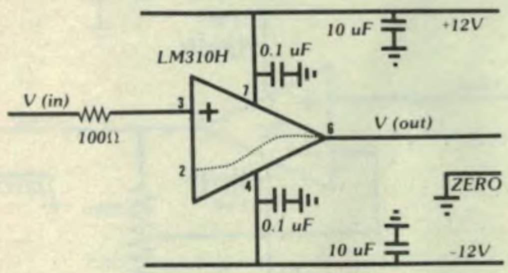


Fig. 9: Use of the LM310H voltage follower.
Gain T = 1

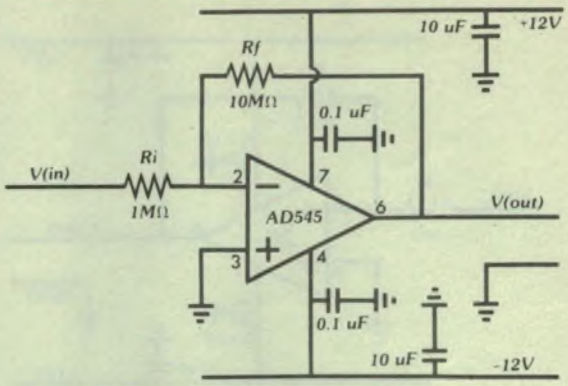


Fig. 10: Practical use of the AD545. Circuit gain
T = −10, input impedance 1MΩ.

OP AMPS Explained

G). When placed in a circuit such as Fig. 5, the feedback loop reduces the effective output impedance by a factor approximately equal to the open loop/closed loop gain ratio. Therefore for low closed loop gain we can expect the effective output impedance Zo to be about one ohm.

Quite separate from input impedance and signal currents there is another quantity, the DC input current I(in). If the first stage of G consists of junction transistors their normal bias current forms this input current and values of one nanoamp to one microamp may be expected. If the first stage of G consists of field effect transistors (FET's) then their gate leakage current forms I(in) and lower values measured in picoamps will occur.

This input current places a limitation on the application of that particular integrated circuit to the values of resistors which may be used around it. For example, if the input bias current is one microamp and resistors R1 and R2 were chosen equal to 4.7 megohms each there would be a few volts DC drops in those resistors and the operating voltages around the circuit would be hopelessly incorrect. A general rule then is to use resistors of thousands of ohms, not megohms, in feedback circuits unless FET type integrated circuits are employed.

Unity gain buffer

The non-inverting or in-phase circuit, Fig. 5, is useful as a buffer stage (between two other systems) as it has high input impedance and low output impedance. This is very popular in certain parts of circuit design and closed loop voltage gains down to 1.0 are used. This unity gain or full feedback case is configured by making R1 infinite (not there) and R2 equal to zero (short circuit). Special integrated circuits such as the LM310 are on the market having this full feedback path provided inside. The high open loop gain is never seen by the user but it results in great gain accuracy, 1.0 ± 0.0001, and low distortion.

Phase inverting circuit

A quite different negative feedback circuit having great power and usefulness is formed when we connect both the input and feedback paths to the same amplifier input terminal as in Fig. 6. The amplifier input chosen must be the negative or inverting terminal. The equations (if you want them) for this circuit are given in the Fig. 6 and we observe that for open loop gain G, input resistor Ri and feedback resistor Rf, the closed loop gain T is given as

$$T = -(Rf/Ri)\ [G/(1+G+(Rf/Ri))] \qquad \text{Eqn. 3}$$

The square bracketed term (the "error multiplier") is always a little less than 1, so the closed loop gain T is given approximately as

$$T = -(Rf/Ri) \qquad \text{Eqn.4}$$

As long as we use an amplifier G having a very high open loop gain and provided we do not try to make the closed loop gain T too big, then the square bracket error multiplier in equation 3 is very close to 1 and equation 4 is very nearly exact.

Again making the assumption that the input current to the block G is negligibly small and the input impedance to G is very high, we observe in Fig. 6 that the signal input current I(in), flowing in from the source V(in), must flow through Ri and entirely through Rf, simply because there is nowhere else to go.

"Virtual earth"

The output voltage Vo is simply G × E where E is the voltage at the input to G in Fig. 6 and Vo is commonly in the range −12V to +12V. Because the open loop gain G is very high, the voltage E must be very small and in practical circuits E is just a few microvolts even when V(in) and Vo are a few volts.

The fact that E is such a very small voltage in practical operational amplifier circuits leads to the concept of a "virtual earth" at that junction. It can be thought of as a short circuit although, of course, no short circuit is present. An example will illustrate the effect:

V(in) = +1 volt, Ri = 1000 ohms, Rf = 10,000 ohms, Vo = −10 volts (note negative sign), E = +100 microvolts and G = 100,000. A simple calculation will show that the current I (slightly less than 1mA) flows from V(in) through Ri and Rf to Vo.

Note that the above description is actually a case of dynamic equilibrium giving the effect of a very low impedance at the junction of Ri and Rf. This effect is used to great advantage in many circuits to be described in later chapters of this series. However we must not place any real low impedance path from this junction to earth as this would ruin the feedback equilibrium effect completely.

Two very important circuit properties follow from the virtual earth low impedance effect and very low voltage E at the junction of Ri and Rf. Firstly the input impedance Zi "looking into" the complete amplifier circuit from the source V(in) is equal to Ri in series with the virtual earth. In our example this would be just 1000 ohms (Ri) plus 10 ohms (virtual earth) or approximately Ri. In general the input impedance Zi looking into any complete inverting operational amplifier is given by:

$$Zi = Ri(\text{approximately})$$

and the input signal current is given by

$$I = Vi/Ri$$

(This of course is distinct and separate from the DC bias current.)

If the amplifier G consists of junction transistors, their input bias current, one nanoamp to one microamp, places a

- MICROPROCESSOR -	
420306565-00	[illegible]
420306573-00	[illegible]
420306617-00	[illegible]
420306618-00	[illegible]
420306619-00	[illegible]
420306675 00	[illegible]
420306676 00	[illegible]
420308038 00	[illegible]
420307011 00	[illegible]
DP8212N	[illegible]
DP8216N	[illegible]
DP8224N	[illegible]
DP8226N	[illegible]
DP8228N	[illegible]
DP8238N	[illegible]
DP8303N	[illegible]
DP8304BN	[illegible]
DP8307N	[illegible]
DP8343N	[illegible]
DP8350N	[illegible]
ICL8212CPA	[illegible]
ICL8250CPE	[illegible]
IMP-00H/881	[illegible]
INS1771N-1	[illegible]
INTEL P8155	[illegible]
SMC COM5016P	[illegible]
SMC COM8116P	[illegible]
SMC FDC1791B	[illegible]
- CMOS -	
CD4000BCN	[illegible]
CD4001BCN	[illegible]
CD4001CN	[illegible]
CD4002BCN	[illegible]
CD4006CN	[illegible]
CD4007CN	[illegible]
CD4008BCN	[illegible]
CD4009CN	[illegible]
CD4010CN	[illegible]
CD4011BCN	[illegible]
CD4012BCN	[illegible]
CD4013BCN	[illegible]
CD4013CN	[illegible]
CD4014BCN	[illegible]
CD4015BCN	[illegible]
CD4015CN	[illegible]
CD4016BCN	[illegible]
CD4017BCN	[illegible]
CD4018BCN	[illegible]
CD4019BCN	[illegible]
CD4020BCN	[illegible]
CD4021BCN	[illegible]
CD4022BCN	[illegible]
CD4023BCN	[illegible]
CD4024BCN	[illegible]
CD4025BCN	[illegible]
CD4027BCN	[illegible]
CD4028BCN	[illegible]
CD4029BCN	[illegible]
CD4030BCN	4.05
CD4034BCN	2.75
CD4035BCN	2.17
CD4040BCN	1.64
CD4041BCN	1.69
CD4042BCN	1.16
CD4043BCN	1.21
CD4043CN	1.15
CD4044BCN	1.38
CD4044CN	[illegible]
CD4046BCN	[illegible]
CD4047BCN	[illegible]
CD4048BCN	[illegible]
CD4049CN	[illegible]
CD4050BCN	[illegible]
CD4051BCN	[illegible]
CD4052BCN	[illegible]
CD4053BCN	[illegible]
CD4060BCN	[illegible]
CD4066BCN	[illegible]
CD4068BCN	[illegible]
CD4071BCN	[illegible]
CD4072BCN	[illegible]
CD4073BCN	[illegible]
CD4075BCN	[illegible]
CD4076BCN	[illegible]
CD4081BCN	[illegible]
CD4082BCN	[illegible]
CD4085BCN	[illegible]
CD4089BCN	[illegible]
CD4093BCN	[illegible]
CD4094BCN	[illegible]
CD4099BCN	[illegible]
CD4502BCN	[illegible]
CD4503BCN	[illegible]
CD4507BCN	[illegible]
CD4510BCN	[illegible]
CD4511BCN	[illegible]
CD4512BCN	[illegible]
CD4514BCN	[illegible]
CD4515BCN	[illegible]
CD4516BCN	[illegible]
CD4518BCN	[illegible]
CD4519BCN	[illegible]
CD4520BCN	[illegible]
CD4521BCN	[illegible]
CD4522BCN	2.40
CD4526BCN	[illegible]
CD4528BCN	[illegible]
CD4528BMJ	[illegible]
CD4529BCN	[illegible]
CD4538BCN	2.07
CD4541BCN	[illegible]
CD4543BCN	[illegible]
CD4553BCN	[illegible]
CD4555BCN	2.50
CD4556BCN	2.50
CD4583BCN	[illegible]
CD4584BCN	[illegible]
CD4723BCN	2.00
CD4724BCN	2.00
MM74C00N	[illegible]
MM74C02N	[illegible]
MM74C04N	[illegible]

MM74C08N	[illegible]
MM74C10N	[illegible]
MM74C14N	[illegible]
MM74C20N	[illegible]
MM74C30N	[illegible]
MM74C32N	[illegible]
MM74C42N	[illegible]
MM74C48N	[illegible]
MM74HC00N	[illegible]
MM74HC02N	[illegible]
MM74HC04N	[illegible]
MM74HC08N	[illegible]
MM74HC10N	[illegible]
MM74HC11N	[illegible]
MM74HC14N	[illegible]
MM74HC20N	[illegible]
MM74HC27N	[illegible]
MM74HC30N	[illegible]
MM74HC32N	[illegible]
MM74HC42N	1.33
MM74HC73N	[illegible]
MM74HC74N	1.01
MM74HC75N	1.20
MM74HC76N	[illegible]
MM74HC85N	2.05
MM74HC86N	[illegible]
MM74HCU04N	0.85
MM74HC107N	1.01
MM74HC109N	1.01
MM74HC112N	1.01
MM74HC113N	[illegible]
MM74HC123N	[illegible]
MM74HC125N	[illegible]
MM74HC126N	[illegible]
MM74HC133N	[illegible]
MM74HC137N	[illegible]
MM74HC138N	[illegible]
MM74HC139N	[illegible]
MM74HC147N	[illegible]
MM74HC151N	1.20
MM74HC153N	1.33
MM74HC154N	[illegible]
MM74HC157N	1.20
MM74HC158N	1.20
MM74HC160N	1.20
MM74HC161N	[illegible]
MM74HC162N	1.73
MM74HC163N	1.73
MM74HC164N	1.48
MM74HC165N	2.61
MM74HC173N	1.33
MM74HC174N	1.33
MM74HC175N	1.33
MM74HC192N	1.87
MM74HC193N	[illegible]
MM74HC194N	[illegible]
MM74HC195N	[illegible]
MM74HC240N	[illegible]
MM74HC241N	[illegible]
MM74HC242N	3.01
MM74HC243N	[illegible]
MM74HC244N	[illegible]
MM74HC245N	3.07
MM74HC251N	1.20
MM74HC253N	1.33
MM74HC257N	1.33
MM74HC259N	2.00
MM74HC266N	[illegible]
MM74HC280N	[illegible]
MM74HC299N	[illegible]
MM74HC354N	6.62
MM74HC365N	3.25
MM74HC366N	3.25
MM74HC367N	3.25
MM74HC368N	3.25
MM74HC373N	3.20
MM74HC374N	3.20
MM74HC390N	3.00
MM74HC423N	[illegible]
MM74HC533N	3.20
MM74HC534N	3.20
MM74HC563N	4.30
MM74HC564N	4.30
MM74HC573N	4.30
MM74HC574N	4.30
MM74HC640N	2.80
MM74HC643N	2.80
MM74HC688N	4.27
MM74HCT240N	3.01
MM74HCT244N	3.01

MM74HCT245N	[illegible]
MM74HCT640N	[illegible]
MM74HCT643N	[illegible]
MM74HC4002N	[illegible]
MM74HC4020N	[illegible]
MM74HC4024N	[illegible]
MM74HC4040N	[illegible]
MM74HC4049N	[illegible]
MM74HC4050N	[illegible]
MM74HC4060N	[illegible]
MM74HC4075N	[illegible]
MM74HC4078N	[illegible]
MM74HC4538N	[illegible]
MM80C95N	[illegible]
MM80C96N	[illegible]
MM80C97N	[illegible]
MM80C98N	[illegible]
MM88C29N	[illegible]
MM88C30N	[illegible]
- TTL LOGIC -	
DM7402N	[illegible]
DM7403N	[illegible]
DM7405N	[illegible]
DM7406N	[illegible]
DM7407N	[illegible]
DM7489N	[illegible]
DM7490AN	[illegible]
DM7496N	[illegible]
DM74100N	[illegible]
DM74107N	[illegible]
DM74109N	[illegible]
DM74121N	[illegible]
DM74123N	[illegible]
DM74125N	[illegible]
DM74126N	[illegible]
DM74132N	[illegible]
DM74141N	[illegible]
DM74145N	[illegible]
DM74147N	[illegible]
DM74150N	[illegible]
DM74151AN	[illegible]
DM74153N	[illegible]
DM74154N	[illegible]
DM74155N	[illegible]
DM74156N	[illegible]
DM74157N	[illegible]
DM74160AN	[illegible]
DM74161AN	[illegible]
DM74162AN	[illegible]
DM74163AN	[illegible]
DM74164N	[illegible]
DM74165N	[illegible]
DM74170N	[illegible]
DM74173N	[illegible]
DM74174N	[illegible]
DM74175N	[illegible]
DM74176N	[illegible]
DM74180N	[illegible]
DM74181N	[illegible]
DM74184AN	[illegible]
DM74185AN	[illegible]
DM74189N	[illegible]
DM74190N	[illegible]
DM74191N	[illegible]
DM74192N	[illegible]
DM74193N	[illegible]
DM74194N	[illegible]
DM74195N	[illegible]
DM74196N	[illegible]
DM74197N	[illegible]
DM74198N	[illegible]
DM74199N	[illegible]
DM74221N	[illegible]
DM74251N	[illegible]
DM74279N	[illegible]
DM74284N	[illegible]
DM74285N	[illegible]
DM74293N	[illegible]
DM74365N	[illegible]
DM74366N	[illegible]
DM74367N	[illegible]
DM74368N	[illegible]
DM74390N	[illegible]
DM74ALS00N	[illegible]
DM74ALS01N	[illegible]
DM74ALS02N	[illegible]
DM74ALS03N	[illegible]
DM74ALS04N	[illegible]
DM74ALS05N	[illegible]
DM74ALS08N	[illegible]
DM74ALS09N	[illegible]
DM74ALS10N	[illegible]
DM74ALS11N	[illegible]
DM74ALS12N	[illegible]
DM74ALS15N	[illegible]
DM74ALS20N	[illegible]
DM74ALS21N	[illegible]
DM74ALS22N	[illegible]
DM74ALS26N	[illegible]
DM74ALS27N	[illegible]
DM74ALS28N	[illegible]
DM74ALS30N	[illegible]
DM74ALS32N	[illegible]
DM74ALS33N	[illegible]

DM74ALS37N	1.03
DM74ALS38N	1.03
DM74ALS40N	1.03
DM74ALS74N	1.28
DM74ALS109N	[illegible]
DM74ALS131N	[illegible]
DM74ALS133N	[illegible]
DM74ALS137N	[illegible]
DM74ALS160N	2.00
DM74ALS162N	2.00
DM74ALS163N	[illegible]
DM74ALS169N	[illegible]
DM74ALS573N	[illegible]
DM74ALS574N	[illegible]
DM74ALS580N	4.28
DM74ALS1000N	1.03
DM74ALS1002N	[illegible]
DM74ALS1003N	[illegible]
DM74ALS1008N	[illegible]
DM74ALS1010N	[illegible]
DM74LS00N	[illegible]
DM74S04N	[illegible]
DM74S05N	[illegible]
DM74S08N	[illegible]
DM74S09N	[illegible]
DM74S10N	[illegible]
DM74S11N	[illegible]
DM74S15N	[illegible]
DM74S20N	[illegible]
DM74S22N	[illegible]
DM74S30N	[illegible]
DM74S32N	[illegible]
DM74S40N	[illegible]
DM74S51N	[illegible]
DM74S64N	[illegible]
DM74S65N	[illegible]
DM74S74N	[illegible]
DM74S86N	[illegible]
DM74S112N	[illegible]
DM74S113N	[illegible]
DM74S114N	[illegible]
DM74S124N	[illegible]
DM74S132N	[illegible]
DM74S133N	[illegible]
DM74S134N	[illegible]
DM74S135N	[illegible]
DM74S138N	[illegible]
DM74S139N	[illegible]
DM74S140N	[illegible]
DM74S151N	[illegible]
DM74S153N	[illegible]
DM74S157N	[illegible]
DM74S158N	[illegible]
DM74S160N	[illegible]
DM74S161N	[illegible]
DM74S162N	[illegible]
DM74S163N	[illegible]
DM74S174N	[illegible]
DM74S175N	[illegible]
DM74S181N	[illegible]
DM74S182N	[illegible]
DM74S188N	[illegible]
DM74S189AN	[illegible]
DM74S194N	[illegible]
DM74S195N	[illegible]
DM74S196N	[illegible]
DM74S197N	[illegible]
DM74S200N	[illegible]
DM74S240N	[illegible]
DM74S241N	[illegible]
DM74S242N	[illegible]
DM74S243N	[illegible]
DM74S244N	[illegible]
DM74S251N	[illegible]
DM74S253N	[illegible]
DM74S257N	[illegible]
DM74S258N	[illegible]
DM74S262N	[illegible]
DM74S280N	[illegible]
DM74S283N	[illegible]
DM74S287N	[illegible]
DM74S288N	[illegible]
DM74S299N	[illegible]
DM74S373N	[illegible]
DM74S374N	[illegible]
DM74S387J	[illegible]
DM74S387N	[illegible]
DM74S472N	[illegible]
DM8099N	[illegible]
DM8123N	[illegible]
DM8130N	[illegible]
DM8131N	[illegible]
DM8136N	[illegible]
DM8211N	[illegible]
DM8219N	[illegible]
DM8220N	[illegible]
DM8223N	[illegible]
DM8288N	[illegible]
DM8312N	[illegible]
DM8520N	[illegible]
DM8542N	[illegible]
DM8544N	[illegible]
DM8552N	[illegible]
DM8553N	[illegible]
DM8556BN	[illegible]
DM8601N	[illegible]
DM8678CAB/N	[illegible]
DM8678BTX/N	[illegible]
DM8694CAB/N	[illegible]
DM8694CAM/N	[illegible]
FSC 4096DC	[illegible]
FSC 9301PC	[illegible]
- CONVERTERS -	
ADB1200PCN	[illegible]
ADB4500PCN	[illegible]
ADC0800PCD	[illegible]
ADC0801LCN	[illegible]
ADC0803LCN	[illegible]
ADC0804LCN	5.20
ADC0808CCN	14.50
ADC0809CCN	[illegible]
ADC0816CCN	19.90
ADC0817CCN	12.89
ADC0820CCN	[illegible]
ADC0831CCN	[illegible]
ADC0833BCN	[illegible]
ADC0833CCN	6.02
ADC1001CCD-1	[illegible]
ADC1021CCD-1	[illegible]
ADC3511CCN	[illegible]
ADC3711CCN	[illegible]
ADD3501CCN	[illegible]
ADD3701CCN	[illegible]
AMD014CD	22.70
AM3705CN	[illegible]

DAC0800LCN	3.60
DAC0808LCN	[illegible]
DAC0831LCN	6.06
DAC1000LCN	[illegible]
DAC1006LCN	12.06
DAC1020LCN	[illegible]
DAC1021LCN	[illegible]
DAC1022LCN	[illegible]
DAC1230HCD	[illegible]
DAC1220LCN	[illegible]
DAC1221LCN	[illegible]
DAC1222LCN	[illegible]
DAC1230LCD	[illegible]
DAC1231LCD	[illegible]
DAC1280HCD	36.02
MA 2-2502	2.87
LF398H	6.94
LF398N	5.47
LF13006N	4.06
LF13201N	5.71
LF13202N	5.71
- LINEAR -	
DT1050	[illegible]
DT1051	[illegible]
LF355N	[illegible]
LF356N	[illegible]
LF357N	[illegible]
LF441CN	[illegible]
LF444CN	[illegible]
LF13741N	[illegible]
LM0002CH	[illegible]
LM0002CN	[illegible]
LM0022CH	[illegible]
LM0024CH	[illegible]
LM0032CG	[illegible]
LM0033CG	[illegible]
LM0036CG	[illegible]
LM0038CD	[illegible]
LM0042CH	[illegible]
LM0044CH	[illegible]
LM0086CD	[illegible]
LM0101CH	[illegible]
LH740ACH	[illegible]
LM10CH	8.00
LM10CLH	[illegible]
LM10CLN	[illegible]
LM11CLH	[illegible]
LM11CLN	[illegible]
LM11CH	[illegible]
LM1304N	[illegible]
LM13080N	[illegible]
LM13600N	[illegible]
LM13700N	[illegible]
LM1414N	[illegible]
LM1458N	[illegible]
LM1496H	3.60
LM1496N	1.60
LM1818N	[illegible]
LM1889N	[illegible]
LM201AH	[illegible]
LM211H	[illegible]
LM2877P	[illegible]
LM2878P	[illegible]
LM301AH	[illegible]
LM301AN	[illegible]
LM306H	[illegible]
LM307H	[illegible]
LM307N	[illegible]
LM308AH	[illegible]
LM308AN	[illegible]
LM308H	[illegible]
LM308N	[illegible]
LM309K	[illegible]
LM310H	[illegible]
LM310N	[illegible]
LM311H	[illegible]
LM311N	[illegible]
LM312H	[illegible]
LM316AH	[illegible]
LM316H	[illegible]
LM318H	[illegible]
LM318J-8	[illegible]
LM318N	[illegible]
LM319N	[illegible]
LM321AH	[illegible]
LM321H	[illegible]
LM324AN	[illegible]
LM339N	[illegible]
LM344H	[illegible]
LM348N	[illegible]
LM358N	[illegible]
LM359N	[illegible]
LM360H	[illegible]
LM360N	[illegible]
LM361N	[illegible]
LM363D	[illegible]
LM363H-100	[illegible]
LM363H-500	[illegible]
LM368H-10	8.00
LM368H-5.0	8.00
LM368H-6.2	8.00
LM372H	[illegible]
LM377N	3.20
LM378N	[illegible]
LM379S	[illegible]
LM380N	[illegible]
LM380N-8	[illegible]
LM381AN	[illegible]
LM381N	[illegible]
LM382N	[illegible]

LM383AT	3.60
LM384N	2.67
LM386N-1	1.07
LM387N	2.15
LM388N-1	1.72
LM389N	1.92
LM390N	2.87
LM391N-100	2.87
LM392N	[illegible]
LM393AN	5.07
LM393N	[illegible]
LM3900N	[illegible]
LM4250CH	[illegible]
LM4250CN	2.40
LM565CH	4.30
LM565CN	[illegible]
LM566CN	[illegible]
LM567CN	[illegible]
LM703LN	[illegible]
LM709CH	[illegible]
LM709CN	[illegible]
LM710CH	[illegible]
LM710CN	[illegible]
LM711CN	1.20
LM725CH	8.00
LM725CN	[illegible]
LM733CH	[illegible]
LM733CN	[illegible]
LM741CH	1.20
LM741CJ-14	[illegible]
LM741CN-14	1.06
LM741CN	[illegible]
LM741CS	[illegible]
LM747CH	[illegible]
LM747CN	[illegible]
LM748CN	[illegible]
MM5824N	[illegible]
NE501 SIG	[illegible]
RC4136N	[illegible]
TBA120S	[illegible]
XR2206CP	[illegible]
XR2216	[illegible]
XR2567	[illegible]
- XTALS -	
CRYS 32KHZ	3.10
CRYS 3.58MHZ	3.10
CRYS 4MHZ	3.10
CRYS 5.068MHZ	3.10
CRYS 8MHZ	3.10
CRYS 16MHZ	3.10
- CLOCKS -	
MA1003	[illegible]
MA1026ALP	[illegible]
MM5309N	[illegible]
MM5369AA/N	[illegible]
MM5865N	[illegible]
MM58167AN	16.01
MM58174AN	16.67
- DATA -	
DATA ADV LO	6.25
DATA AUDIO/R	6.25
DATA CMOS/81	9.00
DATA HYBRID/	6.25
DATA INTERFA	15.00
DATA LINEAR/	20.00
DATA LIN APP	17.00
DATA LOGIC/B	11.25
DATA MEMORY	7.00
DATA TRANSIS	7.50
DATA V.REG/8	6.25
- DIODES -	
1N60	0.00
1N914	0.00
1N3070	0.00
1N5626	0.00
701P85	0.00
701P83	0.00
A14F	0.00
PK40F	2.51
SB2	0.74
- OPTO -	
FOR261F-2	21.72
LH0082CD	51.68
LM3914N	3.34
LM3915N	3.34
LM3916N	3.34
MAN54	5.60
MAN6910?	5.60
NSB3881	10.12
NSB5382	[illegible]
NSB5388	[illegible]
NSB5881	[illegible]
NSB5882	[illegible]
NSB7882	[illegible]
NSB7881	[illegible]
NSB7882	[illegible]
NSB7884	[illegible]
NSC003	[illegible]
NSL4550	[illegible]
NSL4550+CLIP	[illegible]
NSL4555+CLIP	[illegible]
NSL4944	[illegible]
NSL4944+CLIP	[illegible]
NSL4955	[illegible]
NSL4955+CLIP	[illegible]
NSL5053	[illegible]
NSL5053+CLIP	[illegible]
NSL5056	[illegible]
NSL5056+CLIP	[illegible]
NSL5086	[illegible]
NSL5253A+CLI	[illegible]
NSL5353A+CLI	[illegible]
NSL52124	[illegible]
NSL53124	[illegible]
NSM1416	[illegible]
NSM3914	[illegible]
NSM39142	[illegible]
NSM39152	[illegible]
NSM39158	[illegible]
NSM3916	[illegible]
NSM39168	[illegible]
NSM4000A	[illegible]
NSM4005	[illegible]
NSN334	[illegible]
NSN373	[illegible]
NSN374	[illegible]
NSN381	[illegible]
NSN382	[illegible]
NSN534	[illegible]
NSN581	[illegible]
NSN583	[illegible]

NSN584	6.30
NSN782	6.40
NSN783	6.40
NSN784	6.40
XC209 G	0.33
XC209 Y	0.33
XC-500B	0.71
XC5491	1.14
- HARDWARE -	
BEZEL 2344IN	[illegible]
BEZEL 2344IN	2.65
BEZEL 2344IN	2.65
BEZEL 2344IP	2.65
BEZEL 2344IR	2.65
BEZEL 2344IP	2.65
BEZEL 2344IP	2.65
BEZEL 2344IP	[illegible]
BEZEL 2246JP	[illegible]
BEZEL 2246JR	[illegible]
BEZEL 2246JN	[illegible]
BOWM KBA3145	[illegible]
BOWM KBA3150	[illegible]
BOWM KBA3200	18.01
BOWM KBA3203	18.01
BOWM KBA3204	[illegible]
BOWM TP3150	184.70
DUNC 3253R1K	12.40
DUNC 3253P2K	12.40
DUNC 3253R5K	[illegible]
DUNC 3253R10	[illegible]
DUNC 4215A10	[illegible]
DUNC 4215L10	[illegible]
DUNC 4415A10	27.80
DUNC 4415L10	27.80
DUNC 62 DIAL	[illegible]
DUNC 82 DIAL	[illegible]
DUNC KNOB LO	[illegible]
DUNC KNOB L2	[illegible]
DUNC KNOB SQ	2.22
DUNC OTHER	0.00
ROT 12805b	[illegible]
ROT 476042	[illegible]
ROT MU2A1 11	30.63
ROT MU2A1 23	[illegible]
ROT SU2A1 11	[illegible]
ROT SU3A1 23	[illegible]
SOCKET 6 PIN	[illegible]
SOCKET 8 PIN	[illegible]
SOCKET 14 PI	[illegible]
SOCKET 16 PI	[illegible]
SOCKET 18 PI	[illegible]
SOCKET 20 PI	[illegible]
SOCKET 22 PI	[illegible]
SOCKET 24 PI	[illegible]
SOCKET 28 PI	[illegible]
SOCKET 40 PI	[illegible]
SPEC 00AT00	[illegible]
SPEC 43P-101	[illegible]
SPEC 43P-102	[illegible]
SPEC 43P-103	[illegible]
SPEC 43P-104	[illegible]
SPEC 43P-105	[illegible]
SPEC 43P-201	[illegible]
SPEC 43P-202	[illegible]
SPEC 43P-203	[illegible]
SPEC 43P-204	[illegible]
SPEC 43P-205	[illegible]
SPEC 43P-501	[illegible]
SPEC 43P-502	[illegible]
SPEC 43P-503	[illegible]
SPEC 43P-504	[illegible]
SPEC 43P-505	[illegible]
SPEC 63P-101	1.42
SPEC 63P-102	1.42
SPEC 63P-103	1.42
SPEC 63P-104	1.42
SPEC 63P-105	1.42
SPEC 63P-201	1.42
SPEC 63P-202	1.42
SPEC 63P-203	1.42
SPEC 63P-204	1.42
SPEC 63P-205	1.42
SPEC 63P-501	1.42
SPEC 63P-502	1.42
SPEC 63P-503	1.42
SPEC 63P-504	1.42
SPEC 63P-505	1.42
SPEC 64Y-101	3.40
SPEC 64Y-102	3.40
SPEC 64Y-103	3.40
SPEC 64Y-104	3.40
SPEC 64Y-105	3.40
SPEC 64Y-201	3.40
SPEC 64Y-202	[illegible]
SPEC 64Y-203	3.40
SPEC 64Y-204	3.40
SPEC 64Y-205	3.40
SPEC 64Y-501	3.40
SPEC 64Y-502	3.40
SPEC 64Y-503	3.40
SPEC 64Y-504	3.40
SPEC 64Y-505	[illegible]
- INTERFACE -	
DP8310N	6.73
DP8311N	6.73
DS0026CN	2.44
DS1488N	1.26
DS1489AJ	1.72
DS1489AN	[illegible]
DS1489N	[illegible]
DS1691J	[illegible]
DS26LS31CN	[illegible]
DS26LS32CN	[illegible]
DS26LS33CN	[illegible]
DS26S11N	[illegible]
DS3245N	[illegible]
DS3486N	4.00
DS3487N	4.00
DS3605N	[illegible]
DS3611N	[illegible]
DS3612N	[illegible]
DS3613N	[illegible]
DS3614N	[illegible]
DS3625N	[illegible]
DS3630N	[illegible]
DS3631N	[illegible]
DS3632N	[illegible]
DS3633N	[illegible]
DS3634N	[illegible]
DS3640N	[illegible]
DS3644N	[illegible]
DS3648N	[illegible]
DS3649N	[illegible]
DS3662N	[illegible]
DS3675N	[illegible]
DS3686N	[illegible]
DS3687N	[illegible]
DS3692N	[illegible]
DS36149N	[illegible]
DS7524N	[illegible]
DS75107N	[illegible]
DS75108J	[illegible]
DS75109N	[illegible]
DS75110N	[illegible]
DS75113N	[illegible]
DS75121N	[illegible]
DS75124N	[illegible]
DS75125N	[illegible]
DS75150N	[illegible]

DS75154N	[illegible]
DS75160AN	[illegible]
DS75161AN	[illegible]
DS75324N	[illegible]
DS75361N	[illegible]
DS75450N	[illegible]
DS75451N	[illegible]
DS75452N	[illegible]
DS75453N	[illegible]
DS75454N	[illegible]
DS75461N	[illegible]
DS75491N	[illegible]
DS75492N	[illegible]
DS75494N	[illegible]
DS8T26AN	[illegible]
DS8T28N	[illegible]
DS8629N	[illegible]
DS8640N	[illegible]
DS8644N	[illegible]
DS8664N	[illegible]
DS8692N	[illegible]
DS8800N	[illegible]
DS8812N	[illegible]
DS8820AN	[illegible]
DS8820N	[illegible]
DS8822N	[illegible]
DS8830N	[illegible]
DS8831N	[illegible]
DS8832N	[illegible]
DS8833N	[illegible]
DS8834N	[illegible]
DS8835N	[illegible]
DS8836N	[illegible]
DS8837N	[illegible]
DS8838N	[illegible]
DS8839N	[illegible]
DS8853N	[illegible]
DS8859N	[illegible]
DS8861N	[illegible]
DS8863N	[illegible]
DS8867N	[illegible]
DS8868N	[illegible]
DS8870N	[illegible]
DS8871N	[illegible]
DS8872N	[illegible]
DS8875N	[illegible]
DS8877N	[illegible]
DS8880J	[illegible]
DS8880N	[illegible]
DS8881N	[illegible]
DS8885N	[illegible]
DS8887J	[illegible]
DS8889N	[illegible]
DS88C20N	[illegible]
DS88LS120N	[illegible]
DS8896N	[illegible]
- MEMORY -	
MM1101AN	[illegible]
MM1402A	[illegible]
MM2101AN	[illegible]
MM2102AN	[illegible]
MM2102AN-2	[illegible]
MM2114N	[illegible]
MM2114N-055	[illegible]
MM2114N-2	[illegible]
MM2114N-3	[illegible]
MM2708Q	[illegible]
MM2716Q	[illegible]
MM2716Q-1	[illegible]
MM2716Q-TI	[illegible]
MM25320	[illegible]
MM27320	[illegible]
MM2758Q-A	[illegible]
MM5001	[illegible]
MM5050	[illegible]
MM5034N	[illegible]
MM5204Q	28.60
MM5280N	[illegible]
MM5290J-2	[illegible]
MM5290J-3	[illegible]
MM5290N-4	[illegible]
MM5298N-4	[illegible]
NMC27C16Q-35	[illegible]
NMC27C16Q-45	[illegible]
NMC27C16Q-55	[illegible]
NMC27C32Q-35	[illegible]
NMC27C32Q-55	[illegible]
NMC6116LP-3	[illegible]
NMC6514J-9	[illegible]
TMS4C045NL	[illegible]
TMS4045NL	[illegible]
TMS4050NL	[illegible]
- REGULATORS -	
LH0070-0H	10.63
LH0070-1H	[illegible]
LH0071-0H	10.63
LH0071-2H	25.79
LH1605CK	20.75
LM113H	[illegible]
LM1250H?	[illegible]
LM217K	[illegible]
LM2930T-5.0	[illegible]
LM2930T-8.0	[illegible]
LM2931CT	[illegible]
LM304H	[illegible]
LM305AH	3.60
LM305H	[illegible]
LM309H	[illegible]
LM309K	[illegible]
LM309K STEEL	[illegible]
LM317H	[illegible]
LM317HVH	[illegible]
LM317HVK-STE	[illegible]
LM317K-STEEL	[illegible]
LM317KC	[illegible]
LM317LZ	[illegible]
LM317T	[illegible]
LM320H-15	[illegible]
LM320H-5.0	[illegible]
LM320K-12	[illegible]
LM320K-15	[illegible]
LM320K-5.0	[illegible]
LM320KC-12	[illegible]
LM320KC-15	[illegible]
LM320KC-5.0	[illegible]
LM320L2-12	[illegible]
LM320L2-15	[illegible]
LM320L2-5.0	[illegible]
LM320MP-12	[illegible]
LM320T-12	[illegible]
LM320T-5.0	[illegible]
LM323K-STEEL	[illegible]
LM325AN	[illegible]
LM325N	[illegible]
LM326H	[illegible]
LM326N	[illegible]
LM329BZ	[illegible]
LM329CH	[illegible]
LM329DZ	[illegible]
LM336Z-2.5	[illegible]
LM336Z-5.0	[illegible]
LM337H	[illegible]

LM337HVH	10.27
LM337HVK-STE	12.94
LM337K-STEEL	6.83
LM337LZ	1.20
LM337MP	1.60
LM337T	2.53
LM338K-STEEL	9.23
LM340K-12	4.80
LM340K-15	4.80
LM340K-5.0	4.40
LM340K-6.0	4.45
LM340K-8.0	[illegible]
LM340KC-12	1.97
LM340KC-15	1.97
LM340KC-5.0	1.97
LM340KC-8.0	2.09
LM340T-12	0.93
LM340T-15	0.93
LM340T-5	0.83
LM341P-12	[illegible]
LM341P-5.0	[illegible]
LM342P-12	[illegible]
LM342P-15	[illegible]
LM350K-STEEL	7.08
LM350T	[illegible]
LM3524N	[illegible]
LM376N	[illegible]
LM385Z 1.2	[illegible]
LM396K-STEEL	20.23
LM399H	[illegible]
LM723CH	[illegible]
LM723CN	[illegible]
LM7805CK	[illegible]
LM78L05ACZ	[illegible]
LM78L08ACZ	[illegible]
LM78L12ACZ	1.60
LM78L15ACH	1.60
LM78L15ACZ	[illegible]
LM78L24ACZ	[illegible]
LM7905CK	[illegible]
LM7905CT	[illegible]
LM7912CK	[illegible]
LM7912CT	[illegible]
LM7915CK	[illegible]
LM7915CT	[illegible]
LM79L05ACZ	[illegible]
LM79L12ACZ	[illegible]
LM79L15ACZ	[illegible]
RC4195N	[illegible]
SR1605	[illegible]
- RELAYS -	
ELECT MSK2D1	[illegible]
ELECT MSK2D2	[illegible]
ELECT RA3038	[illegible]
ELECT RA3043	[illegible]
ELECT RA3044	[illegible]
ELECT RA3045	[illegible]
- SUNDRY -	
DM9097	[illegible]
LH0091CD	[illegible]
LH0094CD	[illegible]
LM1014N	1.60
LM1801N	[illegible]
LM1812N	[illegible]
LM1830N	[illegible]
LM1871N	[illegible]
LM1872N	[illegible]
LM322N	[illegible]
LM323N	[illegible]
LM375N	[illegible]
LM3905N	[illegible]
LM3909N	[illegible]
LM555CN	[illegible]
LM556CN	[illegible]
MM53200N	6.03
MM54240N	10.41
MM5837N	3.58
N2508N-SIG	2.65
N2509N-SIG	2.65
N2521N-SIG	2.65
N2527N-SIG	2.65
N8T28N	2.65
N8251N-SIG	2.65
N8252N-SIG	2.65
N8269N-SIG	2.65
N8273N-SIG	[illegible]
N8274N-SIG	[illegible]
N8284N-SIG	[illegible]
N82S23N-SIG	[illegible]
N82S10N-SIG	[illegible]
N82S21N-SIG	[illegible]
N8225N-SIG	[illegible]
N8226N-SIG	[illegible]
N8240N-SIG	[illegible]
N8275N-SIG	[illegible]
N8T04BN-SIG	[illegible]
N8T09BN-SIG	[illegible]
N8T35BN-SIG	[illegible]
N8T36BN-SIG	[illegible]
N8T38N-SIG	[illegible]
N8T39N-SIG	[illegible]
N10106BN-SIG	[illegible]
N10116N-SIG	[illegible]
N10125BN-SIG	[illegible]
NE592-SIG	[illegible]
ULN2208N	[illegible]
ULN2209N	[illegible]
VELOSTAT	[illegible]
XR2206CP	[illegible]
XR2211CP	[illegible]
- TEMPERATURE -	
LM135H	[illegible]
LM335H	[illegible]
LM335Z	[illegible]
LM3911H-46	4.50
LM3911N	4.50
- TRANSISTORS -	
2N706	[illegible]
2N1302	[illegible]
2N1308	[illegible]
2N1711	[illegible]
2N2017	[illegible]
2N2160	[illegible]
2N2222	[illegible]
2N2222A	[illegible]
2N2270	[illegible]
2N2367	[illegible]
2N2644	[illegible]
2N2647	[illegible]
2N2904	[illegible]
2N2904A	[illegible]
2N2905	[illegible]
2N2906A	[illegible]
2N2920	[illegible]

2N3019	[illegible]
2N3020	[illegible]
2N3053	[illegible]
2N3058	[illegible]
2N3069	[illegible]
2N3249	[illegible]
2N3460	[illegible]
2N3546	[illegible]
2N3640	[illegible]
2N3704	[illegible]
2N3819	[illegible]
2N3822	[illegible]
2N3823	[illegible]
2N3860	[illegible]
2N3904	[illegible]
2N3905	[illegible]
2N3906	[illegible]
2N3971	[illegible]
2N3993	[illegible]
2N4032	[illegible]
2N4036	[illegible]
2N4037	[illegible]
2N4123	[illegible]
2N4288	[illegible]
2N4360	[illegible]
2N4401	[illegible]
2N4403	[illegible]
2N4918	[illegible]
2N4921	[illegible]
2N5087	[illegible]
2N5089	[illegible]
2N5305	[illegible]
2N5457	[illegible]
2N5459	[illegible]
2N5460	[illegible]
2N5484	[illegible]
2N5485	[illegible]
2N5656	[illegible]
2N5770	[illegible]
2N5771	[illegible]
2N5871	[illegible]
2N5953	[illegible]
2N6027	[illegible]
2N6107	[illegible]
2N6121	[illegible]
2N6123	[illegible]
2N6459	[illegible]
2N6706	[illegible]
2N6707	[illegible]
2N6710	[illegible]
2N6724	[illegible]
2N6725	[illegible]
IM204	[illegible]
BC107	[illegible]
BC108	[illegible]
BC178	[illegible]
BC183L	[illegible]
BC184L	[illegible]
BC308-92	[illegible]
BC309-92	[illegible]
BC317	[illegible]
BC318	[illegible]
BC327-16	[illegible]
BC338	[illegible]
BC547B	[illegible]
BC548C	[illegible]
BC549	[illegible]
BC557B	[illegible]
BC558	[illegible]
BC559	[illegible]
BC639	[illegible]
BC640	[illegible]
BD140	[illegible]
BD235	[illegible]
BD236	[illegible]
BD439	[illegible]
BD440	[illegible]
BD678	[illegible]
BFY51	[illegible]
BF258	[illegible]
BF458	[illegible]
BU208A	[illegible]
MJ3045J	[illegible]
MJE3055	[illegible]
MJE2955	[illegible]
MJE800	[illegible]
MJE700	[illegible]
MJE2800	[illegible]
MOUNT KIT TO	[illegible]
MOUNT KIT TO	[illegible]
MPF102	[illegible]
MPSA13	[illegible]
NPD8303	[illegible]
NSD102	[illegible]
NSD106	[illegible]
NSD204	[illegible]
TIP31C	[illegible]
TIP32C	[illegible]
TIP120	[illegible]
TIP125	[illegible]
TIP2955	[illegible]
TIP3055	[illegible]
TN2017	[illegible]
TN2905A	[illegible]
TN3020	[illegible]
TN3053	[illegible]
TN3245	[illegible]
TN3440	[illegible]
TN3444	[illegible]
TN3467	[illegible]
TN3724	[illegible]
U310	[illegible]

8.30 to 5 Monday to Friday, 8.30 to 12 Sat.
Mail Orders add $3.00 to cover postal charges.
Next day delivery in Sydney add $5.00.
All prices INCLUDE sales tax.
Tax exemption certificates accepted if line value exceeds $10.00.

GEOFF WOOD ELECTRONICS

GEOFF WOOD ELECTRONICS PTY LTD
Incorporated in N.S.W.
656A Darling St, Rozelle 2039
(One door from National Street)
Tel: **810 6845**

bankcard
$10.00 minimum

specialising in electronic components for the professional and hobbyist.

CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS

... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ...

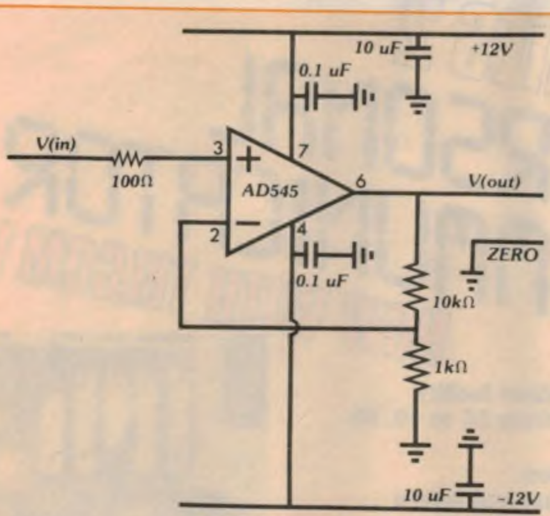


Fig. 11: Practical use of the AD545. Circuit gain T = +11, input impedance approx. 1000MΩ.

TABLE 1 Gain of In-Phase Amplifier Figs 4 and 5

R1	R2	H	Open Loop Gain G	Nom. gain	Actual Gain T
1kΩ	2kΩ	$\frac{1k}{1k+2k} = \frac{1}{3}$	10	3	2.30769
''	''	''	100	3	2.91262
''	''	''	1000	3	2.99102
''	''	''	10000	3	2.9991002
''	''	''	100000	3	2.9999100
''	''	''	1000000	3	2.99999100
''	''	''	10000000	3	2.999999100
''	''	''	100000000	3	2.9999999100
1kΩ	99kΩ	$\frac{1k}{1k+99k} = \frac{1}{100}$	10	100	9.090909
''	''	''	100	100	50.00000
''	''	''	1000	100	90.909090
''	''	''	10000	100	99.009900
''	''	''	100000	100	99.9000999
''	''	''	1000000	100	99.9900009
''	''	''	10000000	100	99.99900001
''	''	''	100000000	100	99.99990000

OP AMPS Explained

limit on the values that can be chosen for Ri and Rf, values in thousands (not millions) of ohms being usual. Thus the circuit input impedance Zi is commonly very low in inverting operational amplifiers despite the high impedance Zig at the entry of the amplifier block G. This low circuit input impedance can be a serious disadvantage in some applications and is a point we must always keep in mind.

Again the natural output impedance of the amplifier block G is reduced by the feedback action and the circuit output impedance Zo may commonly be about one ohm or less.

Practical circuits

Figs. 7 and 8 shows examples of real circuits using an integrated circuit LM741. As this type uses junction transistors, low value resistors are used. Fig. 9 is the LM310H, an integrated circuit internally connected into the unity gain voltage follower configuration. Figs. 10 and 11 show the use of higher value resistors around the AD545, a precision integrated circuit with field effect transistors in the input stage.

Lastly we note that the operational amplifier concept can be implemented in different technologies — valves, junction transistors, field effect transistors — and we can only guess what may be used in the future.

In the next chapter we will consider circuit time constants, frequency capability and the very important stability problem.

NEW RELEASE

microbee

SERIES 2 PERSONAL COMMUNICATOR

NOW WITH TELCOM 1

- Built-in real time clock with alarm facility
- 16 programmable baud rates from 50 to 19200 (7/8 Bit)
- Auto dialling/hangup for modem
- File capture to Wordbee format and screen printing
- Super friendly menu driven
- Usable as stand alone or through Wordbee or Basic
- Now available for all IC or later microbees
- World standard Christensen protocol for file transfer

Now every **microbee** can become a personal terminal using TELCOM 1. TELCOM 1 is a ROM based communications program suitable for all ROM based **microbee** IC and later models. It allows the use of the serial RS232 port at 16 baud rates from 50 to 19200 Baud, provides real time clock with alarm feature, modem control functions such as automatic dialling, BASIC WORDBEE and MACHINE LANGUAGE file transfer via the serial port. Additionally the ROM emulates the ADM 3A and Televideo 912 terminals for connection to other computers. All information can be viewed on the screen and retrieved as a WORDBEE file and even printer-out using the built in screen print utility.

1984 IS THE YEAR OF THE NETWORK . . . . with over 20,000 **microbees** now in everyday use and most with integrated software including WORDBEE, MICROWORLD BASIC and COMMUNICATIONS capability are you missing out on the computing opportunity of the year? Using a low cost modem such as the BEEMODEM you can now talk to other computers around the world, use the public domain bulletin boards, shop electronically, communicate with friends with your own home telex and extend your computing horizons by converting your **microbee** to your personal INFORMATION WINDOW to the world.

A big feature of the **microbee** PERSONAL COMMUNICATOR is the battery backed CMOS RAM which stores your programs even when the power has been disconnected. This is particularly useful with WORDBEE or BASIC files which can be entered at home and then your **microbee** can be taken to school or the office for printout or further editing. If your needs grow you can expand your PERSONAL COMMUNICATOR to the ADVANCED PERSONAL COMPUTER using disk drives. Ask your **microbee computer shop** for details.

microbee SERIES 2 PERSONAL COMMUNICATOR (with TELCOM 1) $499.00
microbee HIGH RESOLUTION MONiTOR (Green) $249.00
microbee HIGH RESOLUTION MONITOR (Amber) $269.00
microbee DOT MATRIX PRINTER with cable $449.00
microbee DATA TAPE RECORDER $49.50
BEEMODEM 300 baud DIGITAL MODEM (Telecom approved) $149.50
TELCOM 1 ROM SET (with manual and conversion details) $15.00

microbee

SERIES 2 ADVANCED PERSONAL COMPUTER

The **microbee Series 2 Advanced Personal Computer** with 400K disk drive and world class software such as CP/M, MICROSOFT BASIC, MULTIPLAN, WORDSTAR and a powerful library of support programs all for only $1495.

The **microbee Series 2 Advanced Personal Computer** is the most powerful and best price/performance computer in its class. What's more any existing **microbee** owner can convert his **microbee** to the **Series 2 APC** at any time.

The **microbee Series 2 APC** uses the popular Z80 microprocessor and runs standard CP/M so that users have access to the vast library of CP/M software available world wide.

You can expand your **microbee Series 2 APC** to drive 2 or more disk drives. A hard disk drive unit is now operational and will release soon.

Your **microbee Series 2 APC** is a world class machine from the hardware as well as the software point of view. The exclusive SETDRIVE utility will convert your disk system to read diskettes from a host of other computers. The **Series 2 APC** is also equipped with VIRTUAL DRIVE capability. This means single disk owners can readily copy from A to B using only one drive. Another world first is the CONFIG program which enables a **Series 2 APC** user to reCONFIGure his CP/M system to select screen positioning, background and foreground colour, parallel and serial printers disk drive information and even auto start disks.

$1495 WITH SINGLE 400K DISK DRIVE

$1795 WITH DOUBLE 400K DISK DRIVE

STIMULATING SOFTWARE

VIPER
A highly addictive game. You must eradicate the rabbits before they reach plague proportions but each time you catch a rabbit your tail grows.
Cassette $14.95 .... Diskette $19.95

BEE MONOPOLY
Now a full graphic version of the old family game of the same name. The entire board, players, Community Chest and Chance cards are displayed as required in this fast moving game. Full details of land ownership and finances. Superb graphics and sound effects. (Requires 32K).
Cassette $14.95 .... Diskette $19.95

SWORD QUEST
Just like the 'Dungeons and Dragons' series. Select your characters level of armour, weapons, strength and skill. Explore in search of treasure and the Great Sword, and battle with the dungeon's creatures.
Cassettee $14.95 .... Diskette $19.95

FROG HOP
A most graphic variation of the popular arcade game. You must hop across a busy street (watch out for the trucks . . .) and across a crocodile infested stream before your frogs are safely home. Guaranteed to appeal to all ages.
Cassette $14.95 .... Diskette $19.95

ROBOT MAN '84
Now one of the most popular games ever written for the **microbee** has been rewritten with new twists, a joystick and colour option.
Cassette $14.95 .... Diskette $19.95

MICROSPACE INVADERS '84
New update of one of the original **microbee** games. Now with full colour and joystick option. Sound and speed controls. Turn your **microbee** into a home arcade machine.
Cassette $14.95 .... Diskette $19.95

SCRAMBLER
A full colour version of the popular arcade game. You are the sole surviving defender of earth and you must destroy the aliens at all cost . . . very effective colour graphics (also suitable for non colour **microbees**).
Cassette $14.95 .... Diskette $19.95

EYE OF MIN
A graphic adventure game that will absorb you for hours. If you can solve this excellent mystery then you can proceed to the next saga 'Sabre of Sultan'. (Requires 32K).
Cassette $14.95 .... Diskette $19.95

SKETCH PAD
Use the high resolution graphics in your **microbee** with this most effective drawing aid. Ideal as an introduction to Cad techniques and you can create complex shapes with a little practice. You can also 'trace' from images taped onto the screen to generate faithful reproductions. Have you ever wondered how programmers create the graphics for their software?
Cassette $14.95 .... Diskette $19.95

LEARNING CAN 'BEE' FUN
Now the full series by John Grimley in one value package containing 6 cassette tapes (or 1 diskette). Utilizing well known games such as 'Donkey Kong', 'Frog Hop' and 'Rescue' you can enjoy the game and learn at the same time.
Cassette Library Pack $49.95
Diskette $39.95

ELECTRONIC HOBBY MATE
A real first. This clever program deals with resistors, capacitors, electronic terms and contains a wealth of 'live' information. A must for all experimenters. Your **microbee** will become a useful design aid.
Cassette $14.95 .... Diskette $19.95

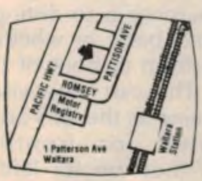
TUTORIAL: Touch Typing Tutor and Basic Tricks. The **microbee** is an ideal educational computer recommended by educational authorities across Australia. This package enables you to learn to touch type using the Pitman touch typing method. For those who want to master Microworld Basic there is a series of hints and suggested subroutines arranged in a most effective menu driven style.
Cassette $14.95 .... Diskette $19.95

RING OF DOOM
Your quest is to search for the Dark Lord of Saurean's Ring of Power. This action adventure game will operate in a 16k **microbee**.
Cassette $14.95 .... Diskette $19.95

FREE DELIVERY OF SOFTWARE for Direct Orders

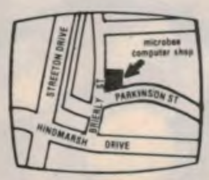
Ask your nearest microbee dealer for a catalogue of over 100 microbee programs now available on cassette, diskette and ROM covering applications in education, games and utility functions.

microbee computer shops



1 Pattison Ave,
Waitara 2077.
Phone (02) 487 2711

729 Glenferrie Rd,
Hawthorn 3122.
Phone (03) 819 5288



Cooleman Court,
Weston A.C.T. 2611.
Phone (062) 88 6384

141 Stirling Highway,
Nedlands, Perth.
Phone (09) 386 8250

bankcard welcome here

DIRECT ORDERS
PHONE (02) 487 2711

APPLIED TECHNOLOGY RETAIL PTY LTD

Authorised Dealers:

NSW: **Jaycar,** (inc Electronic Agencies)
117 York Street, Sydney.
115 Parramatta Road, Concord.
121 Forest Road, Hurstville.
Cnr Carlingford and Pennant Hills Road, Carlingford.
Compu-K, 7 Casino Street, Lismore.
Comput/Ed, 8 Park Arcade, Park Avenue, Coffs Harbour.

ACT: **Computech,** Belconnen Churches Centre, Benjamin Way, Belconnen.
VIC: **Computerland South Melbourne,** 37 Albert Road, Melbourne.
S.A.: **Key Computers,** 1061 South Road, Edwardstown
77 Grenfell Street, Adelaide.

QLD: **Software 80,** 105 Milton Road, Milton
Electrographic Office Systems, 25 Grafton Street, Cairns.
Town and Country Computers, CTL Centre, Anne Street, Aitkenvale, Townsville.
TAS: **Central Data,** 14A Goodwin Street, Launceston.

microbee

Experiment with dummy head recording

By COLIN DAWSON

Dummy head, or binaural, recording can yield quite extraordinary effects. This preamplifier and dummy head will produce some interesting results when used with your stereo recorder.

What exactly is binaural sound and why do we use a dummy head to record it? Put simply, a binaural recording duplicates sounds at the listener's ears as he would naturally hear them. Often, these recorded sounds have an impressive directional quality and, to get the right effect, the use of headphones is mandatory. Depending upon the recording, the sounds produced can be quite startling.

The only way to make an accurate recording of what a person actually hears in a given situation is to mount the microphones so that they have the same orientation and position as real ears. Hence the use of a "dummy head". This has the added advantage that the dummy head will interact with the sound in much the same way as a real head, thereby providing some important acoustic clues about the sound.

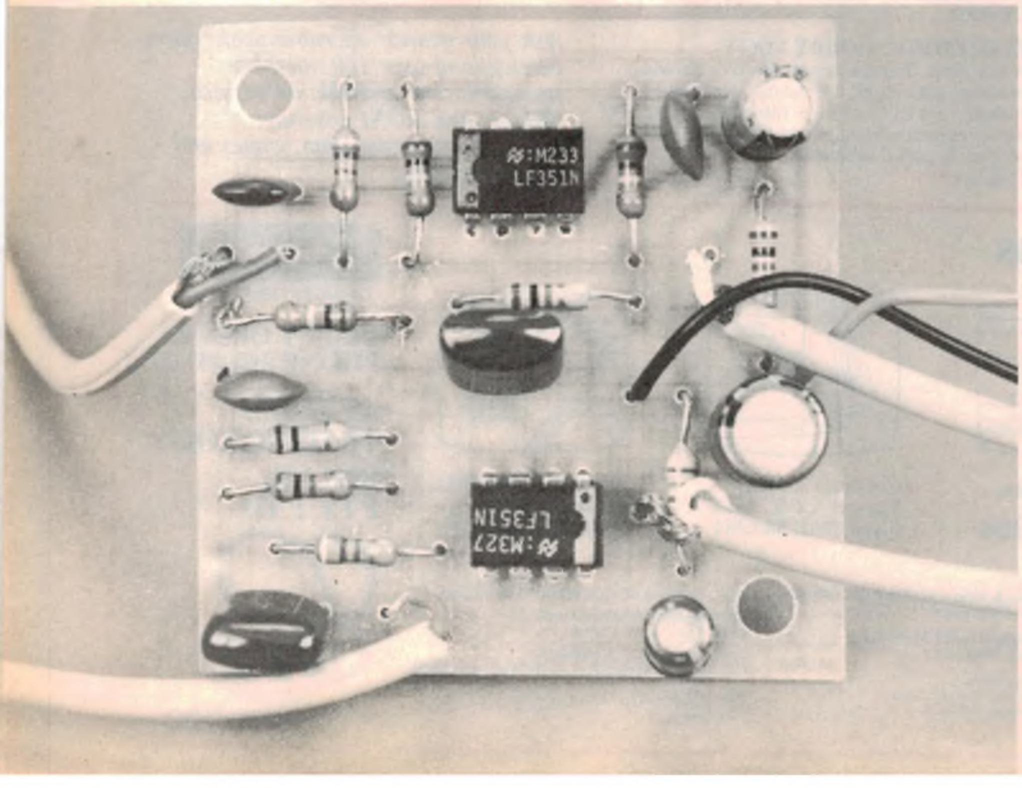
By contrast, recordings made on a portable stereo cassette recorder with built in microphones will at least have an element of stereo sound, but not binaural capability. The main limitation is the fact that both microphones are facing the same direction and therefore lack accurate directional discrimination.

Typical binaural demonstration records include sounds recorded at railway stations, airports, and in domestic situations. The sound of an aircraft thundering overhead or a person whispering in one's ear can be quite convincing.

These recordings are made with a device resembling a pair of headphones, but containing two microphones instead. A subject wearing the device usually provides the "dummy" head, or a real dummy can be used. In practice, it is essential that the subject remains quite still during recording. Even slight rotational movement of the head will introduce subtle variations in the recording which detract from its realism. Similarly, anyone listening to the recording should also resist any temptation to turn the head.

Actually, turning the head is normally an important mechanism in determining the direction of a sound source – we do it constantly without even being aware of it. The main purpose is to distinguish between front and back; ie whether a sound is coming from in front of us or from behind us. This can otherwise be difficult to determine as the ears are not as well adapted for front/back discrimination as they are for left/right discrimination. Turning the head allows left/right sensitivity to be used for front/back judgments.

Additionally, small phase changes are introduced to the signal while the head is



LEFT: larger than life-size photo of the preamplifier PCB. Note that the ICs face in opposite directions.

Each ear of the dummy head is fitted with an electret microphone.

We estimate that the current cost of parts for this project is approximately

$10

This includes sales tax but not the cost of a 9V battery or dummy head.

moving which may further assist in determining direction.

In practice, we need only make very small head movements to accurately locate a sound source that is in front of or behind us. Unfortunately, this psycho-acoustic effect is not possible with recorded sound; instead, the sound source appears to rotate with the head. As a result very little front/back information can be derived from a binaural recording although sounds coming from other directions can provide impressive spatial information.

The dummy head

So meet "George". He's a real dummy, crafted lovingly in our workshop, and he'd be quite handsome if it wasn't for his acne-pocked skull and sour-looking face. But no matter. He's got what it takes, including two ears, a nose, a mouth and a shape that roughly resembles a head.

You see, George has a very serious (well, semi-serious) purpose and that is allow you to record sounds as you would naturally hear them. He literally has something stuck in each ear, the offending objects being electret microphone inserts. These electret microphones allow George to hear the sounds that are to be recorded.

But as if having foreign objects stuck in his ears isn't bad enough, it turns out that George is also a bit of a fairy. He's had his ears pierced – from the back. George has a good excuse for this aberration. In his own words, "the holes punched in me lugholes allow leads to be connected to the electret microphones".

Perhaps this explains the rather pained expression on his face. But let's go back to being semi-serious and see how George was created.

In the beginning, we had to ask ourselves "how real does a dummy head have to be?" Ideally, of course, George should be modelled on a real head, having not only the same shape but also the same density and skin consistency. In practice, it's not all that critical. In fact, simply separating the microphones by a suitable amount, with a partition between them, will produce worthwhile results.

It follows, therefore, that any shape that vaguely resembles a human head should prove more than satisfactory.

Our dummy head was manufactured from newspaper, flour and water (papier-mache). In fact, you could say that George was plastered but we wouldn't stoop so low. For those more familiar with a soldering iron than papier-mache, a realistic facsimile of a human head may prove rather daunting. We invested several man-hours and quite a deal of newspaper to create George and we're quite proud of the result.

A coffee jar was initially used to support the paper. As work progressed, this became the neck and provided a convenient handle. From there it is simply a matter of building up the model layer by layer, although some readers may prefer to use a suitably shaped mould for the cranium to reduce the amount of newspaper required.

Whatever method you use, be warned that only a limited amount of paper can be applied at each session, otherwise the model will become a soggy, gelatinous mess. After each session, the model must be left to dry before additional paper layers are added.

Despite his rather forlorn appearance, George can boast a pair of really fine ears. Their function in locating a sound source really cannot be overlooked. Unfortunately, ears are rather difficult to duplicate using papier-mache. The trick is to make them relatively thin and give them the correct amount of protrusion without having them fall off. We solved the problem by pinning the ears in place until the paste dried, then removing the pins and covering the pin holes with another layer of paper.

By this stage, the model, has definite human characteristics but will probably have more craters than the surface of the Moon. This can be overcome by using a suitable plaster filler to smooth over the worst of the pock marks. Our model was then lightly sandpapered and given a coat of white paint, hence the rather pallid complexion.

Once the model has been completed, it can be anaesthetised and the ear holes drilled to accept the electret microphones. Use a slightly undersized drill so that the microphones will be a press fit and drill the holes to a depth of about 15mm. This done, drill a small hole in the back of each ear to intercept

Experiment with dummy head recording

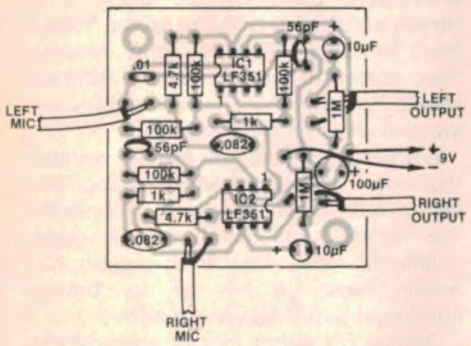
the ear holes. The microphone leads can now be fed through these exit holes and the electrets pushed into position.

So that's George – papered, puttied, painted and pallid. With those lifeless eyes he looks for all the world like a statue of one of those once great Roman emperors. His job is simply too sit in one place and "listen" to the various sounds using his electret eardrums.

Preamplifier circuit

The outputs of the electret microphones are boosted by a stereo preamplifier circuit before being fed into the tape recorder. Aha, electronics – at last we're back on familiar territory.

The circuit is based on two LF351 FET-input op amps (IC1 and IC2), one for each channel or microphone. Both ICs are connected as inverting amplifiers with gains of about 100. Notice that the non-inverting inputs are biased to half



Above: parts layout for the preamplifier PCB. Take care with polarised parts.

supply by a common voltage divider consisting of two 100kΩ resistors, thus eliminating the need for a balanced power supply.

Each microphone is biased with a 4.7kΩ resistor which limits the bias current to less than 2mA. In the case of the left channel, the electret output is AC-coupled to the inverting input of IC1, with the amplified output signal appearing at pin 6. This, in turn, is AC-coupled to the left output socket via a 10µF capacitor.

DC negative feedback for IC1 is provided by the 100kΩ resistor connected between pins 6 and 2, while the parallel 56pF capacitor rolls off the response above 20kHz as a stability measure. With the gain specified, the output level will typically be between 100 and 200mV and can be coupled direct to the line input of the tape recorder.

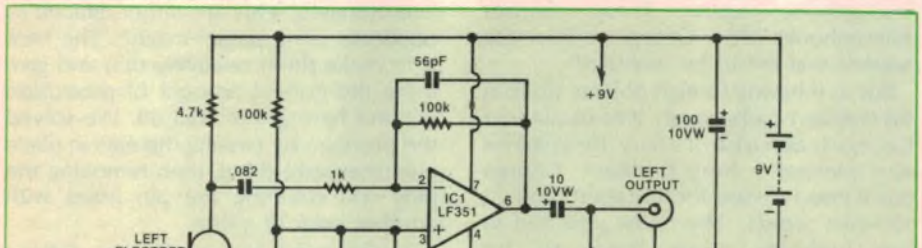
The right channel (IC2) functions in exactly the same manner.

Power for the circuit is derived from a 9V type 216 battery. A 100µF electrolytic capacitor provides supply rail decoupling, while a .01µF capacitor decouples the voltage divider output.

Construction

Construction is simple, with all the parts mounted on a small PCB coded 84sa1 and measuring 51 x 50mm. Assemble the board according to the parts layout diagram, taking care to ensure that the ICs and electrolytic capacitors are correctly oriented.

Connections to the microphone and to



DUMMY HEAD PREAMPLIFIER

PARTS LIST

- 1 PCB, code 84sa1, 51 x 50mm
- 2 electret microphones
- 2 LF351, TL071 FET-input op amps
- 2 RCA phono jacks
- 1 9V battery, Eveready 216 or similar
- 1 battery clip to suit

CAPACITORS

- 1 100µF/10V electrolytic
- 2 10µF/10V electrolytic
- 2 .082µF metallised polyester
- 1 .01µF metallised polyester
- 2 56pF ceramic

RESISTORS(¼W, 5%)

2 x 1MΩ, 4 x 100kΩ, 2 x 4.7kΩ, 2 x 1kΩ

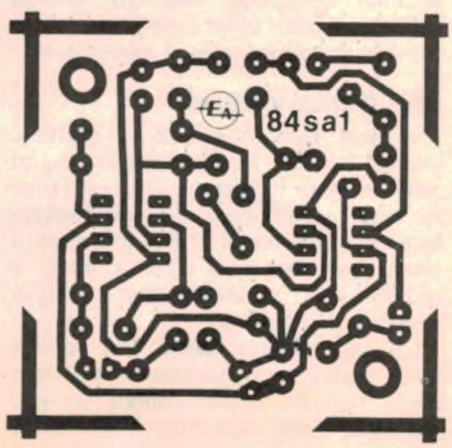
MISCELLANEOUS

Shielded hookup wire, materials to make dummy head, solder etc.

the tape recorder are run using shielded cable. For the prototype, we terminated the output leads in RCA jacks but the type of connector you use will obviously depend on input socket fitted to your tape recorder. It is a good idea to keep the input and output leads as short as possible.

We didn't bother to fit the PCB into a case, although some readers may prefer to do this. A novel alternative might be to mount the board on the back of the dummy head, or even inside the head if you're really clever!

Once the project has been completed, set the dummy head up in the middle of the room and try recording various sounds. For example, you could record the sound of someone walking around the room, or doors opening and closing, or people talking. You might even try whispering in the dummy's ear. The sounds are limited only by your imagination but don't forget that you must use headphones to listen to the results.



New Products...

Product reviews, releases & services

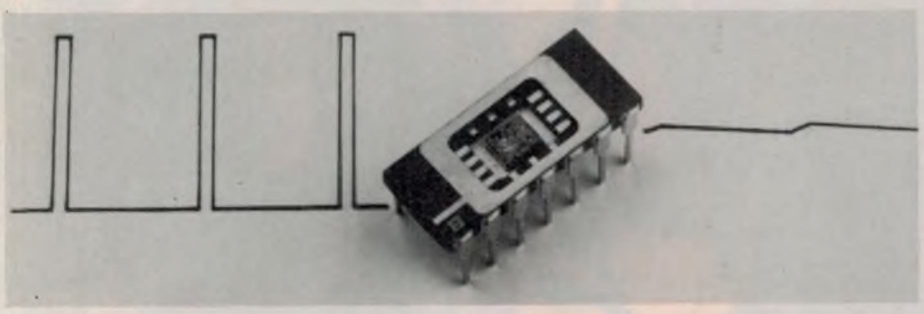
Video enhancer & distribution amplifier

Dick Smith Electronics has introduced a video processor which acts as a video enhancer, picture stabiliser, VHF modulator and video distribution amplifier.

Designated Cat Y-8510, the "Deluxe Video Processor" is designed to correct for loss of detail in signals from degraded video tapes and to overcome the problems sometimes caused by "Copyguard" processing of tapes. The unit is said to be the only one of its type which incorporates an RF modulator, allowing the enhanced signal to be displayed on either VHF channel 1 or 0.

An inbuilt video distribution amplifier is also provided, allowing the output signal to be fed to up to three other video monitors or recorders.

The unit retails for $129.95 and is available from Dick Smith Electronics stores throughout Australia.



RMS/DC converter from Parameters

Parameters Pty Ltd has sent us details of a new RMS to DC converter manufactured by Analog Devices Inc. The single chip AD637 is capable of operation up to 8MHz and computes the true root mean square value of complex AC waveforms, allowing accurate measurements of signals ranging from pure sine waves to complex noise signals and SCR switching waveforms.

Features of the device include an on-chip buffer amplifier, wide operating voltage range (3-18V) and three-state outputs. A dB output and denominator input are also provided. The dB output has a range of 60dB with plus/minus 1dB error over a 7mV to 7V RMS input range. The 0dB level is set by an externally supplied reference current to correspond to any input level from 0.1V to 2V RMS.

The denominator input allows the user to change the transfer equation of the device to compute the absolute value, mean square and root sum of squares of any complex input waveform and produce the equivalent DC output voltage.

Two versions of the AD637 are available, differing only in their fixed offset error and per cent of reading error specification. Both use a 14 pin ceramic package, and are available ex-stock.

For further information contact Parameters Pty Ltd, 41 Herbert St, Artarmon, NSW 2064, (02) 439 3288 or 53 Governor Rd, Mordialloc, Vic 3195, (03) 580 7444.

High-speed miniature drill

Altronics now has available a high-speed miniature electric drill specifically designed for circuit board work. Conveniently hand-sized, the MD 1000 Mini Drill operates from a 9V or 12V DC plugpack (not supplied) and draws up to 2A in heavy duty applications such as drilling aluminium. Maximum chuck capacity is 1.2mm.

Our sample, supplied by Avtek Electronics, came in a "blister pack" complete with one 1mm drill bit, two spare drill chucks, a spanner-like chuck key, and a plug to suit the power supply socket at the top of the drill body.

Advertised price of the MD 1000 is $10 and further information is available from Altronics, PO Box 8280, Stirling St, Perth, WA, 6000, telephone 328 1599 in Perth.

Avtek Electronics Pty Ltd is at 119 York St, Sydney, 2000. Phone (02) 267 8777.

What's a bright young lad

New Products...

General purpose high-current drivers

Two new general purpose high current device drivers are available from Rifa Pty Ltd for applications which require switching of resistive loads, solenoids, and relays. The five pin PBD3544 and PBD3545 are complementary drivers (current sourcing or sinking versions respectively) with a continuous output capability of 2A at a supply voltage of 45V.

Both device drivers provide an error detection function with an error signal back to the host system and contain extensive protection circuitry to insure against short circuited outputs, thermal overload and open circuit error detection channels. Inputs are LS-TTL and CMOS compatible.

For further information contact Rifa Pty Ltd, PO Box 95, Preston, Vic 3072. Phone (03) 480 1211.

1GHz digital frequency meter

AWA Ltd recently released details of the new Leader LDC-825 digital frequency counter, capable of working over the range 10Hz to 1GHz and providing measurements periods from 100ms to 1μs.

Using seven segment fluorescent displays the eight digit readout provides a resolution of 0.1Hz up to 80MHz and 10Hz up to 1GHz. Sensitivity is quoted as 20mV up to 80MHz and 50mV via the 50Ω input of the prescaler. This sensitivity combined with a highly accurate timebase makes the LDC-825 suitable for many applications in product testing and service.

The counter is mains operated and is supplied with two input cables and comprehensive operating instructions. Further information is available from Amalgamated Wireless (Australasia) Ltd, Cnr Talavera Rd and Lane Cove Rds, Macquarie Park, North Ryde, NSW 2113. Phone (02) 887 7111.

New range of keyboards & keypads

Hi-com Unitronics International Pty Ltd has supplied us with samples of their membrane keyboard kits, available with 4, 12 or 16 keys. Each kit contains a plastic membrane key matrix with a flexible connecting strip and 8-pin connector which can fit into one side of a 16-pin IC socket.

Both sides of the keyboard are self-adhesive and are covered by waxed paper until the user is ready to put the parts together. A plastic overlay with a transparent window over each key position is supplied for the top side, so that keytop legends can be inserted between the keyboard and the overlay. Standard legends are supplied in black on white or users can add their own designations.

Alternative legends are available in separate packs in a choice of 16 colours. Face plates and overlays can also be supplied in various combinations.

As well as the membrane type keyboards Hi-com also has available 12-key and 16-key mechanical contact keypads. A sample of the 12-key type shows it to be a compact, low profile unit with pushbutton keys arranged in a standard telephone keypad format. The white keys have a light, positive action and are slightly concave and sloped for easy use when the keypad is horizontal.

The advertised prices of the Hi-com products must make them one of the most inexpensive ways of putting together a keyboard for any application. Membrane types are available for $7.80 (12-key) or $9.20 (16-key) and the mechanical pushbutton type for $6.90 (12-keys) or $7.90 (16-keys). Further information is available from Hi-com Unitronics International Pty Ltd, 7 President Lane, Caringbah, PO Box 20, Sylvania, NSW, 2224. Phone (02) 524 7878.

PC boards for TTL graphics display

Printed circuit boards for the high resolution TTl graphics display published in the February 1984 issue of EA are available from Buzlor Printed Circuits Pty Ltd, 26 Queens Rd, Asquith, NSW. Buzlor is a wholesaler and is offering the double-sided boards at $25.48 each in quantities of 20.

Hand-held current and power meters

Elmeasco Instruments is now distributing a range of six hand-held current and power/power factor meters from F. W. Bell. All models are packaged in a convenient "pistol grip" case and powered by internal batteries. Two analog and four digital readout models are available.

The analog models, the CG100A and CG103A, are capable of measuring currents of up to 200A and 500A respectively, at frequencies up to 1kHz, in cables up to 19mm diameter. Both models are fitted with output jacks to connect to a multimeter, oscilloscope, or chart recorder.

The CG100D and CG104D incorporate a 3½ digit LCD readout and are thus completely self-contained current meters. They have the same measurement specifications as the analog output models and include an automatic digital reading hold as well as analog output jacks.

Also available are the model PG200D digital power meter, and the PFG360D which measures power factor in all quadrants and phase angle from 0-360° over a frequency range of 45-65Hz.

Additional information is available from Elmeasco Instruments Pty Ltd, PO Box 30, Concord, NSW 2137. Phone (02) 736 2888.

Versatile miniature rotary tool kit

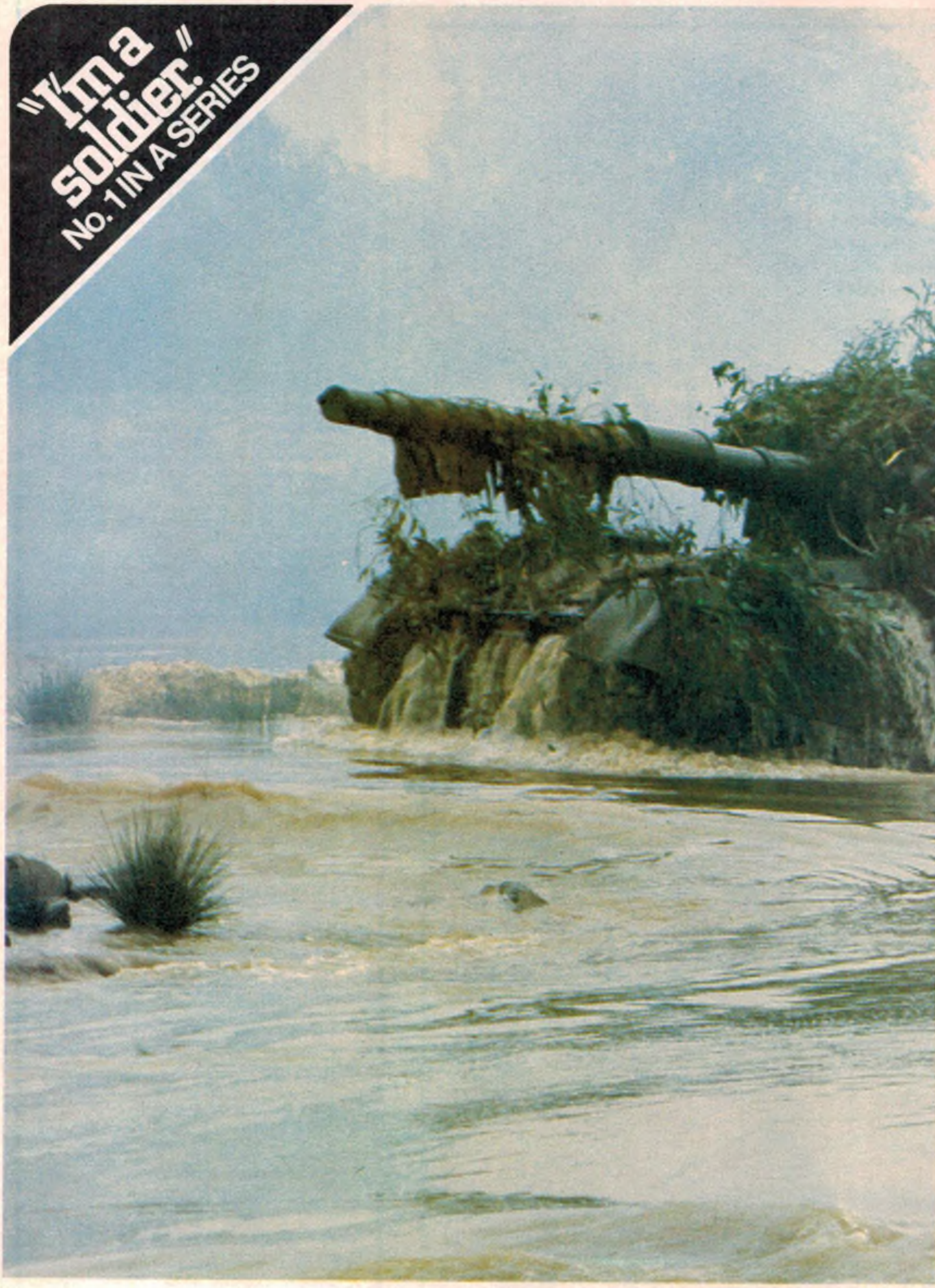
Arlec Pty Ltd has introduced a new high speed miniature rotary tool, the "Supertool" Model ET571, said to be particularly suited for model making and electronics, educational projects and drawing office work.

The unit provides a 12W electric motor running at 10,000rpm and is powered by a 240V plugpack adapter. Eight fittings, six eraser sticks and a collet chuck with five collets are supplied with the Supertool for use in applications including drilling, shaping, cleaning, grinding and erasing. Supplementary bits and cutters are also available for milling, sanding, polishing and engraving.

According to Arlec the tool is invaluable as a drawing office aid, quickly erasing ink and pencil lines from drawings, photocopies and dyeline prints.

Further information on the Arlec Supertool is available from Arlec Pty Ltd, PO Box 170, Box Hill, Vic 3128. Phone (03) 840 1222.

"I'm a soldier."
No. 1 IN A SERIES



"Not every bloke who wants to drive

Sydney 212 1011; Parramatta 635 1511; Newcastle 2 5476; Wollongong 28 6492;
Adelaide 212 1455 (Also Northern Territory); Lismore 21 6111; Melbourne 61 3731; Geelong 21 1588;

Authorised by Director-General of Recruiting, Dept. of Defence.

ARMY

Australian Regular Army

joins the Army a Leopard Tank.”

These days the Army can train you in one or more of 150 different jobs, from Plant Operator to Computer Operator; from Electronic Technician to Assault Pioneer.
First they assess your ability and potential, then they give you the skills to do the job that's right for you.
And because the Army is one of the country's biggest employers, you have the challenge of a rewarding career plus a better-than-average chance for further training and promotion.
If you'd like to know more, phone your nearest Army Careers Adviser.

Bendigo 43 8008; Ballarat 31 1240; Brisbane 226 2626; Townsville 72 4566;
Albury 55 2248; Hobart 34 7077; Launceston 31 1005; Canberra 82 2333; Perth 325 6222.

AGE130.DPS.63EA

New Products...

Digital panel meter

A new microprocessor-based panel meter from Digitec is able to display inputs of from 1 to 5V and 4-20mA as any unit of measure, including degrees celsius, kilograms or pascals. Offset and scale adjustments are provided in addition to two high/low alarms with open collector outputs, and the panel meter has an auto-calibration mode to ensure freedom from drift without constant manual recalibration.

Both 3½ digit and 4 digit versions of the display are available with accuracy specified as 0.02% plus or minus 1 count. For applications requiring higher resolution a 4½ digit model is also available, with an accuracy of 0.01% plus or minus 1 count.

Options for the panel meters include an isolated BCD parallel output and a serial data output.

For further information contact Datac Digital Systems Pty Ltd, 3rd Floor, 3 Chester St, Oakleigh, Vic 3166. (03) 568 6922.

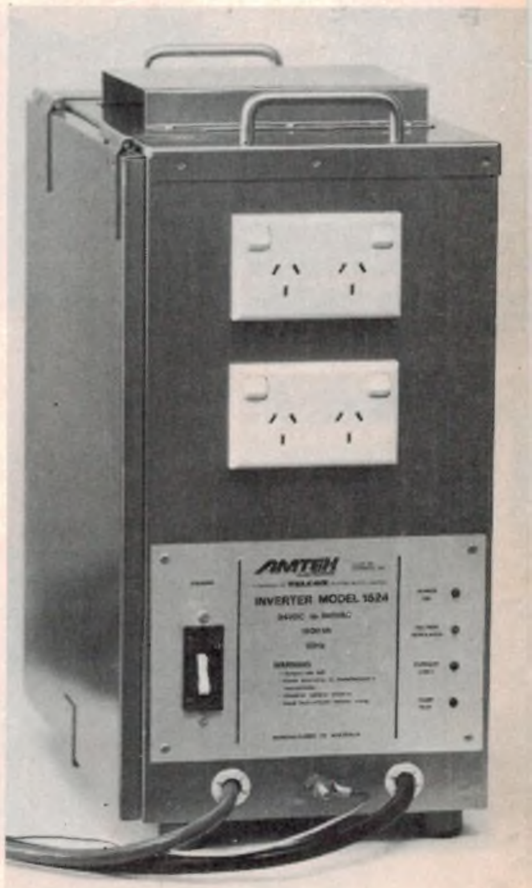
24V to 240V DC/AC inverter

Amtex Electronics has released a new inverter, the Model 1524, which electronically converts a 24V DC input to 240V 50Hz AC. The modified square wave output is said to be capable of operating most standard electrical appliances.

Input current limiting and reverse polarity protection is included, as is a thermostatically controlled cooling fan and thermal shutdown circuitry for overload protection.

Specifications of the inverter include a nominal input voltage of 24V and output power of 1500W continuous and 2500W peak. Typical efficiency is quoted as 88% for a 750W resistive load. Dimensions of the unit are 525 x 260 x 400mm and weight is 30kg. Price is $1850 plus sales tax. Delivery is ex-stock.

For additional information on the model 1524 inverter contact Amtex Electronics, PO Box 285, Chatswood, NSW 2067. Phone (02) 411 1323.

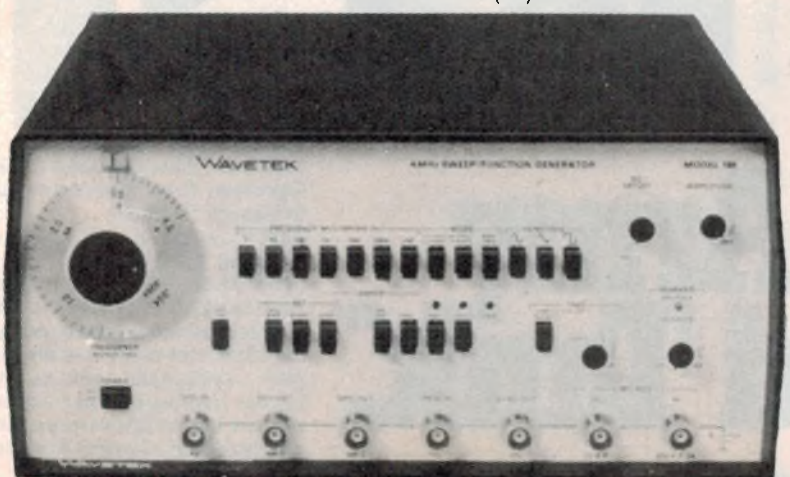


Scientific Devices to represent Wavetek

Scientific Devices Australia Pty Ltd has been appointed the Australian representative for Wavetek Corporation of the United States, further expanding the availability of the company's comprehensive instrumentation product line.

Recently announced is the Wavetek Model 189 sweep/function generator, a 4MHz instrument which offers digital storage and a rotary dial for setting sweep start/stop and marker frequencies. Precision sine, square and triangle wave outputs are provided in a variety of operating modes.

For further information contact Scientific Devices Pty Ltd, 35-37 Hume St, Crows Nest, NSW, 2065. Phone (02) 43 5015.



Plastic framed Philips loudspeakers

Philips has introduced a 5W version of its range of low and medium power plastic-framed loudspeakers and extended the range to include 7.5cm x 15cm and 10cm x 15cm types.

Speakers with the new 5W RMS power handling capability come in six sizes, and

Portable VHF/UHF transceiver range

Niros Telecommunication of Denmark has appointed Telmar Communications as their Australian agent. Niros are well known in Europe for their portable radio transceivers, used by customers such as British Telecom International, the Scottish police force, and fire brigades in Denmark, Holland, Belgium and Germany.

Niros portables are available to cover the low VHF and UHF communications bands and can be supplied with a selective calling option.

Further information is available from Telmar Communications, 604 City Rd, South Melbourne, Vic (03) 690 8666.

are said to be ideal for industrial PA systems as well as standard audio/video products. Each speaker has optional screening or magnetic compensation, particularly required for video applications. They are available with impedances of 4Ω, 8Ω, 15Ω and 25Ω.

For further information contact Philips Electronic Components and Materials, 67 Mars Rd, Lane Cove, 2066. Phone (02) 427 0888.

Get the gear for the new tech/school year!

Casio FX-602P Advanced Programmable

The last word in pocket calculators! Programmable scientific calculator ideal for high school and university students, from one of the world's leading manufacturers. Extra thin and will fit in your pocket. Geared to higher mathematics, physics & engineering. 88 memories, up to 512 steps.

Cat Q-3110
WAS $169

SAVE $30 **$139**

CASSETTE INTERFACE

Get the most from your FX602P with this brilliant addition. Now you can store data, programs, results etc on a standard cassette recorder with the help of this interface.
Cat Q-3125

***ONLY* $49**

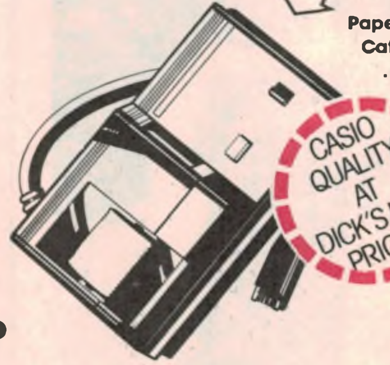
SAVE OVER $20 on this

PRINTER UNIT

If you want your stored data and/or programs in hard copy form, use this superb add-on printer unit. Was $126.50. Cat Q-3127

$99

Paper to suit
Cat Q-3128
... $9.50

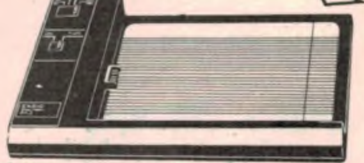


CASIO QUALITY AT DICK'S LOW PRICES!

CASIO FX3600P SCIENTIFIC/ PROGRAMMABLE

Ready to handle anything you can give it! The ideal calculator for tech. & university students, engineers, technicians and lab. workers. This Casio calculator has the added advantage of simple programmability, plus Integrals! Ii has up to 38 step programming capacity with integrals, regression analysis, 7 memories, 10 digit mantissa and 2 digit exponent. Comes complete with wallet and instructions. Cat Q-3105

***ONLY* $62.50**



CASIO HAND HELD COMPUTER

A brand new hand held computer from one of the world's leading manufacturers. The Casio PB100 – learn as you go computer with VLSI CPU equivalent to 150,000 transistors! With 544 program steps and 94 data memories (expandable). 5 x 7 dot matrix 12 digit display and a standard 53 key keyboard.
Cat X-5110

***New model only* $79.95**

1K RAM PACK

Expands the PB100's memory to 1K, programming to 1,568 steps. A must for the serious user. Cat X-5112

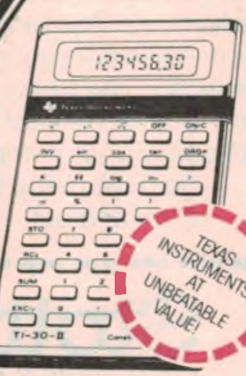
***Unbelievable value! ONLY* $40**

NEW

CASIO FX-550

Superb, new calculator from one of the world's leading manufacturers, with features you'd expect to pay $$$ more for, like 10 digit, LCD, 8 digit mantissa & 2 digit exponent, memory and lots more. The last word in pocket calculators ideal for high school and university students.
Cat Q-3100
Recommended by many leading schools!

***ONLY* $42.50**



TEXAS INSTRUMENTS AT UNBEATABLE VALUE!

Slimline TI-30

Look at this for value! There are more features packed into this budget-priced slide rule calculator than most other manufacturers put into calculators that cost twice the price! Features like LCD, constant memory holds numbers in user memory even while it's turned off, automatic power down shuts calculator off after 5-15 minutes of non-use. There is more! Why not check it out at your nearest store?
Cat Q-3737

$23

METRIC CONVERSION

Still having problems with metrics? Let this superb calculator help you. Pocket sized, LCD, converts imperial to metric and vice-versa. Also does the normal functions.
Cat Q 3025

$19.95

Ruler/Calculator & Clock

No student should be without one of these. Inside this 10ins/250mm metric/imperial rule is an accurate LCD digital clock & a full function LCD 8 digit memory calculator. Plus there's the added bonus of a metric conversion table on the rule too! And all this for the price of a clock alone! Cat Y-1057

$14.95

Includes attractive protective pouch at no extra cost!

REVIEWS OF RECENT

Records & Tapes

CLASSICAL • POPULAR • SPECIAL INTEREST

PROKOFIEFF, RAVEL

GASPARD DE LA NUIT. Three pieces for piano solo, Ondine, Le Gibet and Scarbo.

PIANO SONATA No. 6 in A Major. Ivo Pogorelich, piano DGG Digital disc 2532 093.

The first item in Ravel's Gaspard de la Nuit suite is Ondine – the spirit of the Fountain. At the beginning, this watery little piece never sounds quite fluid enough though it improves later.

In Ondine there is a passage in thirds towards the end that the pianist carries on to a most impressive climax that succeeds in involving both player and listener and makes a fine ending to an otherwise ordinary performance.

In Le Gibet Pogorelich is much more convincing. The music paints to perfection a sinister, windless landscape. A bell tolls dismally despite the windless look of the country; a corpse swings from the gallows in lonely death. The music always reminds me of Cezanne's picture of "The House of the Hanged Man". It recurs here with great fidelity.

Scarbo is probably the most difficult piece written for solo piano since Balakirev's Islamey. The music describes a goblin always up to dirty tricks and hoaxes, pictured in an atmosphere of turmoil. Both the performer's hands are kept ferociously busy and here the pianist makes of it virtuoso exercise. Listen to the passage of swiftly repeated notes and admiration for Pogorelich grows. The recording is digital and the piano tone completely lifelike.

In the Prokofieff piece the pianist successfully changes his style to a percussive one suitable to this composer. His sense of rhythm is solid. It is obvious he appreciates the rather more generous serving of little tunes than is usual in this composer's later works.

After the first movement the second sounds almost Mendelssohnian. Though still strongly rhythmic, the percussiveness is moderated. Somehow it is more reminiscent of Prokofieff's Classical Symphony than one of his later percussive horrors.

The second movement is described as a slow waltz though it would be difficult

to dance to. Impossible, I'd say. It is just a very slow piece in 3/4 time. It is resolutely tuneless though once or twice it hints at introducing one.

Except for a quiet interlude at the beginning, the fourth movement is a spiky vivace leading to a very motoric finale that runs along like a little two-stroke motor bike. Pogorelich uses a brilliant technique to put it into the usual Prokofieff style **(J.R.)**

MAHLER

Symphonies Nos. Five and Six. Vienna Philharmonic Orchestra conducted by Lorin Maazel. Three digital DGG boxed discs D3 37875.

This issue of the Fifth and Six is accompanied by a brochure of such formidable dimensions that, after a while, despite the mass of information it contains, finishes by becoming a bore. Among its copious contents is a relevant but tiresomely dull analysis of a number of movements of many of the nine symphonies set out in mind-crushing detail by a Jack Diether, President of the New York Mahlerites. What a title!

Maazel sets the tempo just right at the beginning of the first movement to convey menace even in the schmaltzy bits that follow. Sometimes it grows a little strident but also deftly avoids any tendency to drool. The tempo remains steady but not plodding with the brass a trifle too assertive where allowed.

The long passionate climax subsides beautifully smoothly to accommodate the softer passages that follow. The movement's boa constrictor length is balanced by the beautiful adagietto – perhaps Mahler's best-known excerpt.

The 16-minute scherzo starts like a perverse landler. Yet despite all the multitudinous notes the result is sugary, although a special word of praise is due for the fat toned German horn playing and the digital recording.

The Viennese Strings come through with a beautiful bloom. The music flows without pause into the most delicate of fugatos all at the right brisk tempo but always unhurried. Looking back the work is really cyclic with just the right rhetoric. Maazel gives us a really fine performance of the sixth. In every way comparable to its closest competitors.

His vision is intense and he holds the music compellingly in a way that defies inattention. He pays due respect to the "Alma" (his wife) theme and the many pastoral interludes that occur along his route. Later the playing is distinguished by breadth and a wealth of detail all delivered with expressive warmth. The version used is the Revised Edition though Maazel doesn't follow all the starred changes. A very interesting reading, much of it very moving indeed. **(J.R.)**

STRAUSS, RICHARD

Ein Heldenleben. Symphonic Poems. Boston Symphony Orchestra with Joseph Silverstein, solo violin, conducted by Seigi Ozawa. Philips Analog Disc 6514 222.

Tod und Verklarung. Symphonic poem. Metamorphosen. for 23 solo strings. Berlin Philharmonic Orchestra conducted by Herbert von Karajan. DGG Digital disc 2532 074.

It will be almost certain to be known to seasoned readers of this column that Strauss' A Hero's Life is autobiographical. What is not so certain is that the title bestowed on it by its creator was intended ironically or set down out of sheer vanity, or even megalomania. Great as Strauss was, the latter was probable.

What is not so obscure is the origin of some of the musical ideas. The opening

theme comes from Beethoven's Eroica. The nitpicking little tune that follows can be found in the Mastersingers' Beckmesser. And so it goes. The change of mood to the love music is the first note of originality, in the true sense. We have first the garrulous, skittish young wife and the sterner stuff of the often exquisite lovemusic. Its modulation from key to remote key never fails to excite me, no matter how well I know it.

Here is no vulgarity. Familiarity perhaps. But its deeply felt passion never fails to move me and Ozawa draws the best from his orchestra. The solo violinist occasionally overdoes the tremolo but is always dead on the note. Probably the outcome of the Stokowsky tradition from his old Philly days. Then comes an abrupt end to dalliance and our hero's off to the wars. I cannot recall whether Strauss did any military service but his orchestra kicks up a devil of a row in this episode.

By the way when Beecham was rehearsing the work at the beginning of the century it was during this part of the score that the first basoon stopped playing. When Beecham looked enquiring towards him he said: "Two bars after No. 27, Sir Thomas. I cannot make out if the note is D-sharp or D-flat."

Beecham examined his score. "It doesn't really matter," he said. The uproar is terrific but this analog disc still presents more details than I've heard elsewhere. The hero reverts to more Eroicaism, then come references to some of his earlier compositions beautifully grafted into the whole.

From here the interest slackens. After all heroism is a difficult role to sustain. But Ozawa does the score proud and the orchestra treats him generously. If you haven't already got a Heldenleben I can recommend this one.

Karajan generates a real feeling of approaching death right in the opening bars of his Tod und Verklarung. Here is the quiet of the sick room, the only sound the breathing of the sufferer between his spasms of pain and memories of his past life. The program is graphic, each episode vividly brought to life.

The spasms mount at every repeat till the patient's final unsuccessful fight for breath. The dynamic range is good. I was worried at first about the fortissimos in this digital recording but I needn't have bothered. There was always exhausted peace between each bout of pain. True the chief interest is the realism of the scene Strauss paints so vividly. Many years later on his own deathbed strauss said to a bystander: "You know, death is just like what I wrote in Tod ad Verklang so many years ago."

The meritricious Resurrection theme is not so convincing – about as persuasive as the vision of the dead child at the end of Puccini's Suor Angelico. This Strauss dolls up to give a travesty of nobility. My pressing runs a bit flat towards the end but nowhere else. My equipment? I doubt it.

I have always loved Metamorphosen which I first heard in unusual circumstances. I was in hospital recovering slowly from intensive surgery some 30-odd years ago when the news came over my small bedroom wireless that Strauss had died. The BBC, to honour the composer played this, his last great work, the first time I had ever heard it and I found strange comfort in its autumnal beauties.

Written for 23 solo strings the instruments interweave and combine in an always masterly fashion. As an example of technique it is without peer. It was inspired by the postwar regrets of a German for the destruction of his country. That it contains no account of the damage wrought by Germans on their enemies' territories is never taken into account – a typical German trait.

But that is in the nature of things and does not prevent me from recommending as heartily as possible these two performances. **(J.R.)**

BEETHOVEN

Piano Sonatas: Opus 57, "Appassionata". Opus 111, "The last great piano sonata". Played by Carol Rosenberger. DMS Delos compact disc D/CD 3009. [From P.C.Stereo,Pty Ltd. PO Box 272, Mt Gravatt, Qld 4122. Phone (02) 343 1612.]

I first encountered Carol Rosenberger in her recording of "Water Music of the Impressionists" (Delos DM 3006) and suggested that it was a recording which must surely gain the attention of audiophiles – a prediction that proved to be accurate. I was similarly impressed with the follow-up recording for Delos of the Beethoven piano sonatas 57 and 111 – Delos digital/vinyl DMS 3009.

Now both have been issued in CD form, with the Beethoven Sonatas disc being the first of the duo to reach me.

Listening to it in that form, I cannot but remark again on the musical and physical resources which Carol Rosenberger reveals in coping with the emotional passions and turbulence of the Opus 57 "Appassionata". The work was written in the summer of 1806, when Beethoven's mind was in a turmoil, as revealed by letters to his "immortal beloved".

For the performance, the soloist had available a magnificent Bosendorfer Concert Grand, with its enormous power in the bass register. Telarc engineers matched it with high-overload B&K microphones and preamplifier equipment, feeding a Soundstream digital master recorder. The facilities are used to the full in the opening movement Allegro assai.

But, in the Andante, the passions suddenly subside. Carol Rosenberger is contemplative and tender; the Bosendorfer reveals an almost organ-like bass and, elsewhere, bell-like notes in the upper register.

But then follows the turbulent Finale, making new demands on the soloist, the instrument and the recording system.

As an encore, you have Sonata 111, described by Beethoven's biographer Wilhelm von Lenz as the "Testament sonata ...the Master's great farewell to the piano sonata, his final statement in that form". Or, as Virgil Thompson put it: "representing the whole gamut of dynamic violence and delicacy and deep song with its undercurrent of musical meditation".

The last, incidentally, is a quote from Carol Rosenberger's own essay on the composer, the instrument and the sonatas, occupying 14 of the 20 pages in the accompanying booklet.

By way of interest, the CD pressing carries the endorsement "manufactured by Sanyo, Japan". It is completely free from any audible surface defects and free from the high-amplitude tracking stresses which some phono cartridges can exhibit with conventional phono discs, no matter how carefully produced.

Just here and there I felt that this order of transparency might justify a somewhat different mic placement to subdue the non-musical sounds from the instrument. But is it a fault or a feature to be able to hear things like the thud of hammers in a piano, the "chiff" from an organ pipe, or the movement of fingers over guitar strings?

Think about it, because it becomes relevant in a transparent recording system. (W.N.W.)

Records & Tapes

WALDTEUFEL

Famous Waltzes, played by the Orchestra of the Vienna Volksoper, conducted by Franz Bauer-Theuss. Philips compact disc 400 012-2.

As a change from the concert works that have thus far dominated the compact discs to hand for review, this recording of famous waltzes in the turn-of-the-century style should tickle the ears of those who are partial to them. They should certainly be familiar.

The composer, Emil Waldteufel (1837-1915) was a professional pianist but, coming from a family of dance musicians, and one which could provide an orchestra for society occasions in Paris, Emil found no great difficulty in turning his hand to composing music of the appropriate kind.

In 1874, the Prince of Wales heard him play his waltz "Manola" at a soiree in Paris and agreed to introduce it in London. Later, with the Prince's further assistance, he secured a contract with a London publisher, which opened the way for the launching of a series of successful compositions.

Five such are featured on this recording and, in order of composition, are: "Less Sirenes" (The Sirens), "Tres Jolie" (Very Pretty), "Pluie de Diamants" (Diamond Rain), "Dolores" and "Les Patineurs" (The skaters). Two others are notable in that they were commissioned adaptations of themes by other composers: "Estudiantina" (after Paul Lacome) and "Espana" (after Chabrier).

Brief notes on each are contained in the accompanying booklet.

The Orchestra of the Vienna Volksoper appears to be of quite substantial proportions but with a sound and style to match the music. Play the recording and, for 55 minutes, you'll be transported half a world away and a century back in time – except, of course, that the sound quality is what you can expect only from a modern compact disc. (W.N.W.)

LOVE SONGS

Just One: Renee & Renato. Hollywood stereo LP VPLI6663. Distributed through RCA.

Renee and Renato are best known for their smash hit "Save Your Love" but does anybody know anything else about them? The absence of jacket notes doesn't help. From the cover picture,

Renato would appear to be a somewhat overweight Italian gentleman but Renee's voice sounds English, despite her French name.

Be that as it may, it's an enjoyable album featuring 12 songs in all, sung in a lighthearted up-tempo Italian style: Side 1 leads off with "Angel Angel", followed by "Carousel of Love" "Sing with Me", I Will Always Love You", "A Little Bitta Me" and "Destiny". As will be apparent, most of the tunes have a romantic theme.

The songs on side 2 received more airplay and, for the most part, are more familiar: "Magic Night", "Just One More Kiss", "Renee Renee", I'm a Going to Brighton", "Another Cup of Charlie", and the haunting "Save Your Love". I particularly enjoyed "Another Cup of Charlie" in which Renato pleads for a cup of tea all the way through the song only to change his mind at the last minute. As he puts it: "I'm a'changin' ma mind. I wanna capuccino!"

If the style appeals, then have no fear of recording quality. It's very good, with little evidence of surface noise or tape hiss. I did, however, find it advantageous to wind the treble control back a little but this could be due to my pick-up cartridge. (G.S)

AGELESS HYMNS

Hymns for all Ages. Featuring contemporary artists. Stereo LP, Word SPCN7-01 8905 10-9. [From Word Records Aust, 18-26 Canterbury Rd, Heathmont, Vic 3135. Phone (03) 729 3777]

This new album has the potential to please some and disappoint others. First the bad news:

The reference on the jacket to "Ageless hymns", and the titles of those hymns may prompt the expectation of a traditional presentation – suited to those who prefer it that way. But the presentation isn't traditional and many will reject it on that account. Even so, here is a list of the track titles:

Christ the Solid Rock – I Surrender All / I Need Thee Every Hour – On the Garden – It Is Well With My Soul – At the Cross – O Sacred Head – Lead Me Gently Home, Father – My Jesus, As Thou Wilt – Beyond the Sunset – Amazing Grace – Jesus Loves Me / Oh, How He Loves You and Me.

Now for the good news: the ageless hymns are performed by contemporary Word artists who have their fans in Christian youth circles. Amy Grant is often heard on air as, of course is B. J. Thomas. Evie is well known here from her association with the Billy Graham team and the story of Joni, the quadraplegic Christian singer has been told in book and film. Add the Imperials, Leon Patillo, Benny Hester and Dave Boyer and you have sufficient reason for many in the younger age group to rush off to the record store.

If you haven't, thus far, accepted the idea of a generation gap, this record may well convince you! (W.N.W.)

BURL IVES

The Talented Man. Stereo LP. Powderworks POW-3015. Distributed through RCA.

Where else could Burl Ives have been brought up but in a place like Jasper County, Illinois, USA? And what better setting to generate an early interest in folk music handed down through the generations?

For a while his interest turned to football but music took over again and, from the later '30s Burl Ives career revolved around radio, the stage, films and, of course television. This recording, originally made in 1978, is probably the Burl Ives that you best remember – not a

JAYCAR NUMBER 1 FOR *NEW PRODUCTS*

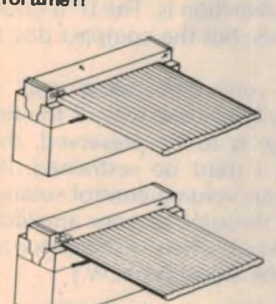
LOW COST SILICON PHOTO CELLS

We now stock a COMPLETE range of high efficiency Silicon Solar Cells
All cells will give 0.45V under rated load and they can be stacked in series or in parallel for higher current.

Cat. No	Description	Price 1-9	Price 10+
ZM9002	Rect. 10x20mm 45mA	$2.95	$2.45
ZM9003	3" diameter 1 amp	$29.50	$26.50
ZM9004	3" diameter x 30° segment 78mA	$3.50	$3.25
ZM9005	4" diameter x ¼ segment 450mA	$12.95	$12.45

NEW! INSULATION DISPLACEMENT CONNECTORS & RIBBON CABLE!!

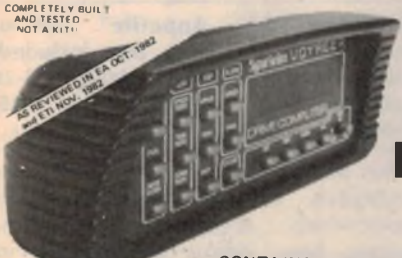
I.D. Insulation displacement. The quick and reliable way of making multiple connections to computer peripheral connectors.
Great for Disc Drives, Printers etc. Crimp them yourself and save a fortune!!



Connectors:
16 pin DIP HEADER Cat. PI6550 $1.99
24 pin DIP HEADER Cat. PI6555 $2.50
P.C. Edge Connector 34 way (suits 5¼" Disk drive) Cat. PI6560 $8.50
25 pin Cannon 'D' male Cat. PI6575 $8.95
25 pin Cannon 'D' female Cat. PI6576 $8.95

Cable:
16 way Cat. WM4502 $1.50/metre
25 way (suit DB25's & 24 way DIP) Cat. WM4504 $2.50/metre
34 way for Disk Drives Cat. WM4506 $3.45/metre

THE BEST CAR COMPUTER BELOW $200



CONTAINS EQUIVALENT OF THOUSANDS OF TRANSISTORS – USES MASSIVE CUSTOM LSI CHIP TO ACHIEVE LOW PRICE

only $199 complete

Send SAE for more information.

IDEAL RALLY COMPUTER!

FEATURES
- INSTANT FUEL CONSUMPTION IN LITRES/100KM AND MPG!! (MOST OTHERS HAVE ONLY ONE OF THE ABOVE) JUST SWITCH FROM ONE TO THE OTHER AS YOU DRIVE ALONG.
- INSTANT SPEED, TIME AND OTHER FUEL DATA.
- VISUAL AND AUDIBLE EXCESS SPEED ALARM.

Video Enhancer

NOT A KIT – BUILT AND TESTED....
Cat. AV6500

$89

Unbelievable but true. This unit enables you to actually IMPROVE a copy of a recorded video tape. How? By amplifying the top end of the video signal by a small amount. This sharpens up the detail of the picture. Dubs can actually look better than the original. Works as a video distribution amplifier as well. Will drive up to 4 VCR's from one VCR input.

VIDEO STABILISER Cat. AV6502

As many of you know, many video tapes, – especially from the USA have the sync pulses suppressed to prevent unauthorised copying of the original dub. This process is fine because it hinders unauthorised re-recording (dubbing) of material. It is annoying though when you hire the original and find that the "Copyguard" is causing problems with your TV. The AV6502 re-inserts the sync pulses automatically and restores stability.
WARNING! The AV6502 is intended solely for the use above. Whilst the AV6502 will virtually remove copyguard on a tape copy (and hence restore the picture) it is against the law to unlawfully copy copyright material.
The AV6502 looks almost identical to the AV6500 **ONLY $79.95**

"PANBRAKE" SHEET METAL FOLDER $69.50

- Handles up to 16 gauge aluminium!
- Slotted upper clamping bar allows complex corner bends etc.
- Handles material up to 445mm wide!

Save a fortune building metalwork yourself!!! ONLY $69.50
Now you can afford one in your own workshop. Make your own chassis, boxes, brackets etc. (Please allow $8 for freight as it is very heavy!)

Motorola Piezo

We have a great range of these piezo electric horns and dome tweeters.
Cat. AS3110 KSN1005A 50 watt PA horn square $16.00 each
Cat. AS3112 KSN1025A 100 watt PA horn rect. $26.00 each
Cat. AS3114 KSN1038 50 watt Hi Fi horn round $16.00 each
Cat. AS3116 KSN1039 50 watt Hi Fi dome $14.00 each
Cat. AS3118 KSN1071 50 watt dual element 1 source $24.00 each

Jaycar NUMBER 1 FOR KITS

125 YORK STREET, SYDNEY 2000
PHONE 264 6688 TELEX 72293
"NEVILLES CORNER"
Cnr CARLINGFORD & PENNANT HILLS ROAD
CARLINGFORD
PHONE 872 4444
MAIL ORDERS TO BOX K39 HAYMARKET, SYDNEY 2000

POST AND PACKING CHARGES
$5 – $9.99 ($1.50) $10 – $24.99 ($3.20)
$25 – $49.99 ($4.50) $50 – $99.99 ($6.50)
$100 up ($8.00)

Mail Order By BANKCARD
Via Your Phone

Records & Tapes

great singer or musician in the formal sense, but a man with a talent to be noticed, liked and listened to. The titles here:

Comin' After Jenny — Galisteo — Time — Snowbird — Real Roses — Roll Up Some Inspiration — Another Day, Another Year — Raindrops Keep Falling On My Head — One More Time Billy Brown — Tide Down Here At Home.

The quality is well up to normal standards and the playing time about 28 minutes. (W.N.W)

SOUND SPECTACULAR

SAINT-SAENS. Symphony No. 3 "Organ". The Philadelphia Orchestra conducted by Eugene Ormandy. Michael Murray, Organist. Telarc compact disc CD-80051. [From P. C. Stero Pty Ltd, PO Box 272, Mt Gravatt, Qld 4022; Phone (07) 343 1612].

When they tackled the production of this recording in 1980, Telarc certainly did not do it by halves. Surprisingly, for a then-small company, they managed to secure the services of the Philadelphia Orchestra and its Musical director, Eugene Ormandy, then in his 44th year in that role, and soon to retire.

Not prepared to make do with organ sound dubbed from another location, Telarc arranged to make the entire recording in the St Francis de Sales church in Philadelphia — a large reverberant building with a magnificent 4-manual, 112-rank organ, broadly corresponding to the kind of instrument and environment envisaged by Saint-Saens. For the recording, it was re-voiced to standard pitch.

Several rows of pews had to be removed to make room for the orchestra and, during the actual recording sessions, nearby streets had to be closed to traffic.

To play the organ, Telarc used their own "adopted" organist, Michael Murray, a one-time student of Marcel Dupre and firmly established, since then, as a concert artist and broadcaster in the USA, Canada, Britain and the Continent.

Commissioned by the London Philharmonic Society, Saint-Saens' Third Symphony was first performed in May, 1886, with a composer as conductor. A gifted professional organist himself, Saint-Saens saw the work as the climax of his musical career — a conviction that has since been shared by many others. In it, he introduces the organ voices as part of the orchestra but later unleashes them in a brief but magnificent demonstration of sonic power.

When the LP version was released in late 1980 (Telarc Digital 10051) it was hailed by a reviewer in "Audio" magazine as "the demo disc of all time". Listening again to that same vinyl pressing, Side 1 (Adagio; allegro moderato, &c) it seemed quite unexceptional to my 1984 ears.

Curiously, I had similar reservations about a Barenboim/DG recording of the same work, reviewed in the August '83 issue. Perhaps it has something to do

with the sonic remoteness of an orchestra, playing quietly in a large, resonant environment, with the mic gain kept low in anticipation of things to come.

But in Part II (Allegro moderato, presto, &c) the orchestra, the music, the whole environment comes alive, climaxing with the entrance of the organ, fortissimo. A "demo" disc, indeed!

I played the original vinyl and the new CD version side by side. In Part I, there were only wispish differences between them, the main distinction being the complete silence of the CD surface against those tiny dust clicks that could be heard from the vinyl.

In Part II, surface noise would simply not have been audible anyway but, in the complex louder passages, the difference in definition is. The LP is good by LP standards, but the compact disc is better.

It is also very demanding and it becomes plainly evident why, if the full dynamic range is to be preserved, the levels in Part I must be restrained. Be cautious in your volume control setting, the first time through, or your amplifier will run out of puff when Michael Murray pulls out all the stops! (W.N.W.)

KEITH THOMAS

"INSTRUMENTAL Appetite". Stereo, Myrrh MSB-6709. Extra disc included. [From Word Records Aust, 18-26 Canterbury Rd, Heathmont, Vic 3135. Phone (03) 729 3777].

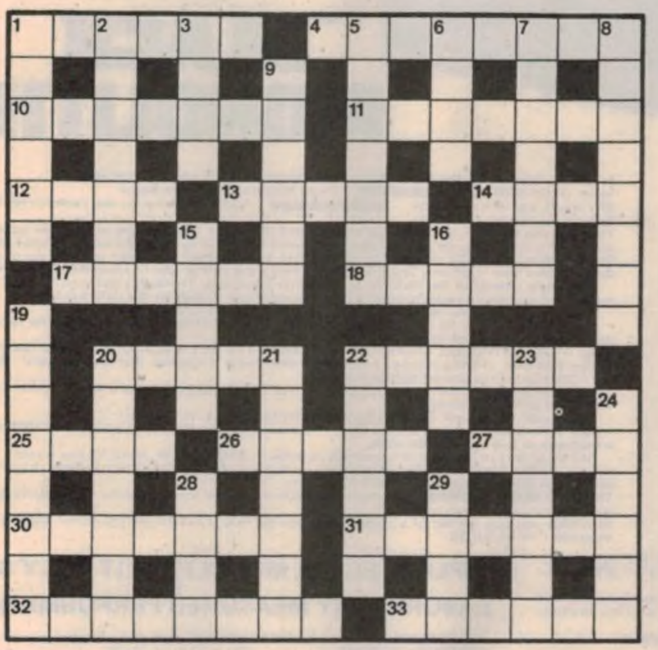
This album features Keith Thomas on keyboards, with associate artists on woodwinds, acoustic and electric guitars, bass, drums and percussion. Their objective is to communicate the Christian ideal through the "imagery of music". There are eight tracks on the two sides:

Road To Paradise — I Can't Believe It's True — Midnight Celebration — Made To Love You — Livin' Without Your Love — The Heartmender — Changes — One More Song For You.

MARCH CROSSWORD

ACROSS

1. Electronic unit. (6)
4. Computer input mechanism. (8)
10. Additional capacitor. (7)
11. Radio ham. (7)
12. Non-manual mode. (4)
13. Feature of a meter. (5)
14. Travel through a filter. (4)
17. Eliminated unnecessary recorded material. (6)
18. Component activated by another. (5)
20. Data transfer device. (5)
22. Colloquial term for a light tube. (6)
25. Tape noise. (4)
26. CRO control. (1-4)
27. It's thought to be a wave of the brain! (4)
30. Perform specified computer operations. (7)
31. Electrical pioneer. (7)
32. Electrical component. (8)
33. How electrons move in conductors. (6)



DOWN

1. Form of inductance. (6)
2. Moved from chosen setting. (7)
3. Panel item. (4)
5. Makes a circuit perform normal operations. (7)
6. Applied voltage. (4)
7. Traditional base for magnetic tape. (7)
8. Body detectable by its radio emissions. (4, 4)
9. Formed an image in a CRO. (6)
15. Musical composition. (5)
16. RF coupling transformer. (5)
19. Likely location of an electronic hearing aid. (2,3,3)
20. Transistors. (7)
21. Generator for ignition pulses. (7)
22. Edge of signal reception area. (6)
23. Emit electromagnetic energy. (7)
24. Type of resonator. (6)
28. Locates recording position. (4)
29. Fail to form a sharp image. (4)

SOLUTION FOR FEBRUARY

There are no lyrics and herein lies a problem. While the performance is sharp and the sound quality is excellent, the music could mean something or nothing at all, depending on whether you happen to know the lyrics that fit the titles. I didn't!

"Instrumental Appetite" may be fine as modern background music in the lounge room but whether you get the "message of (God's) love" is another matter.

But then there's this "extra disc included", which happens to be a "Word Records" sampler disc entitled "Valualbum II", SPL-136. It offers 10 Gospel tracks, a mix of instrumental and vocal in the modern manner, featuring Word artists like Andrew Culverwell, Pete Carlson, Keith Thomas, David Edwards, Kenny Marks, Dion, Morris Chapman, Leslie Phillips, Paul Clark and John Fischer.

As with most samplers, the quality is excellent and, for a price tag of $8.99, readers with an ear for modern Gospel may easily see the two discs as good value. (W.N.W.)

VIDEO CASSETTE

GALA CONCERT featuring Dame Joan Sutherland, Luciano Pavarotti and Richard Bonynge conducting the Elizabethan Orchestra. Stereo video cassette, running time 123 minutes (approx). Distributed by Syme Home Video.

I imagine that most people interested in operatic music would have made a point of watching this concert from the Sydney Opera House, a few months ago, when it was carried across Australia by ABC television and FM as a simulcast transmission. If you did, you will not need prompting as to whether or not you should take advantage of this video cassette release by Syme Home Video.

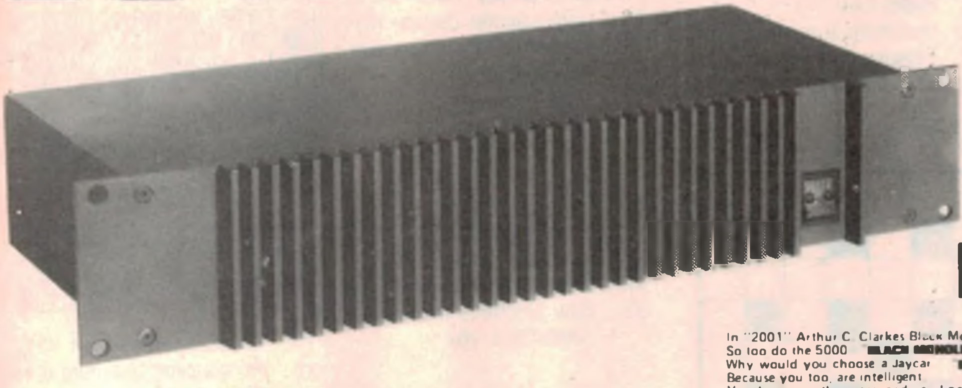
As distinct from the telecast which, as I remember, involved a presenter and supportive interviews, this is a straightforward tape of the concert, supplemented only by title captions of the individual items. Essentially, however, the video here would have been sourced from the same camera chain as the broadcast.

Without attempting to repeat in detail the 16 titles that comprise the official program, plus encores, the performance commenced with an overture (Bellini) followed by arias – solo and duet – from La Traviata (Verdi); Tosca (Puccini); I Lombardi (Verdi); I Puritani (Bellini); La Sonnambula (Bellini); Adriana Lecouvreur (Cilea); Werther (Massenet); Thais (Massenet); Hamlet (Thomas); Pagliacci (Leoncavallo); Lucia di lammermoor (Donzetti).

The enthusiasm of the audience present at the concert is plainly evident and the cassette will revive, for many, the magic of the evening.

Unfortunately, for audiophiles, the analog soundtrack on a present-day videocassette falls well short of hifi expectations, particularly if listened to through a mono VCR and the audio end of a TV set. However, audiophiles will be well aware of such limitations, and may be prepared to make allowances with program material such as this. (W.N.W.)

LOWEST PRICES -



5000 POWER AMPLIFIER

REF: ETI JAN/MARCH 1981

"BLACK MONOLITH"

In "2001" Arthur C Clarkes Black Monolith symbolised awesome power – intelligence
So too do the 5000 BLACK MONOLITH Power Mosfet amp kits from Jaycar
Why would you choose a Jaycar BLACK MONOLITH 5000 Power amp kit over conventional kits?
Because you too, are intelligent
You have seen the specs, and you know that this amp IS the best. You want the best because (whether you know it or not) you are a perfectionist. You won't be conned by cheap and nasty compromises to David Tillbrook's brilliant design. You will want to know if there have been mods to the original design. (There have – and only Jaycar kits reflect them). But let's be specific about the improvements

- Completely redesigned flag heatsinks for the Driver Transistors. Thoroughly endorsed by David Tillbrook. (The original ones were to small if the bias current was set high for low distortion)
- Ventilation grilles in the covers. These were not included in the original design
- Blind tapped holes in the exclusive 'Superfinish' front panel. Heavy guage screws used for stronger connection of the heatsink bracket to the panel
- Jig drilled, EXTRUDED, deburred and black anodised heatsink bracket in heavy guage. All other kits we have seen, a flimsy punched out piece of sheet metal is supplied. Not even anodised!! This is one of the most critical components in the kit
- Beryllium Oxide heatsink washers supplied. A tube of heatsink compound is also supplied – with enough left over to use elsewhere
- 'Superfinish' Front Panel. Despite what others may claim ours is still the best
- Dual 3 Pin DIN 30V Power Outlets. This extra power outlet enables you to power extra 5000 series components as they arrive on the scene
- And all of the extra features of our normal Superfinish 5000 amp, like: Metal 1% film resistors, Pre wound chokes, Fibreglass PCB's, Heavy duty earth braid, Quality capacitors, Original chassis bar design, Flux shorting straps on transformers etc., etc

The Jaycar BLACK MONOLITH is worth far more than the inferior kits around the market today. However, in some cases, it costs no more!!
Remember you only get out of a product what you put in to it and the performance of Jaycar kits is measured IN RESULTS

- THE CLASSIC POWER FET DESIGN
- SOLID ALUMINIUM FOUNDRY CAST AND MACHINED FRONT PANEL HEATSINK. SUPERFINISH
- DUAL 200V.A. POWER SUPPLIES WITH 35A BRIDGE AND 32,000uF OF FILTERING!!
- PROFESSIONAL 19" RACK MOUNT CONFIGURATION

CAT KE 4200

Jaycar has two versions of this kit, the BLACK MONOLITH (see right) and our budget (but still high quality) version. The Jaycar budget 5000 Mosfet still contains many of the exclusive features of the BLACK MONOLITH and is still far better than any full 5000 amp kit under $300
You get the same chassis and exlusive 'Superfinish' front panel so your amp will still look great. The main difference between the two is that you do not get the Beryllium Oxide washers (Mica supplied), heatsink grease, the special driver transistor heatsinks (original ones supplied), ventilated cover and dual 3 pin DIN power outlets (single supplied)
If you are on a tight budget this is the amp for you. You will not be able to hear the difference between either version

ONLY $299 FOR THE COMPLETE KIT

COMPLETE BLACK MONOLITH KIT ONLY $319

LABORATORY MEASURED PERFORMANCE

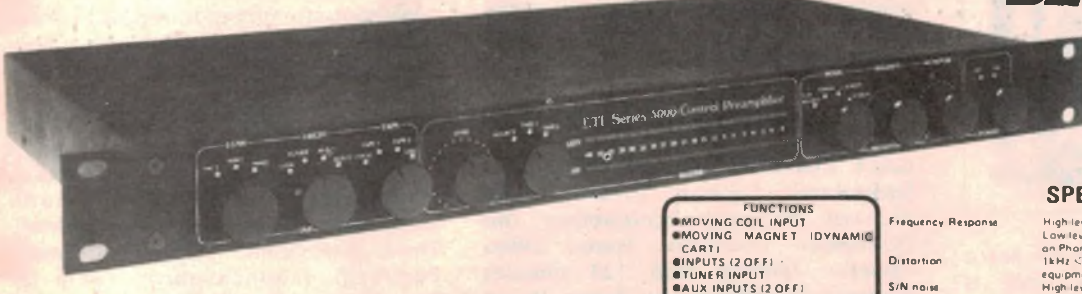
POWER OUTPUT	Around 100W RMS into 8 ohms (both channels driven)
FREQUENCY RESPONSE	8Hz to 20kHz, +0 –0.4dB 2.8Hz to 65kHz, +0 –3dB Note: These figures are determined soley by passive filters
INPUT SENSITIVITY	1V RMS for 100W output
HUM	–100dB below full output (flat)
NOISE	–116dB below full output (flat, 20kHz bandwidth)
2nd HARMONIC DISTORTION	<0.001% at 1kHz (0.0007% on prototypes) at 100W output using a ±56V supply rated at 4A continuous <0.003% at 10kHz and 100W
3rd HARMONIC DISTORTION	<0.0003% for all frequencies less than 10kHz and all powers below clipping
TOTAL HARMONIC DISTORTION	Determined by 2nd harmonic distortion (see above)
INTERMODULATION DISTORTION	<0.003% at 100W (50Hz and 7kHz mixed 4:1)
STABILITY	Unconditional

5000 CONTROL PREAMPLIFIER

FEATURING A MOVING COIL CARTRIDGE PREAMP WITH UNBELIEVABLY LOW NOISE FIGURES

"BLUEPRINT"

REF: ETI JUNE/OCT 1981



CAT KE 4202

The refinement to this preamp has been incredible. At one stage we had two versions of the preamp but people were only interested in the Blueprint. Now we only have the Blueprint
Why is the Blueprint so good? Well, there are many reasons but a few of the main ones: Firstly, we use a far, far superior screened cable in the kit. It is much lower in capacitance than the cheap imported excuse for screened cable found in ALL other versions that we have seen. This cable is made in Australia especially for us and costs over 5 times more than the imported junk. When you consider that over THIRTY FEET of screened cable runs around inside the preamp you will appreciate the low capacitance cable. High capacitance cable in signal lines could effect high frequency performance
We use a specially selected version of the LM394 ultra matched transistor for the moving coil preamp. It is a whisker better than the other LM394's and part of our Blueprint philosophy
We employ HARD (not soft) gold plated RCA input sockets on ALL INPUTS (previously just M.C.). Probably a bit extravagant (except M.C.), we think, but nice. A pair of solid metal, gold plated RCA line sockets are provided to connect to your M.C. cartridge. Special Nylon mounting grommets are provided for all input and output sockets. Far superior to squashy and perishable rubber grommets provided in other kits. Extra touchs like roller tinned PCB's (to reduce dry or noisy solder joints), 1% metal film resistors, quality I.C. sockets where practicable, English 'lorlin' low noise selector switches, special rear panel, solid machined matching aluminium knobs and specially polished rectangular (multicoloured) LEDs add up to a classic kit
Like the Black Monolith the Blueprint is the intelligent choice. Even if you were a millionaire and could afford anything you probably would do no better spending virtually any amount of money more

THE BLUEPRINT IS UNBELIEVABLE VALUE FOR MONEY AT ONLY $299 FOR THE COMPLETE KIT

FUNCTIONS

- MOVING COIL INPUT
- MOVING MAGNET (DYNAMIC CART)
- INPUTS (2 OFF)
- TUNER INPUT
- AUX INPUTS (2 OFF)
- TAPE INPUTS (2 OFF)
- INPUT LEVEL CONTROL
- TAPE OUTPUTS (2 OFF)
- 400Hz CALIBRATION OSCILLATOR
- LED AVERAGE (VU) & PEAK
- LEVEL METERS -48dB TO +9dB
- MODE SWITCH, STEREO BALANCE CONTROL LINE OUT, MONITOR OUT, MONITOR VOLUME CONTROL

FEATURES

- EXTREMELY CLOSE TRACKING TO RIAA PHONO EQ
- GOLD PLATED CONNECTORS ON ALL INPUTS
- ENGLISH 'LORLIN' LOW NOISE SELECTOR SWITCHES
- LOW NOISE 1% 50ppm METAL FILM RESISTORS USED
- TINNED FIBREGLASS PCB's
- LOW CAPACITANCE SCREENED CABLE USED THROUGHOUT
- QUALITY I.C. SOCKETS
- SPECIAL REAR PANEL
- MULTICOLOURED RECTANGULAR LEDs USED

SPECIFICATIONS

Frequency Response	High level input 15Hz 130kHz, +0, –1dB Low level input – conforms to RIAA equalisation, ±0.2dB (see detail on Phono specs.)
Distortion	1kHz <0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation)
S/N noise	High level input, master full, with respect to 300mV input signal at full output (1.2V) >92dB flat; >100dB A-weighted MM input, master full, with respect to full output (1.2V) at 5mV input, 500 ohm source resistance connected >86dB flat >92dB A-weighted MC input, master full, with respect to full output (1.2V) and 200uV input signal >71dB flat >75dB A-weighted

ETI-478MM MOVING MAGNET INPUT STAGE

Gain	74, 1kHz			
Frequency Response	Conforms to RIAA Equalisation ±0.2dB			
Total Harmonic Distortion	<0.001%, 1kHz, 10mV RMS input			
Headroom	>28dB with respect to 5mV RMS input signal, i.e. 135mV RMS			
Noise	Total equivalent input noise, 122nV 'A', input shorted, 216nV flat, input shorted			
S/N ratio		1mV	5mV	10mV
	Flat	73dB	87dB	93dB
	A-weighted	78dB	92dB	98dB

ETI-478MC MOVING COIL INPUT STAGE

Gain	24
Frequency Response	7Hz – 135kHz +0, –1dB
Total Harmonic Distortion	<0.003%, 1kHz, 30mV input
Noise	Total equivalent input noise 83nV flat, input shorted 42nV 'A', input shorted 56nV flat, after RIAA Eq. input shorted 34nV 'A', after RIAA Eq. input shorted

Books & Literature

Ham radio handbook

HEIL HAM RADIO HANDBOOK: By Rob Heil, K9EID. Published by Melco Publishing, Illinois, USA. Soft covers, 168 pages, 153mm x 230mm. Illustrated with photographs, line drawings, and circuits. Recommended Australian price $14.50.

This book is aimed primarily at the new amateur; the fellow who has just obtained his licence and is anxious to get on the air. At least as far as the author is concerned the mere possession of a licence does not indicate that the holder is technically qualified to set up a station, or to operate it correctly, ie, adopt correct on-air operating procedures, if he does get it working.

In fact the author appears to be something of a crusader who has many pet hates concerning the technical incompetence and generally careless on-air operating standards of many amateurs. This book is an obvious attempt to correct this state of affairs and will doubtless be applauded by all right thinking and mature amateurs. Just how successful the attempt will be is another matter.

Operating procedures aside, which are covered in the first few chapters, the book majors on a wide range of practical matters which it is reasonable to suppose that the beginner is unfamiliar with, at least in detail. There are 20 chapters in all, too many to list in detail, but the following are typical. Band Characteristics, Antenna Systems, Mobile, Audio Equalisation, Simple Electronics, Home Brewing, Simple Electronic Circuits, Reference Tables, etc.

The chapter on simple electronics is a little out of character, in that anyone who can pass an amateur licence test should be thoroughly familiar with most, if not all, of its contents. However, its inclusion will broaden the appeal of the book so that it includes those preparing for an examination, as well as those who have just passed one.

By and large the book is well prepared and reasonably well written, although there are a few instances of poor English and sentence construction, and a tendency to refer to some devices by their brand name rather than the generic term. In short, the author tends to make, in print, some of the errors he complains about in on-air procedure. These are points that could be tidied up in any subsequent edition.

In spite of these minor criticisms, and the fact that it is written for the US scene, the book could be a useful aid to those studying for, or who have just obtained, a local amateur licence.

Our copy came from Technical Book and Magazine Company Pty Ltd, 289 Swanston St, Melbourne, Victoria 3000. (P.G.W.)

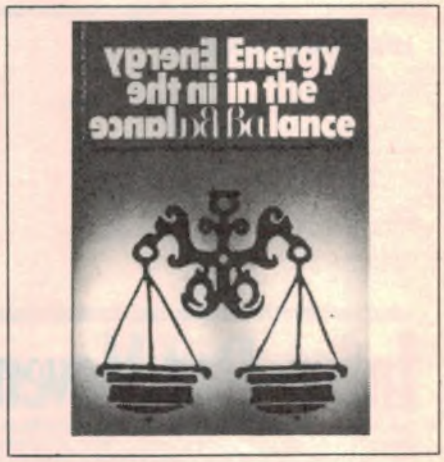
Stereo servicing

FUNDAMENTALS OF STEREO SERVICING, Joel Goldberg. Published by Prentice Hall. Hard covers 242 x 183mm 241 pages, illustrated with line drawings and photographs. ISBN 013 344549 6. $33.50.

I found this book rather disappointing, especially in view of the high price for such a relatively slim volume. There are 15 chapters in all, beginning with amplifier theory and circuitry, input and output devices, AM and FM tuners, and circuit analysis. The remainder of the book is devoted to troubleshooting, test equipment and its use, power supplies, power and low level amplifiers, repair of tuners, FM stereo decoders and tape decks.

Each chapter ends with a number of self checking questions and most of the illustrations of circuit practice are derived from the Zenith Corporation and the Delco division of General Motors so are not very typical of the equipment on sale in this country.

A number of the illustrations leave a lot to the imagination, examples being the photos on pages 217 and 219 where photos of a cassette mechanism and the works of an eight track equivalent are reproduced from a service manual with all the reference numbers but only a few of the parts actually described, an omission that could leave a beginner somewhat perplexed. There are a number of references to another book by the same author, "Radio, Television and Sound System Repair" from the same publisher. I sometimes wish somebody could produce a 1980's equivalent of Langford Smith's "Radiotron Designer's Handbook". He could sell a million (N.J.M.)



Energy: future options

ENERGY IN THE BALANCE: Papers from the British Association for the Advancement of Science, 1979. Published by Westbury House, Surrey, England. Soft covers, 234 pages, 145mm x 210mm, illustrated with graphs and photographs. ISBN 0 86103 031 1. Recommended retail price $29.

This book is a collection of papers given at the annual meeting of the British Association for the Advancement of Science, held at the Heriot-Watt University in Edinburgh in September 1979, and which dealt with the impact of Britain's North Sea oil and gas development. Subjects dealt with range all the way from the effect on real estate values to oil pollution.

But, as the title implies, the collection is not confined to gas and oil alone. Several papers look ahead to the time when the oil and gas runs out and when alternative energy sources will need to be exploited. These range all the way from remaining coal reserves to wind, wave, tidal, solar, geothermal, and nuclear energy.

The authors of all the papers have

Design of high-performance feedback amplifiers

DESIGN OF HIGH-PERFORMANCE NEGATIVE-FEEDBACK AMPLIFIERS, by E. H. Nordholt. Published by Elsever Scientific Publishing Company, Molenwerf 1, PO Box 211, 1000 AE Amsterdam, The Netherlands. Hard covers 250 x 170mm. 234 pages, numerous line diagrams. Price US $57.50.

This book is basically a revised edition of the author's PhD thesis published in June, 1980. Since the book was originally published as a thesis, it assumes readers will have prior knowledge of circuit analysis techniques such as s-plane representation, hybrid π equivalent circuits and two port networks (among others).

The PhD thesis, and hence this book, was more or less inspired by a previous book on amplifier design titled, "Amplifying Devices and Low-Pass Amplifier Design" by E. M. Cherry and D. E. Hooper, published in 1968. Because of this association, and the need for a good basic knowledge, it is recommended that Cherry and Hooper's book be looked at before reading Nordholt's book.

In "Design of High-performance Negative-Feedback Amplifiers" the approach taken to the design of an amplifier is a systematic analysis of various parameters which affect amplifier performance, then the development of amplifier configurations which produce optimum results.

There are seven chapters in the book. In chapter one criteria are deduced for optimum matching of amplifier input and output impedances to the source and load, the aim being to preserve the signal to noise ratio and achieve optimum information transfer. In addition, classifications of basic amplifier configurations with up to four feedback loops are given and the characteristic properties and practical merits of each configuration are discussed.

Similar classifications are given in chapter two for configurations using a single active device and the two-port parameters of the configurations are given. Balanced versions of the simple, single device configurations are mentioned but not studied in great detail.

Chapter three concerns itself with noise in amplifier stages and formulates design criteria for the selection of the most favourable input stage configuration, and the active device (transistor or FET) to be used in this stage for a given signal to noise ratio.

Chapter four discusses distortion and outlines those amplifier stages producing the least distortion. Chapter five considers the bandwidth and stability of various amplifier stages and means by which these parameters can be increased.

The design of bias circuitry is covered in chapter six. It is shown that, in most cases, design of the bias circuitry can be done in such a way that the signal path of the amplifier is hardly affected. Finally, an outline of the design method developed in the book is given in chapter seven and three examples of amplifiers designed by the author according to the principles developed are discussed briefly. Full details (and circuit diagrams) are not published in the book although references are provided for the interested reader.

Our only real criticism of the book concerns its lack of worked examples. When reading a book such as this, worked examples will often clear up small points which the text has left unclear or show the way towards correct use of the information given. As a matter of interest, we looked up one of the reference examples quoted in chapter seven and found it to be an excellent example of the recommended design procedure.

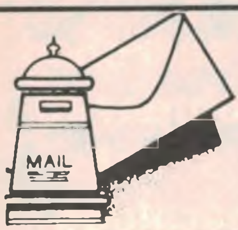
On the whole this book is recommended to those interested in the design of amplifiers. However, be prepared to brush up on basic theory and to locate the examples given in chapter seven. (J.S.)

attempted to present the pros and cons of all these systems in as an objective and unemotional manner as possible, supported by as many facts as are available, and drawing attention to the lack of vital information where this exists.

Sections include: Oil and gas; effects on the environment (dealing largely with pollution). North Sea oil and gas; effects on society. Technology for deep diving. Geology and Geophysics of the North Sea. The future; changing over from oil.

Not surprisingly, some of the papers will present heavy going to those not close to the subject, but they nevertheless contain a vast amount of statistical data and facts which could prove invaluable to anyone concerned with the energy crisis. And, while some of the material is applicable only to the country concerned, much of it would apply universally.

Our copy came from Butterworths Pty Ltd, 271 Lane Cove Rd, North Ryde, NSW. (P.G.W.)



Letters to the editor

TV fires and home appliances

I have been following your articles on TV fires, and thought you would be interested in an experience I had with a TV set not quite three months old. A copy of correspondence to the manufacturer is self explanatory. (The writer encloses a copy of a letter describing a fire in a television set which caused the plastic cover of an EHT transformer to give off acrid smoke, forcing him to vacate the room for 15 minutes.)

I am an officer with the Townsville Fire Brigade, having nearly 21 years with same. During that time I have had only one fire which I could positively attribute to a TV set, but we have had many others since the advent of TV.

By far the most prevalent fires concerning electrical equipment would have to be electric stoves. The most recent one involved a woman who had completed cooking the evening meal and was watching television. She had been using a frying pan on the stove and on completion of cooking had covered the oil in the pan with a plate. Her small daughter had entered the kitchen and turned the hotplate control to maximum. The oil in turn heated up and eventually caught fire. The woman became hysterical and her screams were heard by a neighbour, who rushed into the house, sized up the situation and promptly extinguished the outbreak with a garden hose. Lucky for him there was not a great quantity of oil in the frying pan.

It seems to me that something could be done to make electric stove controls a lot safer in the presence of small children. To activate the burner on a gas stove the knob must first be pushed in before the gas will flow. Perhaps a similar control could be utilised in elelctric stoves also.

I dare say you will receive a flood of letters like mine and if these are put before the right authorities, then something may be done to make living in this country a little bit safer. Although the quality of life is progressing upwards, it seems at times we are stepping backwards, but I guess when price governs demand of various goods, then quality must suffer. If more people demanded quality products, and were prepared to pay the price, then we would not have to tolerate the flood of inferior goods in our society. Many people, will, however, always buy according to price and not quality.

D. R. Whitehouse,
Townsville, Qld.

Serviceman column

Your January issue of EA proved to be a problem solving issue for our service department in Coburg, Victoria. The article "The Serviceman" solved a problem affecting a TV which had been located in our service division for three weeks, with the exact problem right to detail. Thank you for these informative articles and we hope they continue.

Michael Maminski,
Service Manager,
Northern Electronics, Vic.

Compact disc and quality control

It seems that like any new technical innovation the Compact Disc has received a lot of publicity and attracted much comment. Not all, as we know, has been favourable and in the most part has been due to ignorance or has its basis with people who have vested interests in competing equipment. At the other end of the scale, technical reviewers seem to be unaware of any real faults with the system, and are constantly extolling its virtues.

As with any new system, problems do occur, and as you pointed out in one of your lead articles on the CD system, are likely to be of the go no-go variety. This brings me to the reason for this letter.

Having purchased the top of the line Sony CDP101 soon after its release in Australia, I started to build up my collection of discs. Not all went smoothly; sometimes certain discs refused to be read by the machine, or at certain points the disc would skip, not unlike a scratch in a record. The discs were examined for dust, then cleaned. After this failed to make any significant difference, the offending discs were taken back to the retailer who played them on his shop system with no problems at all.

It is important to note that the shop player is a Philips. I then took my player to Sony suspecting a focus or alignment problem. I included two discs that had been giving trouble with a detailed index so that they could find the places on the disc where the machine failed to track.

A week or so later the Service Manager rang me personally and invited me to see the results of the tests that had been performed on the discs and the player. According to the Service Manager, very few players had been returned with any hardware problems. He went into great detail about the operation of the CD system and the error correction techniques developed by Sony and employed in their CD players.

He then showed me the test setup and the results gained from their new CD disc analyser. When the player itself had been tested, no faults of any kind had been detected but as far as the discs themselves were concerned it was a different matter. Both discs showed gross errors due to noise in the form of imperfections on the disc surface itself or in the plastic coating. The printouts from the analyser showed the error on the discs at the points that I had noted. At these points, the block error rate exceeded the amount that the error correction system could handle.

Other errors in the form of Q-Mode 3 and pause flag errors were also detected but these have no bearing on the major problem.

It appears that because the Sony machine uses a 16-bit decoder it is more susceptible to disc errors. This was borne out by the fact that the Philips player in the shop is a 14-bit machine and it did not exhibit any of the tracking problems that the Sony did. This is not meant as a criticism of the Sony player, but merely points out that the degree of precision in manufacturing the discs calls for stringent quality control.

I realise that at the moment the demand for discs outstrips the ability of the few manufacturers to produce them, but is this any excuse for poor manufacture of what promises to be an incredible step forward in sound reproduction? We have, for far too long, accepted the appalling quality of most records, so do we now have a repeat of the same situation in a system that, with a little care, can provide almost perfect reproduction?

It also seems that not all the disc manufacturers are guilty of poor quality, with the Japanese being considerably more consistent than the West Germans. Perhaps the West Germans test their discs on the Phillips machines and this has a bearing on the matter. We can only hope that time and competition from other manufacturers will improve the situation.

Simon Leadley,
Vaucluse, NSW.

DICK DOES IT AGAIN!

The new, improved DATAPHONE II

plug~in Data Modem + Phone

still only $199!

Now with added phone!

Australia's fastest-selling direct data modem is now even better value than ever! Not only have we improved its performance and reliability, but we've added a high quality pushbutton type electronic phone as well – for added convenience. It even has last-number-redial. And all this is at no extra charge!

No delays – install it yourself!

Besides the added convenience, the built-in phone brings a further dramatic bonus: installing the Dataphone II is now simply a matter of plugging into a standard Telecom phone socket. It's legal and there's no delay or fee to pay!

Australia's first direct modem to meet new Telecom regulations!

Dick Smith's Dataphone was the first to meet the 1982 Telecom regulations permitting privately owned direct-coupled data modems. It was also the first to break through the $200 price barrier, opening the way for owners of virtually any personal computer to communicate with other computers over the switched telephone network.

Here's your chance to join the many thousands of happy Dataphone users, with this improved and upgraded model!

Telecom Authorisation No. C83/37/1080

Dataphone II's features:

★ Simple plug-in connection – no delay or fee.
★ Built-in pushbutton phone with last number re-dial.
★ Full duplex, Answer/Originate operation for convenience.
★ Operates at the standard data rate of 300 baud.
★ Designed in Australia and fully authorised by Telecom.
★ Uses standard RS-232C computer interface.
★ Outstanding value for money at only $199!

Cat X-3272

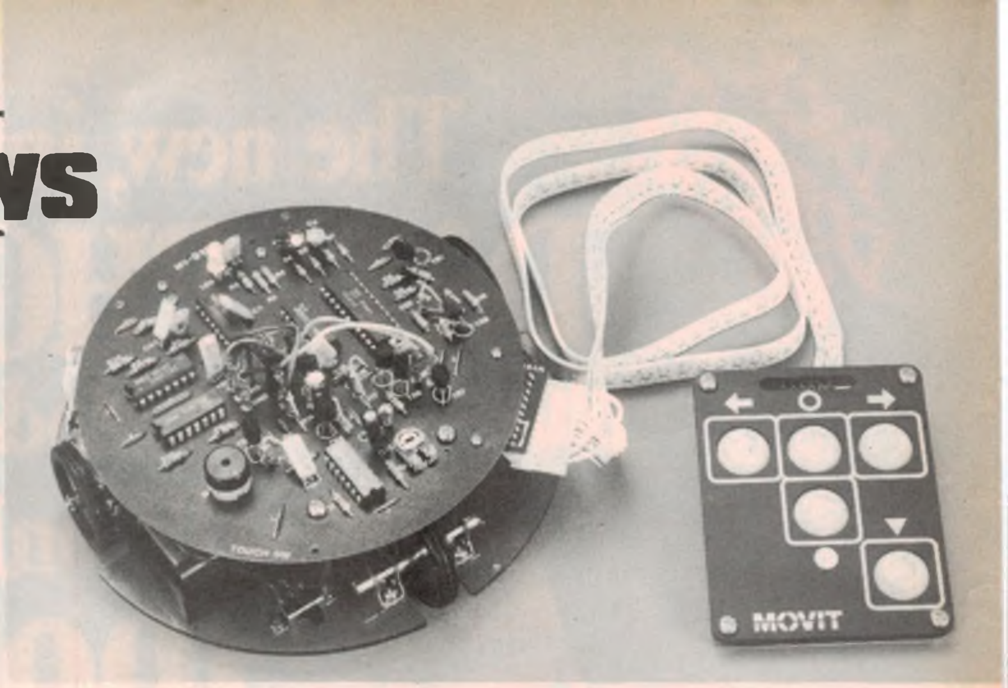
DICK SMITH Electronics

See page 107 for full address details

DSE/A686/PA

Micronews

Experiment with robotics: Memocon Crawler



The "Microbot" kits distributed by Jaycar Electronics are self-contained mobile platforms fitted with a range of sensors. The top-of-the line "Crawler" is programmable and ideally suited to robotics experiments.

Many people would like to gain some experience with robotics but have been deterred by the costs involved. Even the simplest type of programmable vehicle can cost over $300, putting them out of reach of the casual hobbyist.

Fortunately however there is now a low-cost way of becoming acquainted with some of the problems and possibilities of robotics. The Movit Microbots available from Jaycar are kits which form intriguing stand-alone mobile gadgets that can respond to their environment. Starting from around $40 the Microbots can be built up "as is" or used as the basis of a customised experimental robot.

The top of the range, at $79.95, the Memocon "Crawler" is a programmable mobile platform with its own on-board memory to store sequences of movement instructions. A detachable five-key keypad allows the user to enter directions for movement and activate an LED blinker and small speaker. Once stored these instructions can be performed once only or repeatedly.

Parts are packed in separate plastic bags in the order required for assembly.

The Crawler consists of a circular perspex base with a diameter of 140mm. Two small electric motors driving rubber-tyred wheels provide motive power, while a third trailing wheel rotates freely. Motors and gear trains, two battery holders and an on/off switch are carried on the base.

A circular printed circuit board is mounted above the base on a plastic hinge and two 30mm metal pillars. The PCB is 120mm in diameter and carries the control circuitry for the motors, LED and piezoelectric speaker. A clear perspex dome is bolted over the circuit board so that the overall height of the completed Crawler is approximately 6.5cm.

The hinged mounting of the PCB allows it to be swung up out of the way when the batteries must be changed.

A 9V transistor battery supplies the electronics via a 5V zener regulator circuit while two 1.5V penlight cells power the motors. We found that these cells must be in almost peak condition to meet the current drain of the two motors.

Touch-operated switch

On the underside of the circuit board is a touch operated switch which initiates the sequence of programmed motions. A 256 x 4 bit static RAM chip is used to store instruction sequences, allowing programs of up to 256 steps (naturally enough, as four bits suffice to control all functions of the unit). A pause in a program however, counts as a step.

A small keypad plugs into a 10-pin connector at the rear of the circuit board. The pad is connected to the Crawler by an 80cm length of flat cable and provides five rubber pushbuttons. Two of these control the speaker and LED and two others activate the motors.

The fifth button is the "input" key and produces a strobe signal which writes each command combination into the Crawler's memory.

Steering is performed by switching either the left or right motor and both motors are powered to move the Crawler in a straight line. Ground clearance of the Crawler is only 5 or 6mm however, so it operates best on a smooth surface. It won't work on a shag pile carpet!

Building the kit

The Memocon Crawler kit is well packaged and goes together neatly with just simple tools. A small Philips head screwdriver and needle-nosed pliers are the minimum requirements, although a hammer is suggested to assist (gently) in forcing some of the push-fit gears over the wheel shafts.

Instructions are in the form of an illustrated broadsheet with detailed diagrams for each of the 15 stages of the assembly. The parts required for each stage are packaged in separately labelled plastic bags, each indicated at the appropriate place in the instructions. A small spanner and a tube of lubricating grease for the gears are included in the kit.

No soldering is required, as all wires are supplied pre-cut and fitted with push on connectors. The electronics are pre-assembled so the main tasks in building a Crawler are mounting the motors, battery holders and gear trains. Some parts of the assembly require a little fiddling to get tiny nuts and bolts into confined spaces. Tweezers and a flat, well-lighted work space help here.

Lock nuts are not supplied, and when using the Crawler we found that some of the nuts tend to work loose. A dab of nail polish on each nut prevents possible problems.

The keyboard is pre-wired and only requires the insertion of the rubber keys and spacers between two pieces of composition board.

Programming

A circuit diagram of the control section of the Crawler is supplied with the instructions and indicates the conceptual simplicity of the programming scheme. The keypad connects directly to the four data input lines and the R/W line of the RAM chip. Pushing one or more buttons places a "1" on the appropriate line and holding down a button while pushing the input key latches the key combination into memory.

A counter, reset by the touch switch, clocks through each address of the RAM and reads the control bits out to the circuitry which activates the motors, LED and speaker. A variable potentiometer on the circuit board controls the speed of the address counter, allowing the length of each program step to be adjusted between approximately 0.3 and 0.7 of a second.

It would be a small matter to replace the keypad with a connection to a parallel output port of a microcomputer. Basic or assembly language statements could then be used to set up the appropriate bit combinations for each program step, with a fifth output bit toggled to latch the data into RAM. With the touch switch replaced by a sixth bit to reset the address counter the way is open for fully automated programming of the Crawler.

Expansion of the hardware is also a possibility. Some glue and scrap plastic could be used to add a pen-holder to the Crawler, allowing it to be used for drawing as it is steered over a large sheet of paper. A small solenoid could be used to raise and lower the pen, although this would involve some additional electronic components. The solenoid driver could be substituted for either the LED or the speaker to allow the same programming format to be retained.

No doubt readers will also have their own ideas on expansion. Basically the Memocon Crawler provides all the components of a programmable, mobile platform in a well-designed, easy to assemble package. Given the relatively low cost the Crawler is an excellent way to get into the fascinating world of robotics, without breaking the bank. (P.V.)

Infocentre service

Paris Radio Electronics has expanded its dial-up "Infocentre" service with an agreement by Tandy to supply information on TRS-80 Color Computer hardware and software. Users can also leave questions on the system for Tandy Computer Customer Services for answer within 48 hours.

In addition to the Colour Computer, the Message Centre provides information on a wide range of 6809 computer hardware, software and literature, price lists and book reviews, a bulletin board, and programs which can be downloaded by users into their own systems.

Readers wishing to access the system should phone Jacky Cockinos on (02) 344 9111 for an authorisation code and user identification number. The dial-up system is available from 5.30pm to 9.00am week-days and on week-ends, and is a free service.

AVTEK MULTI MODEM

SEE EA JAN. 1984

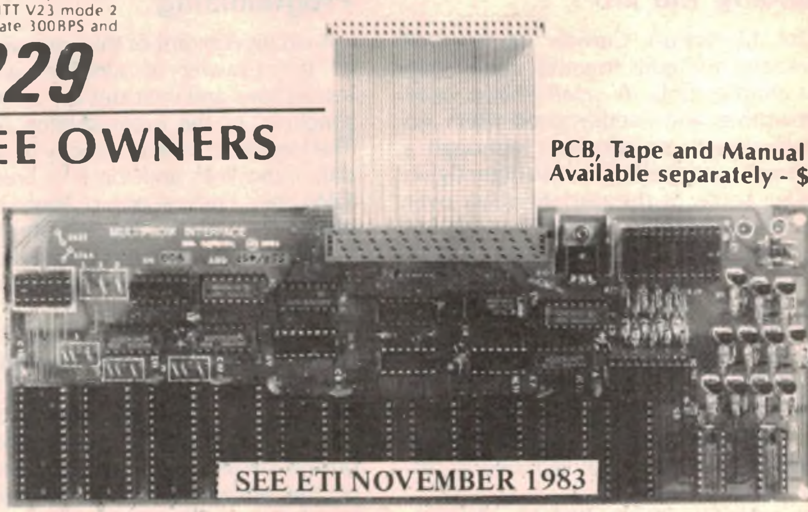
THIS KIT WILL 'KILL' ALL OTHER KITS AVAILABLE IN ITS TOTAL COMMUNICATION WITH THE WORLD . . . READ ON

Modulation - Frequency shift keying: Digital Interface - RSC-232C: Auto answer and disconnect: Data communicatin to basic Bell or CCITT specifications giving a world data communications capability: Operates with your normal phone: 300BPS or 1200BPS with backward channel 75BPS. Indicators and test switch. Auto answer or manual connect: Backward channel standard on 1200BPS mode: Direct connection, inbuilt line isolation unit. Operates in the following modes:- Bell 103 originate 300BPS, Bell 103 answer 300BPS, Bell 202 equalised 1200 BPS, Bell 202 1200BPS, CCITT V23 mode 2 equalised 1200BPS, CCITT V23 mode 2 1200BPS, CCITT V21 originate 300BPS and CCITT V21 answer 300BPS.

ONLY $229

ATTENTION MICROBEE OWNERS

MULTIPROM INTERFACE KIT $99



PCB, Tape and Manual Available separately - $69

The Multiprom board is an extension of the Microbees memory in ROM. It simply plugs into the fifty way bus expansion port on the core board. It fits either neatly inside the Microbee or behind it, using the Microbee's own power supply.

The board takes the EDASM and NET eprom normally residing inside the Microbee, but allows several different sets to fit in: Editor-Assembler, Wordbee, Logo, MiniPascal, Network ROM, Bemon or your own program. It has room for 4 sets of eproms in the EDASM location and 3 sets of eproms in the NET location, a total of 44K of eprom. The board can be simply daisy chained with up to 6 slave boards (using an outside power supply in this case), allowing a maximum total of 308K in ROM. The EDASM locations accept either type 2532 or 2764 eproms and they can be mixed. Another powerful feature of the board is the input/output system, 11 outputs, open collector transistor driven. Each can turn ON or OFF a relay under program control. 8 inputs, buffered and protected can read 8 switch status - ideal for computer controlling of model trains, alarm systems, tape recorders, machinery etc.

The Avtek kit includes a plated through board plus all components to make this exciting project. There is also provision on the board to change the address of the ports used for eprom selection and input/output.

Little BIG Board

SEE ETI OCTOBER 1983 FOR FULL DETAILS

The Pulsar Series 6000 microcomputer card has been designed to provide a cost-effective general purpose central processor that will find application in a wide range of systems, from stand-alone and dedicated control processors to multi-processing and network configurations. While the 6000 Series is fully compatible with the industry standard STD bus, attention was given to partitioning the circuit so that a complete disc-based computer system could be constructed using just one card. Included on the board is: Z80A processor operating at a full 4MHz, 64K bytes dynamic RAM, single/double density floppy disc controller, two RS232C serial I/O ports, 2K bytes EPROM bootstrap/monitor and battery-backed real-time clock and calendar. Interfacing to the STD bus allows systems to include modules from a range of over 1800 cards available from some 80 manufacturers.

Card Includes:
- **Power-on automatic bootstrap to CP/M in on-board EPROM**
- **Real time clock chip with battery backed supply**

BUS Interface:
- **All signals meet STD Bus electrical specs.**

External Connections:
- **50 way edge connector provided for 8" floppy disc connections**
- **1 x 16 pin RS232C for terminal conn**
- **1 x 16 pin RS232C for printer connection**

PCB, Manual and ROM $149

FULL KIT $450

CP/M in 8" or 5¼" 1200 or 9600 Baud (please specify) ONLY $150

NEW KIT - SERIAL TO PARALLEL CONVERTOR

SEE ETI JANUARY 1984

KIT without Centronics Connector $29

KIT with pre-crimped Centronics Connector and lead $59

MULTI ROM BOARDS

XM-1 - This is a totally new product developed EXCLUSIVELY for AVTEK - It takes two sets of EPROMs (e.g. WORDBEE and EDASM) and allows you to choose between them by simple KEYBOARD COMMANDS. It will take a short time to assemble and is simply installed inside the MICROBEE with one DIP plug (supplied) and two solder connections.
Suits early model MICROBEE plus models using 2532 type EPROMs.
These have serial numbers starting with 8.

SAVE $$4.95 - NOW ONLY $15.00

XM-2 - same as XM-1 but suits the MICROBEE IC and is even simpler to fit. Also responds to PAK1 and PAK2 commands.
These have serial numbers starting with 9.

SAVE $1.95 - NOW ONLY $15.00

EPROM PROGRAMMER
See ETI January 1983

Plugs straight into the MICROBEE I/O port. Suitable for 2716, 2732, 2532, 2732A and 2764 EPROMs. Burn your games programmes and eliminate cassette loading time.

FEATURES: ● Sockets for all other IC's ● 1 x 2716 supplied - get started straight away ● Front panel and mains (SEC approved) transformer ● 28 pin and 16 pin wire wrap sockets to flush mount personality plugs (2 included) and ZIF socket (included) ● DB15 plug ● Complete to last nut and bolt ● See review ETI August 1983.

ONLY $55.00

RADIOTELETYPE DECODER
See ETI April 1983

Display RTTY encoded messages on your video monitor. Receive up to date weather information, international news before the papers and all sorts of military info. Simple circuit, uses PLL techniques. Single PCB construction. Kit includes DB15 plug and backshell for connection to MICROBEE. Shielded pre-tinned PCB.

ONLY $19.50

MICROBEE LIGHT PEN
See ETI August 1983

AT LAST! A light pen for the BEE. This pen works in the low resolution graphics mode and connects directly from the I/O port. Complete kit including DB15 and 2m cord. Fully documented with software example.

PROVIDES DIRECT PERSONAL CONTACT WITH YOUR BEE!

ONLY $19.95

FAX DECODER
See ETI September 1983

This project allows you to decode the signals of shortwave stations transmitting radio facsimile weather maps, satellite pictures etc., and then reproduce them on your dot matrix printer. Complete kit of parts includes DB15 and ribbon cable. Software listing.

ONLY $24.50

bankcard

AVTEK (ELECTRONICS) Pty. Ltd.

TWO GREAT LOCATIONS
119 YORK STREET, SYDNEY 2000
PHONE: (02) 267 8777
(Above Charlie Browns Place)
172 LIVERPOOL ROAD (HUME HIGHWAY), ENFIELD
PHONE: (02) 745 2122
All Correspondence to:
P.O. BOX Q302, QUEEN VICTORIA BUILDING, SYDNEY 2000

POST AND PACKING
Divide the value of your order by 20 (5%) to get post and packing value and then add $2.00 — it's that simple!
All Bankcard orders can only be sent to a normal address (NOT a P.O. Box). All Bankcard orders will be sent by registered mail (add $3 to P&P charges).
ENFIELD OPEN ON SUNDAY

Micronews

Microsoft unleashes a mouse

Microsoft Pty Ltd has released two versions of its "mouse" pointing device, one for the IBM PC and the other a general purpose MS-DOS device. Priced at $295, the IBM compatible mouse comes with three programs to help the user to learn how to effectively use the unit.

Linda Graham, general manager for Microsoft in Australia, says that the mouse adds a new dimension to microcomputer applications. "As personal computers move increasingly towards a graphics-based display, you'll find more and more application programs where the mouse functions as the primary user interface. It is simply much easier to point to a box on the screen than it is to type a command".

The Microsoft Mouse can be used on any flat surface and can be used to quickly reposition or move a cursor across the screen. Two buttons are provided to select alternatives or commands from a menu displayed on the screen.

So far the Microsoft Multi-Tool Word system has been released as the first mouse-based application package for MS-DOS 16-bit microcomputers. Under control of this program the mouse is used to quickly insert, delete and reposition blocks of text within a document, without having to use the keyboard.

A disk provided with the mouse contains three programs designed to train the user in operating principles. The first program is a music tutorial that teaches the user how to point with the mouse by moving the cursor around on a piano keyboard displayed on the CRT screen. Pressing a button on the mouse causes the computer to play the note to which the mouse points.

Another application provided with the mouse is the game of life, which presents the user with a grid filled in by pointing to individual cells. Using a command activated by a button on the mouse, the cells which are filled in replicate themselves according to the rules of the game.

The third program provided is a Multi-Tool Note Pad, a memo program including insert and delete features.

Third party software developers will also be encouraged to provide further programs for the mouse, as the Microsoft package includes a standard interface driver, supporting all of Microsoft's high level languages, including Basic, Fortran and Pascal. The availability of this driver will considerably ease the task of incorporating the mouse into independent applications programs.

For further information contact Microsoft Pty Ltd, PO Box 98, Terrey Hills, NSW, 2084.

Commodore flies in supplies

Towards the end of last year demand for the Commodore VIC 20 and '64 computer was running so high that the company was forced to fly in several plane loads of equipment to supplement normal sea deliveries. Shown above is one shipment — around 12,000 computers.

More software from Imagineering

Imagineering has released a range of new programs for the VIC 20 and Commodore 64 home computers. Distributed under the "Mission Control" label, the 25 new programs are described as colourful, fast action games, and are available from microcomputer stores and the computer sections of department stores throughout Australia.

All programs in the range are written by Australian authors. According to Phillip Woolley, Marketing Manager for Imagineering, "it is important to support Australian authors and show the consumer that local talent can produce high quality products. We are continually looking for new authors and our contacts in the US with major software companies such as Broderbund, HES, Sirus and On-Line allows us to forward the very best packages for evaluation, for possible marketing in the US".

Prospective authors of software for the VIC 20 and Commodore 64 computers can contact Imagineering at PO Box 558, Broadway, NSW, 2007. Phone (02) 212 1411.

Printer "exerciser" from MicroPro Design

MicroPro Design Pty Ltd has announced the availability of a new product to aid demonstrations of RS-232 and Centronics compatible printers, terminals and plotters. Called the "Printer Exerciser", the new device is designed specifically to allow sales people to show off the features and performance of printers, although it also finds applications in the testing and maintenance of such equipment.

The unit allows an attached printer to be driven with a standard ASCII character set or a custom message in EPROM, which could contain sequences to show all the features of a particular printer and up to four pages of text. Ease of connection and configuration make the exerciser a boon when setting up a new printer prior to connecting it to a customer's computer.

For further information contact MicroPro Design Pty Ltd, PO Box 153, North Sydney, NSW, 2060.

DICK SMITH VZ-200 PRICE SLASH!

Now $99

WAS $199

OVER 20,000 SOLD IN JUST A FEW MONTHS!

EXCLUSIVE!

Dick Smith's VZ-200 User's Club

AUTOMATIC MEMBERSHIP when you buy your VZ-200 personal colour computer . . .

- FREE newsletter
- Latest VZ-200 product news
- Hints and tips from other users
- Programs
- And more!

ONLY with the fantastic VZ-200 Colour Computer

find out more!

Introduction to Computing

Are you a 'babe in the woods' when it comes to computing? Here's a book written just for you — in language you can understand! Cat B-7200.

ONLY **$9.95**

VZ-200 Technical Manual

Want to get the most from your VZ-200? This technical manual explains all the ins and outs, ups and downs. For the real computer enthusiast or beginner who wants to know more. Cat B-7204.

JUST **$9.50**

First Book of Programs

Tried, trusted and true programs for your VZ-200. There's something for everyone — and remember, they're all written in BASIC so you can save them on cassette. That means you'll only have to key them in once, to use them anytime! Cat B-7202.

ONLY **$6.95**

Giant Book of Programs

Okay, you've worked your way through the basics and your ready for more. If you are interested in Board games, Adventures, Simulations, Dice, Space and Brain games, then this book is for you. 179 pages of fun for your VZ-200. B-7210

ONLY **$9.95**

look at this great range of educational, financial & games software

SPEED READING*
Ideal for improving reading and comprehension skills—written by an experienced Australian primary school teacher! Cat X-7257.

TYPING TEACHER
Even if you're a complete newcomer, this program will quickly get you familiar and confident with the keyboard. Cat X-7258.

ELEMENTARY GEOMETRY*
Not too strong on geometry? This program should help. It uses a friendly explanation/quiz approach. Cat X-7256.

STATISTICS 1
A great introduction to the basic principles of statistical analysis. Tests your knowledge with examples! Cat X-7251.

STATISTICS 2*
Following on from Stat. 1, this program views more advanced concepts (eg: the Chi square test). Cat X-7252.

MATRIX*
Working out mathematical matrices can be a real chore. Use this program to help develop your skills. Cat X-7253.

TENNIS/GOLF LESSON*
Challenge your computer to a game of tennis or golf. It plays by the rules, so you'll learn about the game. Cat X-7254.

*Requires 24K of memory

Exciting New Programs

POKER–Cat X-7233 SLOT MACHINE -Cat X-7234 BLACK JACK*–Cat X-7235 CIRCUS–Cat X-7236 BIORHYTHM–Cat X-7237 HORSE RACING*–Cat X-7238 VZ INVADERS–Cat X-7239 DYNASTY DERBY*–Cat X-7240 VZ GHOST HUNT–Cat. X-7242 HOPPY*–Cat. X-7243 SUPER STAR BUSTER*–Cat. X-7247 ASTEROIDS*–Cat. X-7248 INTRO TO BASIC–Cat. X-7255 HANGMAN*–Cat. X-7233 MATCHBOX –Cat. X-7231* FINANCIAL RAT* – Cat. X-7263

$12.50 EA

Sky-high action & thrills!

Amazing! Try your hand at Lear Jet* (Cat X-7241) It's fast, furious and lots of fun. **$29.95**

Air traffic controller X-7249 **$19.95**

only $169!

With all the personal computers around these days, you're probably wondering which one is the best value.

Before you buy any computer, take a look at three things: its power (or usefulness), its back-up and its price/future.

The Dick Smith VZ-200 features an 8K Microsoft BASIC, PLUS an additional 8K 'enhancements'. Compare that to the Tandy MC-10! And it has 8K user memory inbuilt: compare that to the VIC 20!

The Dick Smith VZ-200 is backed, of course, by the Dick Smith Electronics organisation. Complete technical and service facilities, program development, etc — all guaranteed.

The Dick Smith VZ-200 sells for only $169 — the first personal colour computer in Australia to sell below $200! There are many other computers now being unloaded around this figure — but be careful! Some companies have already gone broke and others may be drastically reducing prices just to clear dead stock! You could be buying an 'orphan'!

look at these exciting ways to expand your system

Low-Cost **Colour Monitor**

Don't want to tie up the family's colour TV? This high quality, 36cm colour video monitor gives bright, crisp pictures — sound too! Cat X-1195.

$389

NEW Joystick Controllers

AND INTERFACE!

A pair of sturdy, super-responsive joysticks that add a whole new dimension to action games! Cat X-7212.

$39.50

National Cassette Recorder

Get optimum performance from your VZ-200! How? By storing programs and data on this deluxe recorder! This Quality National Cassette Recorder is ideal: Works perfectly with the VZ-200. Cat. A-4093

value at **$55.00**

Want more memory? Just plug this in & you've got it!

16K Memory Module

It couldn't be simpler. Add this module, and expand the VZ-200's RAM memory to a generous 24K! Cat X-7205.

$79

Use a Centronics type printer!

Printer Interface

Lets your VZ-200 talk to almost any Centronics-type printer. Top quality! Cat X-7210.

$49.50

PRICE/TECHNOLOGY BREAKTHROUGH!

Four-colour Printer/Plotter

Don't buy just a printer — here's a fantastic NEW 4-colour printer that's an X-Y plotter as well! Produce graphs, pie charts, printing in many different sizes and colours. It's all so easy to do, using simple commands in your BASIC programs! Cat X-7208

$299

DICK SMITH Electronics

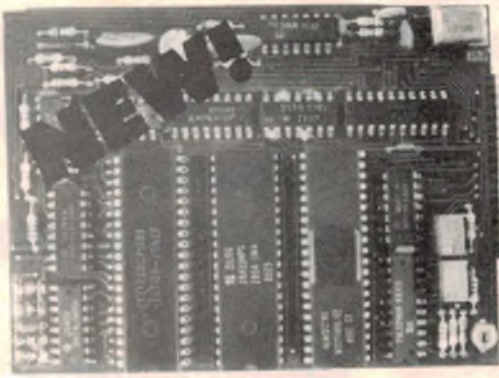
See page 107 for full address details.

A690M/AT

MICROCOMPUTER ENGINEERING

PO Box 258 Haymarket 2001, NSW
Phone (02) 660 2924

UNIVERSAL FLOPPY DISK CONTROLLER CARD



DO NOT THROW AWAY YOUR OLD Z80 BASED COMPUTER

● UFDC is designed to be "piggy backed" to Z80 socket ● suits ANY Z80 CPU based computers ● can support up to four drives in any combination of 5¼, 8 inch, SSSD or DSDD ● design around WD2793 floppy disk controller (on chip PLL data separator, write precompensation logic and programmable clock rate) ● UFDC has got Z80 DMA chip ● matches any speed of CPU and can be used for mem-to-mem transfers ● you can adjust Head Load time and Write Precompensation to your disk drive requirements ● plug compatible with Shugart 400/450 drives ● no interrupt or wait states for programming simplicity ● simple assignment of the UFDC registers to any one of 16 banks of your computer's I/O ports ● full software support ● sample of the CP/M 2.2 BIOS ● dimension 120x90mm

The UFDC has been implemented for Super-80 and System-80 computers using simple DOS. CP/M 2.2 has been implemented for Super-80 computer and supports 80/40 trk DSDD Disk Drives. Reads Telcon 388K Televideo 802 342K, DEC VT-180x 340K, IBM PC, Osborne 90K, 8" IBM 3740 formats and can be expanded. With VDUEB installed emulates ADM-31 terminal.

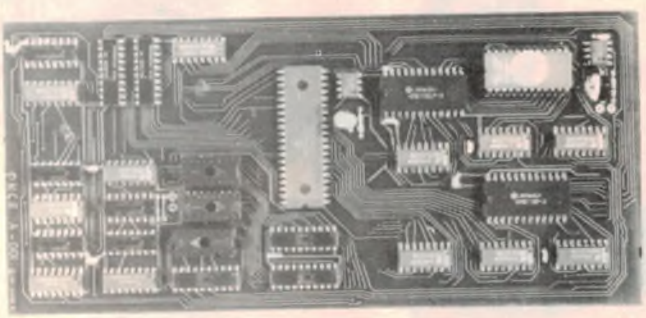
For more information on how to install UFDC on YOUR System, contact M.C.E.

PRICES $299

assembled and tested

$4 P&P

SUPER-80 VDU EXPANSION BOARD



The VDUEB converts your Super-80 into a professional computer. The screen format is 80 x 25 and the raster dimensions are software programmable to 64 x 16, 32 x 16 or any other formats ● full lower and upper ASCII character set ● 32K ROM based graphics char's ● 128 fully programmable character set ● inverse character mode ● 560 x 225 dot addressable graphics ● sound routine for BELL and music ● new Monitor EPROM supplied with 1200 baud cassette interface ● fully compatible with existing BASIC and software.

PRICES **$229** Assembled and tested
$169 Kit form
$99 PCB and EPROMS
$4.50 Manual
$4 P&P

SUPER-80 VDUEB SOFTWARE LIST

● CP/M 2.2 Super-80*	$170
● Super-80 DOS	$10
● Edit-80	$20
● Debug-80	$15
● EXMON monitor	$8
● Z80 Disassembler	$25
● Extended Monitor & Disassem	$10
● Microbee Tape Loader	$5
● Sprite Programmer	$8
● Dot & line graph driver	$20
● PACKMEN	$20
● Super-80 Invaders	$20
● Martian Attack	$8
● Othello	$10
● Adventure (two prog)	$
● Wordprocessors (three prog)	$10-$40
● Graphics tool kit	$15
● Super-80 Chess	$20
● Eng Progr for struc design	$10
● UFDC CP/M BIOS*, only	$70

**Source code of all programs supplied.* ADD $1.00 for P&P.

For more information regarding FREE software and CP/M software please contact MCE or Super-80/VDUEB USER CLUB at 15 Bray Court, North Rocks 2151, NSW. Phone (02) 871 8394.

SWITCHING POWER SUPPLY FOR SUPER-80

● PSA-2B 60VA +5V/6A, −5V/0.5A, +12V/2A, −12V/0.5A	$139.00
● Controller-to-Drive Cable (supports two drives)	$39.95
● Disk Drive Power Supply connectors 8, 5¼ inch	$4.95
● WD2793 disk controller	$76.95
● Z80A DMA	$15.95

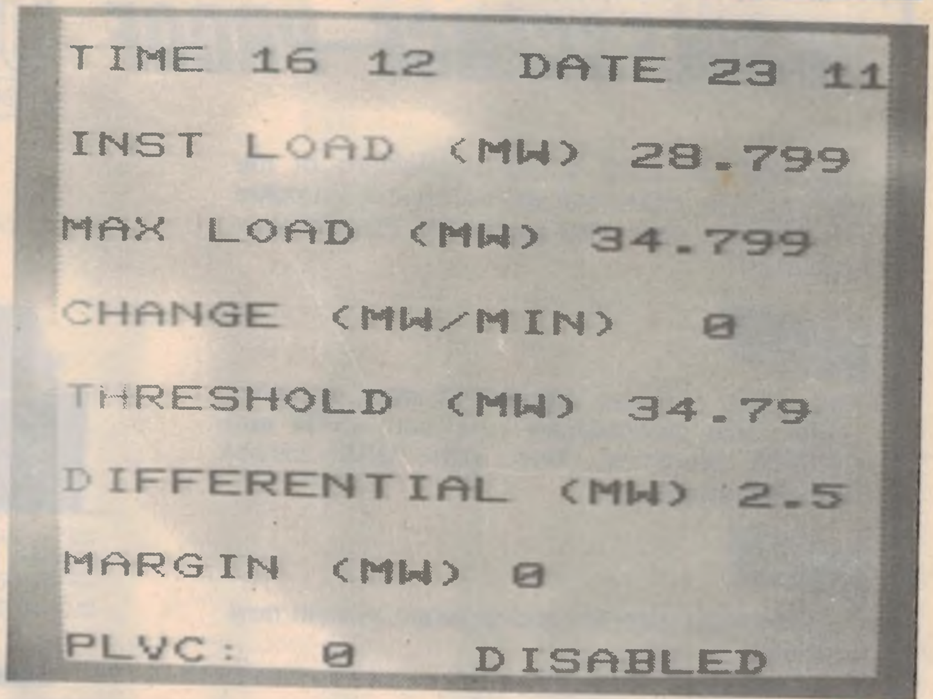
ADD $3 P&P

bankcard welcome here

All Prices Include Sales Tax and are subject to change.
Mail order: MCE, PO Box 258 Haymarket 2001, NSW. Phone order: (02) 660 2924.

Micronews

VIC 20 monitors power consumption



A Commodore VIC 20 computer is being used by the Peel-Cunningham County Council in Tamworth, NSW to monitor and record electricity consumption over the council's entire service area.

A council design engineer, Mr Ron Main, began the project with a VIC 20 he bought for his own use. After expanding the VIC 20 to handle high resolution graphics he wrote a program to display the typical daily load curve of the County Council supply area.

The County Council purchased Mr Main's program, which was then expanded to monitor the total electricity load at 15 minute intervals throughout the day. Mr Ian Webster, a graduate from Newcastle University, assisted with this part of the project.

In addition to graphically displaying the peak demand period for each day, week or month the VIC 20 also stores hourly ambient temperature readings, monitors and controls the load for controlled emission space heaters, controls off-peak hot water systems, monitors substation and customer meters and provides a bulk supply financial system, at a total cost of just over $1000.

The VIC 20 system consists of a disk drive, video monitor, dot matrix printer and a plotter.

New software package for Comemco C-10

Adaptive Electronics Pty Ltd recently announced the C-10 MP, a package which combines hardware and software developed by Cromemco with software from MicroPro International.

The C-10MP system combines the C-10 computer (reviewed in EA, August 1983) with MicroPro's WordStar, InfoStar, CalcStar and Mailmerge in addition to Cromemco's Write Master, PlanMaster, MoneyMaster, Structured Basic and the CDOS operating system. Each of the programs is provided with on-screen menus to select particular operations while more experienced users can customise the menus or bypass them altogether.

Also available is a software package which converts the C-10SP to an MP system. The C10SP will continue to be offered and is not affected by the announcement of the C-10MP.

Adaptive Electronics has also announced the availability of a new keyboard for the C-10 systems. The Model CKBC expanded keyboard provides a Selectric-style layout, a numeric pad and 20 special purpose function keys. Features of the keyboard design include a low profile, adjustable tilt and a convenient palm rest.

For further information on the C-10MP system contact Adaptive Electronics Pty Ltd, 418 St Kilda Rd, Melbourne, 3004, (03) 267 6800.

News from the clubs

- The Illawarra Microbee Computer Club meets on the fourth Monday of each month at the Wollongong Institute of Education, Norfields Ave, Gwynneville, at 7.30pm. The club has been meeting for around six months now, with an average attendance of 40 people per meeting.

For further information contact the club organiser, Ronald Read, Illawarra Microbee Computer Club, C/- 49 Beatus St, Unanderra, NSW, 2526. Phone (042) 71 2384.

- A Beenet, BBC and Econet Users Group meets on the last Monday of each month for discussions of various aspects of networking using the BBC and Acorn computers. The group also publishes a monthly newsletter and maintains a library of public domain software. Further information is available from the group at PO Box 262, Kingswood, SA, 5062.

- A new club for users of Commodore computers has been formed in Hobart. Membership fees of the Commodore Users Association are $10 per year, with associate membership for $7 (if you use some other type of computer) and $3 per year for students.

Further information is available from Vincent Staggard, GPO Box 391D, Hobart, Tas, 7000.

- The Macarthur Computer Users Association meets at 7.30pm in the library of Airds High School, Briar Rd, Campbelltown, on the first Monday of each month. The club is not oriented towards any specific machine, with most popular models represented.

Further information is available from the club secretary, Mr J. Napier, 23 Athel Tree Crescent, Bradbury, 2560. Phone (046) 26 1625.

- The Sorcerer Users Group of South Australia has members in all states as well as New Zealand and Canada. Information is available from the secretary, Don Ide, 14 Scott Rd, Newton, SA, 5074.

- The Adelaide Micro Users Group Inc publishes a monthly newsletter full of tips and advice for the users of Tandy compatible computers. The latest issue includes details of meetings, Basic and assembly language programming tips and Tandy Color Computer items.

Their latest venture is a dial-up bulletin board, accessible at very reasonable rates. Contact the secretary, 36 Sturt St, Adelaide, SA, 5000.

50 & 25 YEARS AGO

"Electronics Australia" is one of the longest running technical publications in the world. We started as "Wireless Weekly" in August 1922 and became "Radio and Hobbies in Australia" in April 1939. The title was changed to "Radio, Television and Hobbies" in February 1955 and finally, to "Electronics Australia" in April 1965. Below we feature some items from past issues.

March 1934

Electrical & Radio Exhibition: From 28 February to 10 March the Sydney Town Hall was the venue for this annual event. A total of 44 stalls was listed with everyone from the ABC to "Wireless Weekly" having something to show the public.

Apart from endless receiver displays, vacuum cleaner demonstrations, etc, the ABC had a working studio feeding their regular programs to air, and the PMG were offering free calls via the recently introduced Sydney-London radio telephone service. It was the industry event of the year and a good time was had by all.

☆ ☆ ☆

"ATTEN — wait for it — SHUN": Another use for loudspeaker equipment is on the parade ground; where they are drilling deep, it seems, the men at the rear tend to move a second or so behind the order; this is because the sound takes time to travel. But at Poona, on January 1, they connected loudspeakers by underground cable to the microphone of Colonel Spring, and drilled 3000 troops in "perfect synchrony".

☆ ☆ ☆

Pedal power in New Guinea: Advice received by Amalgamated Wireless from New Guinea indicates that surprising results have been achieved with a small transmitter recently manufactured by Amalgamated Wireless for use in the wilds with power supplied by a native "boy". This transmitter has proved capable of sending spoken communications for a distance of 350 miles, the transmission having been received by the wireless operator on the motor vessel Macdhui at sea.

The transmitter was developed for demonstration purposes in New Guinea and Papua. The whole equipment weighs only 200lb, including a bicycle-like framework upon which a native "rides", thus providing the required power. It can be carried, in sections, into the roughest country, and will no doubt prove valuable, not only to the Administrators of the Territories, but also to private pioneering enterprises, in search of gold or trade.

☆ ☆ ☆

When five metres was really short: An important study of ultra-high frequency radio waves transmitted at intervals of 500ft from ground level to a height of nearly four miles above Boston, began on November 1, with a daily broadcast on a wavelength of five metres from the weather research aeroplane of the Massachusetts Institute of Technology.

The primary object of the radio wave study is to learn more about the behaviour of very short waves transmitted from known altitudes up to 20,000 feet, the ceiling of the 'plane. The investigation is considered by the American Radio Relay League to be the most important of its kind ever attempted, and all amateur radio operators in the USA and Canada have been notified to listen for the broadcasts and report reception conditions.

March 1959

Twenty years old: In this month's editorial John Moyle reminded readers that, with this issue, the magazine in its monthly format completed its first 20 years of publication but that, in the "Wireless Weekly" format, it went back to 1922.

In concluding the editorial he expressed the hope that he would still be around to celebrate our 40th birthday. Tragically, it was a vain hope; John Moyle passed away almost exactly one year later, in March 1960.

☆ ☆ ☆

Valves make a last ditch stand: Radical changes in local car radio design are certain with the introduction to this country of valves designed for operation with a plate supply of 12 volts. These valves are suitable for the RF, mixer, IF and early audio stages of car radio receivers.

They are intended to be used in conjunction with one or more power transistors, the latter also operating directly from the car's supply and driving the loudspeaker.

Several manufacturers are at present turning out "hybrid" valve-transistor receivers which, in general, use four of the low voltage valves plus two transistors.

Components saved by this system are the vibrator, vibrator transformer, filter choke, filter capacitors and high frequency filter components.

☆ ☆ ☆

Proton beam brain operation: A team of five Swedish and one Scottish doctor performed a brain operation in which there was no knife and no anaesthetic at the Gustaf Werner Institute for Nuclear Chemistry last December. The patient suffered from acute pain and depression, and less than half a cubic centimetre of tissue in an insensitive portion of the brain had to be destroyed. Forty radiations from a proton beam, directed at different angles by rotating the operating bottle, were made, and the patient was conscious all the time. The theatre is 65ft below the ground, and during each radiation a team of doctors sat watching the patient on a TV set.

☆ ☆ ☆

Even before the energy crisis: The power which the Sun pours into the Earth in the form of heat is tremendous and, because it involves no outlay on our part, presents many advantages as a source of power. Unfortunately the structures required to use the sun's power are large and awkward, but results can be spectacular. The apparatus described can produce enough heat to melt bars of steel.

Information centre

VECTOR GRAPHICS: Is it possible to modify a small black and white television set so that, via suitable digital-analog converters, the X and Y deflection circuitry of the set can be controlled by a computer?

This, together with the same sort of thing on the beam control, could make up a very cheap vector graphics device for any computer with the resolution limited only by the number of bits you can put through the DACs.

The vectors, points, beam intensity, refresh etc can either be handled by a program in the computer or else a specialised "black box" with a cheap CPU, EPROM and RAM could act as a slave to the main computer. This could then be programmed by the main computer with pseudo code for vectors, segments and whatever without burdening the main computer with refreshing tasks.

Commands and data could be sent or received from this DPU (display processing unit) by a single port like a Centronics port and would thus be almost universally usable. I've already tried using an oscilloscope by the X and Y inputs but have had limited success because of the small screen. (P.P., Lethbridge Park, NSW).

● Unfortunately it is very difficult to make the magnetic deflection circuits of a TV set respond to signals other than the 50Hz and 15625Hz for which they were intended. Some large screen oscilloscopes have been produced commercially in the past by firms such as EMI and BWD but the bandwidth of these instruments was quite limited.

The only satisfactory way of using a TV set as a "plotter", which is what you are attempting to do, is to use it in the way all personal computers do. The computer "sees" the TV screen as a memory map which is a grid of so many picture elements or pixels as they are called. Have a good look at the article entitled "High resolution graphics display" in last month's issue.

CAR COMPUTER: Recently I purchased a Dick Smith Car Computer kit which, when installed in the car, works well except for the fact that every time I switch off the ignition the memory data is lost. Also, when switched on again, the LEDs and display digits all come on together. I have to turn the ignition switch off and on a few times to get the display to read 'REDY'.

As your column has helped me before I was hoping you may have the answer to my problem (A.R., Slade Point, Qld).

● Our Notes and Errata cover your problems. The required modifications are as follows: Due to low activity crystals being supplied with some kits, the computer powers up incorrectly when the ignition voltage is applied. This is due to the Reset occurring before the crystal starts to oscillate. A possible solution is to connect a 10MΩ resistor across each 27pF capacitor to ground. Alternatively a 10MΩ resistor across the crystal can aid the starting. The 0.1μF capacitor at pin 9 of IC5c can be increased to 0.47μF, giving a longer Reset time for very slow-to-start crystals. Specifications for the correct crystal are: 3.579545 MHz AT-cut parallel resonant, Co=7pF, CLoad=20pF, R1=500Ω

A 10kΩ resistor should be connected from pin 9 of IC6c to ground to keep CB2 low after the Reset and before it is driven high. This ensures that the NMI does not occur before all initial

Building the Sync-a-Slide:

SYNC-A-SLIDE: I am intending to make several "Audio Visual" slide shows of my recent travels and to this end have recently purchased a photocopy of an EA article entitled "The Sync-a-Slide automatic slide advance" (June 1976).

Upon reading the article I find some aspects of the circuitry confusing. It does not seem to be as well written nor descriptive as I have come to expect from your usual constructional articles. Can you elucidate please?

First question (see p56, 3rd last par): "The transition time of the output is slowed by the 100kΩ resistor and 0.1μF capacitor". Where are these? I guess that the 47kΩ resistor and 1μF tantalum capacitor might do this job; if so which values are correct?

Second question, p57 first paragraph: Why would you need to have the Sync-a-Slide connected to the tape recorder monitor output whilst recording the tone? I assume that this is where the tone (plus incidental audio) is supposed to be extracted when playing back. My recorder is a National mono portable cassette tape recorder having "mike in", "aux in" and "monitor 8-ohm" jack sockets. When a monitor output is taken from the "monitor" output when playing back, the jack switches the speaker off so that the only output is via the monitor output.

Surely an output from across the speaker leads would be more appropriate? This would allow the commentary and tone signal to both be utilised. Correct?

Third question: No information is given as to the use of the knob on the front panel and I can only guess it is attached to a pot which I assume varies the recorded pulse frequency.

Why do you need to vary this frequency if the stated 60Hz is suitable and how does one know later on when actually showing the slides with commentary which frequency was chosen? This, I assume, would need to be very accurately reset (without the assistance of any sort of readout or even a graduated scale).

In addition it seems bad practice to have a large protruding knob which could easily be knocked off its setting. It would seem that a screwdriver type of pot flush with the front panel or a trimpot would be better if a pot is needed at all.

Fourth question: although I have an electrical background and a reasonable hobby-type knowledge of electronics, I cannot fathom out what connections are required from the Sync-a-Slide unit to the input of the tape recorder. My mono cassette recorder has a 200Ω dynamic mike and a "mike" input impedence of 10kΩ, not 20kΩ as stated in the article, which will obviously alter the 50mV tone voltage available.

The three leads from the PC board are labelled "E, Hi, Lo and Cue Tones." The schematic has the hi and lo marked 50mV and 1mV respectively (presumably RMS tone voltage), and is all labelled "Mic level cue tones to recorder". Why does one need a high and low output? 50mV seems like an enormous signal to feed in at microphone level. Where do these conditions have been set, and will prevent data loss at switch-on.

We hope that with these modifications, your problems will be solved.

BREAKERLESS IGNITION: In reference to your article "Breakerless Ignition using Sparkrite Contactless Trigger", by John Clarke. I have a Ford V8 with Motorcraft distributor and as far as I am aware there is no magnetic rotor available for V8 motors. But being determined to fit my vehicle with contactless ignition, I have considered at least two options as follows:

1. Using the magnetic rotor intended for 4-cylinder engines and two Hall effect triggers in parallel, one located at 0°-360° and the other at 135° or 225° depending on cam rotation. It would be necessary to adjust the value of the 18Ω resistor which I cannot do without assistance.
2. Using the magnetic rotor intended for 4-cylinder engines and two Hall effect triggers and the associated two interface circuits and operating these in parallel. It would be necessary for me to manufacture a bracket on which to mount two Hall effect devices and then mount this in place of the points. (F.M., Woodville, SA.)

● We would prefer your second method for using two Hall effect sensors. The circuit of the transistor ignition should be duplicated for the second Hall effect sensor up to and including the BD139 transistor, Q3. Connect the collectors of the BD139s together. This will provide a wired OR function. In other words when either Hall effect sensor goes high one BD139 is on which turns off the BUX80 via Q4. The ignition coil then fires.

When installing the magnet ring and Hall sensor, note that each Hall sensor must be located centrally to its respective ring magnet. In other words, one Hall effect sensor will need to be mounted higher on its bracket to line up with the higher mounted ring magnet.

Better still, if you wait a couple of months you can use the V8 version we are working on.

Electronics Australia Reader Service

"Electronics Australia" provides the following services:

PHOTOSTAT COPIES: $3 per project, or $6 where a project spreads over multiple issues (price includes postage). Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries. We reserve the right to supply complete back issues instead of photostats, where these are available.

CHASSIS DIAGRAMS: For the few projects which require a custom metal chassis (as distinct from standard cases) dyeline plans showing dimensions are normally available. $3 including postage.

PC BOARD PATTERNS: High contrast, actual size transparencies: $3, including postage. Please specify positive or negative.

PROJECT QUERIES: Members of our technical staff are not normally available to discuss individual projects, either in person at our office, or by telephone.

REPLIES BY POST: Limited to advice concerning projects published within the last three years. Charge $3. We cannot provide lengthy answers, undertake special research, or discuss design changes. Nor can we provide any information on commercial equipment.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" or submitted without fee may be answered in the "Information Centre" pages, at the discretion of the Editor.

COMPONENTS: We do not sell electronic components. Prices and specifications should be sought from advertisers or agents.

BACK ISSUES: Available only until our stocks are exhausted. Within six months of publication, face value plus 30c for post and packing for each issue. Seven months and older, $3 (includes post and packing and storage fee).

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Chippendale, 2008.

outputs go to on the tape recorder?

If to the "mike" input jack, where does the microphone go? I would appreciate your help in interpreting the article before actually beginning its construction. (N.W., Peakhurst, NSW).

● We'll answer each of your questions in the order set out in your letter.

1. Transition time of output — the values should have been given in the text as 47kΩ and 1μF (not 100kΩ and 0.1μF). The actual values are probably not all that critical so we suggest that you use values shown on circuit.

2. You are correct in assuming that the tones (plus incidental audio) are extracted from the tape recorder monitor output during playback, although it is not necessary to have the monitor output connected to the Sync-a-Slide while recording the tones. Transistor TR2 simply saves you the trouble of having to fiddle around with cables once the system is set up.

The "Monitor 8-ohm" socket on your tape recorder is not really a monitor socket at all but, more accurately, an external speaker socket. You can solve your problem by extracting the output from the speaker terminals as you suggest. Note that it is desirable to insert a limiting resistor (say 1kΩ) in series with the Sync-a-Slide input to prevent damage to the input transistor (TR1).

3. The knob on the front panel was used with a potentiometer to allow easy selection of the tone frequency. In practice, a trimpot is probably the best way to go (as shown on the parts overlay diagram). Once set, it would probably require no further adjustment.

4. The 1mV signal output from the Sync-a-Slide is connected to the microphone input of the tape recorder (forget the 50mV output). All you have to do is connect it in parallel with the microphone. If loading proves a problem, try reducing the 47kΩ resistor in the output voltage divider network.

MISLEADING ANSWERS: In reading the December issue of EA I noticed two answers in your Information Centre which I felt could be most misleading. First, in answer to the question "Dwell Extender" you state " 'reactive discharge ignition systems . . . are merely a transistorised ignition system with a fancy name' ". It would have taken very little research to indicate that this is not the case at all. There are two "reactive discharge" systems presently on the market, the SX2000 and the TX2001, produced by Electronic Design Associates.

The two systems are electronically identical except for the fact that the TX2001 employs the Hall-effect trigger that you have appropriated for your own system. Far from being transistorised (or "inductive discharge") systems, they are modified CDI systems. On a scope, both produce the typical strong, fast rise time, negative-going pulse of CDI. Where they differ from CDI systems is that the negative pulse is followed by a postive ramp, giving a very extended spark duration.

In this way they do provide all the benefits of both systems — the ability to fire fouled plugs inherent in CDI operation, without the misfire problems associated with CDI systems on many modern engines. They also possess the potential problem of all CDIs — crossfire on some engines. In this last respect they do seem less troublesome than many CDIs; a rally Rover SDI (V8) was running in the UK two or three years ago using an SX2000 without any problems.

The second misleading answer is to the question on the sub-woofer enclosure. The first suggestion of splitting the tube into shorter lengths cannot be applied in any simple way, as your answer suggests. By doing this, you will automatically increase vent size, thereby making the necessary port length longer. The problem simply reappears. The only way to make that solution workable would be to use two smaller diameter parts, which would still run the risk of turbulence effects.

Siting the vent in another face is the most practical answer and while you do give it, your answer is so vague as to make it very easy for C.L. to underestimate the potential difficulties in either of his other suggestions. (P.M., Toowong, Qld).

● Aren't we simple souls? Fancy thinking that no company would be devious enough to call a CDI system a reactive discharge system. You're right of course, as we have since found out. In fact we now have a copy of the EDA Sparkrite TX2002 circuit which incorporates both reactive and inductive discharge circuits. The inductive circuit is a conventional transistor assisted ignition system while the reactive circuit is a modified CDI system, as you suggest.

Our answer on the sub-woofer enclosure had an important proviso: that any one of the reader's suggested solutions must enable the box to be tuned to the correct frequency. Familiarity with the maths involved, such as the articles by Brian Davies on enclosure design in August, September and December 1981 referred to by C.L., would indicate that splitting the tube would require smaller diameter tubing to be used. This is sometimes done in commercial practice.

While our answer to the reader may seem vague to you we take into account the knowledge exhibited by the reader in framing an answer. Our aim is to give enough information to help sort out a particular problem. If we give long and detailed answers to every letter then fewer letters can be handled.

RADIO RECEPTION PROBLEMS: I am a caravan owner and I and any number of caravanning friends have trouble with interference to radio reception when using 12V fluorescent lights from the car battery. The trouble seems to be the fact that the inverter chops, the DC, giving rise to very fast rise times and a wide range of radio frequencies.

I have tried all sorts of filters and even an outside shielded aerial, all to no avail. Is there some easy answer, or could an inverter be designed with a sine wave output? (N.W., Peakhurst, NSW.)

● Listening to the radio in a caravan is fraught with problems at the best of times. For a start the caravan itself acts as a Faraday shield so that any signals which do get to the antenna of a portable radio will have been drastically attenuated. This means that the interference signals produced by the fluorescent light have an unfair advantage because they are produced within the caravan.

Using an inverter with a sine wave output would not help at all because even if the voltage waveform is a sine wave the current waveform will definitely not be. The fluorescent tube can be regarded as a voltage limiting device, operating at a 100 volts or so in either direction.

So regardless of whether the driving voltage is a sine wave or not, the current waveform will have fast rise and fall times and there will be hash from the discharge superimposed on it. Adding a capacitor across the fluoro tube can sometimes effect a partical cure, depending on the particular tube. But whatever you do, you are really up against it when using fluorescent lights.

One solution, which may not be aesthetically appealing, would be to make up a wire mesh cage for the fluoro fixture which would then be earthed to the caravan chassis. If you used the square mesh intended for aviaries it might not look too untidy and may just do the trick. But there is still the problem of the shielding effect of the caravan body, as far as the radio is concerned.

To solve this you need an external antenna (ie, outside and on top of the caravan) with a shielded cable to the radio. Again the shield would have to be connected to the caravan body to be effective.

APPLE INTERFERENCE: I have an Apple computer with disk drives, monitor and so on which works fine. Recently I purchased a cordless telephone from Dick Smith Electronics (cat no Y-1190) and have found that it is useless to use the phone while the computer is turned on as the interference generated by the computer makes the phone go haywire. I can neither make or receive calls.

I have tried insulating the computer's power supply, power cable and circuitry with ferrite cores, metal plates and so on but have had no luck stopping the interference. Can you help me? (D.H., Toowoomba, Qld.)

● The way of solving this problem is to shield rather than "insulate" the computer. The idea is to prevent any interference signals from being radiated from the computer gear. Unfortunately, this means you have to shield the computer; its power supply, disk drives and even the monitor.

This task may be so difficult to do properly that it may be easier to simply disable the phone while you have the computer running. A somewhat less drastic solution may be to keep the phone base unit and handset well away from the computer. We agree that neither of these solutions may be very attractive.

An idea of what will be required to shield your computer may be gained from an article we published in August 1982 entitled "RFI shielding for the System-80". Back copies are available from our Information Service at $3.00.

It may also be a good idea to discuss the problem with your local Apple distributor. They may well have come across this problem before and may have worked out a solution.

How to generate TV sub-titles:

TV SUB-TITLES: Your article "Crystal Locked TV Pattern Generator" (EA November 1983) by John Clarke is very close to a topic that has been in my mind for a long time, that is how to do subtitles on a TV picture as often seen on Channel 0/28.

For this to happen we need basically a phase-locked clock, a character generator and suitable gating circuits. I would be very interested if you could give me some advice on how to realise the project. (N.K., Cabramatta, NSW).

● From the diagram included with your letter we assume that you would want to use a sub-titling set-up in conjunction with a VCR and video camera. In fact, the circuitry of a character-generating unit is very close to that of a typical personal computer although the large character format required would have to be stored in a custom EPROM or produced by a special program. In fact, most personal computers could be made to do the job, but for one constraint.

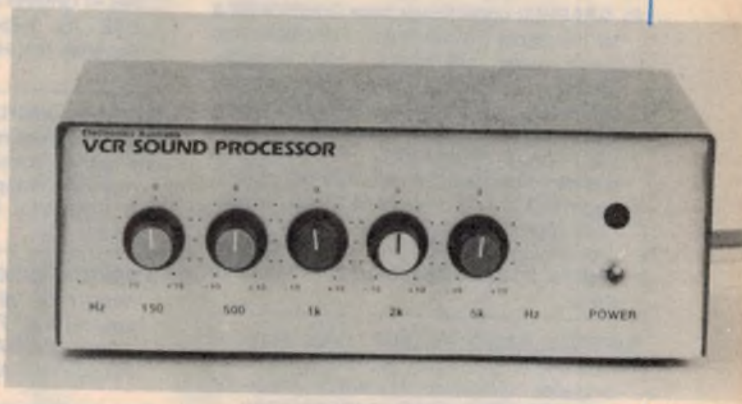
Some VCRs would be able to satisfactorily record and playback the video signal from a typical personal computer although this would vary depending on which VCR and which computer was used. But the moment you wish to mix a sub-title signal over a signal from a camera you have several problems.

The format of the computer's sync and blanking pulses in its composite video is likely to be quite a lot simpler than that from a typical video camera, even those that do not have interlace. And the two signals will not be synchronised.

That is one of the reasons why the character-generators used in TV studios are so expensive. They conform to broadcast standards in their sync and blanking and they can be locked to a master sync generator.

So, you need a computer which can be locked to an external sync generator and you need a video mixer with its own master sync generator. For the present that is a pretty tall order.

Next month in * Electronics Australia



VCR Sound Processor

Give the sound from your VCR a lift with this new easy-to-build VCR Sound Processor. A stereo simulator turns the mono sound into pseudo stereo; a 5-band graphic equaliser lets you adjust the sound exactly to your liking; and low-pass and notch filters get rid of the nasty high frequency noise so common on videocassette sound tracks.

Versatile LCR Bridge

If you're really involved with electronics, the new LCR Bridge introduced this month will prove indispensable. Part 2 provides the circuit and gives the full construction details.

Bonus 1984 Dick Smith catalog

Plus:

Phase Linear compact disc player reviewed; Op Amps Explained, Pt 2; a look at a Qantas 747 simulator; plus all our regular features.

*Although these articles have been prepared for publication, circumstances may change the final content. However, we will make every attempt to include the articles featured here.

Subscription Offer Prizewinner

The EA special subscription offer sent out exclusively with Dick Smith's November 1983 mailer has proved to be very successful. Our thanks to all those readers who took advantage of the offer. The winner of the Fluke 77 multimeter was Mr I. Avery, Kiama 2533.

EA marketplace EA marketplace

FOR SALE

EL GRAPHIX: upper/lower case Graphics Kit 4 for the Super-80 computer. Full Upper and Lower case characters, 160 versatile graphics characters, nine new monitor commands, Graphics subroutines built in, Centronics AND RS232 routines built in, VDU page Dump/VDU shift/rotate/fill routines. Complete kit only $55.50 inc p/p, upgrade kits 1, 2 or 3 only $25.00 inc p/p, even upgrade Dicks "Deluxe" kit $27.50 inc p/p. El Graphix, PO Box 278, Croydon, Victoria, 3136. Phone (03) 725 9842 (after 7pm).

VINTAGE RADIO VALVES: Huge range of new and unused many pre-war types, trade enquiries welcome. Macarthur Radio-TV. Katoomba NSW, 2780. (047) 82 1722.

SUPER 80 SOFTWARE: Large range of Super 80 games with sound. Latest program "Scrambles" similar to arcade game scramble. For detailed list write to Matrix Software, 140 Doncaster Ave, Kensington 2033.

SPECTRUM SOFTWARE: UK and Aust. Bargain prices. Also custom programming service. Send SAE for details. Softpac Enterprises, 109 Kennedy St, Sth Hedland, WA 6722.

SUPER 80 SOFTWARE: Caterpillar $14.95 — specify normal or El Graphix 4, Renumber $9.50 — suits 16K +, El Draw $10.95 — req El Graphix 4. All in M/C. Send order, or SAE for information, to Mastersoft, 6 Beverley Crt, Heathmont 3135. P&P $1.50.

LINEAR AMPLIFIER: 2-30MHz, 3.5kW output, latest model Clippertron, high quality amplifier, accepts 5 to 100 watts RF, auto matching complete with power meters, etc, $1200 ono. Phone: 331 5809 or 331 3791.

AMIDON FERROMAGNETIC CORES: Large range for all receiver and transmitter applications. For data and price list send 105 x 220 SASE to: R. J. & U.S. Imports, PO Box 157 Mortdale, NSW 2223.

READER SERVICE

BUILD YOUR OWN: Microcomputer circuits using Z80 chip at lowest possible cost. Full details and circuits in easy to read book with monitor PROM able to run hex keypad and eight digit LED display. Book and monitor PROM $30. RKO Electronics, PO Box 219, Springvale 3171.

COMPUTER CLINIC PTY LTD: Repairs and services small business and personal computer systems, disk drives and printers. Bankcard. (07) 269 8573, PO Box 68, Aspley, 4034.

BUSINESS FOR SALE

TWO WAY RADIO AND MARINE ELECTRONICS

including 3 Community Bases.

Expanding business showing good figures and potential on Qld's Sunshine Coast.

$40,000 W.I.W.O.

Phone or write: Noosa Two Way & Elect, (071) 49 7999, Eumundi Rd, Noosaville 4566.

DISPLAY ADVERTS IN MARKETPLACE are available in sizes from a minimum of 2cm x 1 col rated at $15 for a col cm.

CLASSIFIED RATES $3.60 for 40 letters or part thereof per insertion payable in advance. Minimum 80 letters.

CLOSING DATE is six weeks prior to the on-sale date. Issues are on sale the first Wednesday of each month.

EPROM COPYING SERVICE: Reliable, fast and confidential service. All standard EPROM types from 2KB to 16KB. Also Hex-Code printouts available. Rates (plus postage); $1.40/$2.40/$4.00/$6.40 for 2/4/8 or 16KB EPROM copy. Printouts at half these rates. Single and bulk orders welcome. Contact Helmut, ph (03) 561 7416 any time.

WANTED

THANKS: To everyone who phoned re circuit for an AWA Radiola 715-CZ regards, Gary Brooker.

New Personal Computers. . . ctd from p9

and the other for graphics. A terminal emulation program, Pascal and Logo languages and an Assembler/Debugger will be introduced by Apple later this year.

Currently more than 100 companies are working on developing software and hardware accessories for the Macintosh, according to Apple. The popular Lotus 1-2-3 integrated business package will be available, together with a customised version of Microsoft's Multiplan spreadsheet.

The basic Macintosh hardware includes a detachable keyboard and a main unit, which houses a 22.9cm (diagonal) black-on-white video display, a MC6800 central processor, a 7.5cm microfloppy disk drive, two serial ports and sound and speech synthesisers, 64k of ROM and 128K bytes of RAM support the software.

The built-in microfloppy drive uses plastic-encased disks which each provide 400K bytes of storage. A second disk drive can be added externally. Apple's Lisa 2 computers also use the 7.5cm disk drives, so the new Lisa can also run Macintosh programs.

According to Apple, the Macintosh was designed to be manufactured "by the millions" to meet the anticipated high demand. A specially designed factory has been built in California. It uses a high degree of automation which allows one Macintosh to be produced every 27 seconds.

EA Magazine Holders

The binders and magazine holders are available over the counter from Electronics Australia, 57 Regent Street, Sydney, NSW — Price: $5.10 binders, $4.50 holders.

Mail orders should be sent to Electronics Australia, PO Box 163, Chippendale, NSW 2008.

Prices including postage are:

Holders: $5.50 NSW; $5.60 other states: or six for $29.00 NSW; $31.50 other states, $A33.00 NZ.

Binders: $7.00 NSW; $8.50 other states: or six for $33.00 NSW; $36.00 other states, $A37.00 NZ.

EA PC BOARDS AND FRONT PANELS

Some readers have problems obtaining PC boards and front panels for projects. Many of our advertisers sell these items and their advertisements should be checked in the first instance. Failing that, below is a list of firms which produce or sell PC boards and front panels.

NSW

Jaycar Electronics
117 York Street,
Sydney 2000.
Telephone 264 6688,
267 1614

Cnr. Carlingford & Pennant Hills Road,
Carlingford 2118.
Telephone 872 4444

115-117 Parramatta Road,
Concord, 2137.
Telephone 745 3077.

121 Forest Road,
Hurstville 2220.
Telephone 570 7000

Radio Despatch Service,
869 George Street,
Sydney 2000.
Telephone 211 0816.

RCS Radio Pty Ltd,
651 Forest Road,
Bexley, NSW 2207.
Telephone: 587 3491

VIC.

Rod Irving Electronics,
425 High Street,
Northcote, 3070.
Telephone 489 8131.

48 A'Beckett Street,
Melbourne 3001.
Telephone 347 7917
347 9251.

Kalextronics,
101 Burgundy Street,
Heidelberg 3084.
Telephone 743 1011.

Shop 11,
Regional Shopping Centre,
Melton 3338.
Telephone 743 1011.

Sunbury Printed Circuits,
Lot 14, Factory 3,
MacDougal Road,
Sunbury 3429.
Telephone 744 2714

WA

Altronics,
105 Stirling Street,
Perth 6000.
Telephone 328 1599.

Jemal Products,
5 Forge Street,
Kewdale, 6105
Telephone (09) 451 8726

N.Z.

Marday Services,
PO Box 19 189,
Avondale, Auckland.

Mini Tech Manufacturing Co Ltd,
PO Box 9194,
Newmarket.

Printed Circuits Limited,
PO Box 4248,
Christchurch.

SUBSCRIPTION SERVICE

ELECTRONICS Australia

Subscription Rates

$29.00 per year within Australia

$31.00 per year elsewhere

Make sure you receive every copy of the magazine by ordering it from your newsagent or the publisher. For publisher subscriptions post this coupon, with your remittance to Electronics Australia Subscription Dept, John Fairfax & Sons Ltd, GPO Box 506, Sydney 2001. Subscription will start with first available issue.

Name ....

Address ....

Postcode .... **Enclosed is** .... **for** .... **years**

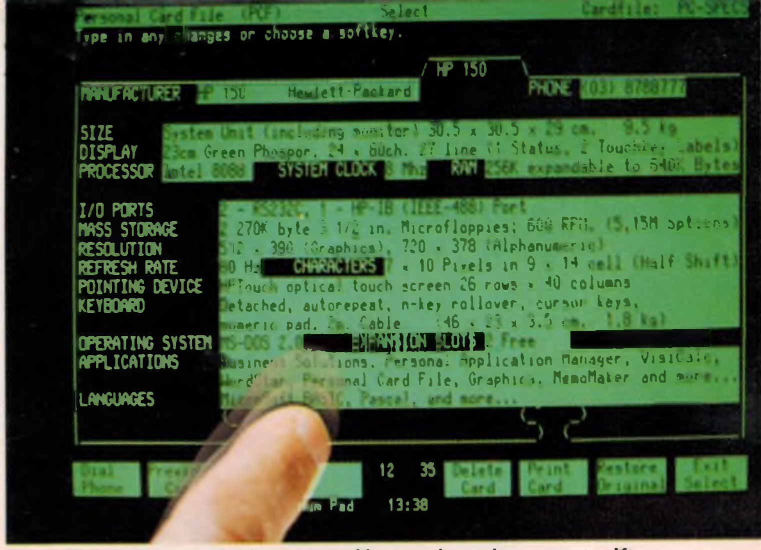
ADVERTISING INDEX

AN INTRODUCTION TO

DIGITAL ELECTRONICS

Electronic equipment now plays an important role in almost every field of human endeavour. And every day, more and more electronic equipment is "going digital". Even professional engineers and technicians find it hard to keep pace. In order to understand new developments, you need a good grounding in basic digital concepts, and An Introduction to Digital Electronics can give you that grounding. Tens of thousands of people — engineers, technicians, students and hobbyists — have used the previous editions of this book to find out what the digital revolutions is all about. The fourth edition has been updated and expanded, to make it of even greater value.

Available from "Electronics Australia", 57 Regent St, Chippendale. **PRICE $4.50** OR by mail order from "Electronics Australia", PO Box 163, Chippendale, 2008. **PRICE $5.40.**



The HP150 computer can be operated by touching the screen itself!

Now "touch-screen"- more power to Uncle Conrad's little finger.

Using a computer–even a so-called personal computer–is by no means second nature to an executive. The key-board itself can be a barrier to many.

Hewlett-Packard's advanced technology has overcome this barrier for you. The remarkable new 16 bit HP150 desk top computer with its MS-DOS operating system can actually be worked by touching the video screen with your finger.

Touching aids your productivity

Even Uncle Conrad; who has already been using computers to great advantage in his business; can improve performance with an HP150.

He now has, on his own desk, a powerful computer capable of running a wide variety of practical software. It can produce reports, spread sheets, forecasts, payrolls and confidential data which he alone needs to access rapidly.

The "touch-screen" has enormous advantages.

Your instincts increase performance

From infancy we learn to point at those things we wish to control, or bring to notice. How often have you heard the phrase "I would like to point out..."

This "pointing" instinct inspired Hewlett-Packard designers to create a computer which truly deserves the adjective, *personal*.

The ability of the HP150 to respond when you simply touch the screen gives rapid access to information more easily than you ever thought possible.

Power on your desk

The HP150 system is compact and takes up very little space on your desk.

You can operate the system via the keyboard *and or* by touching the screen itself. The degree to which you use either depends on personal preference, and the software involved.

Touching is believing

To understand how close you are to using a truly *personal* computer, test drive the HP150.

Telephone Hewlett-Packard on one of these numbers to find the HP computer dealer most convenient to you.

Sydney: 888 7202
Melbourne: 878 8777
Adelaide: 272 5911
Perth: 383 2188
Brisbane: 30 4133
Canberra: 80 4244

Keeping industry, business and Uncle Conrad in touch.

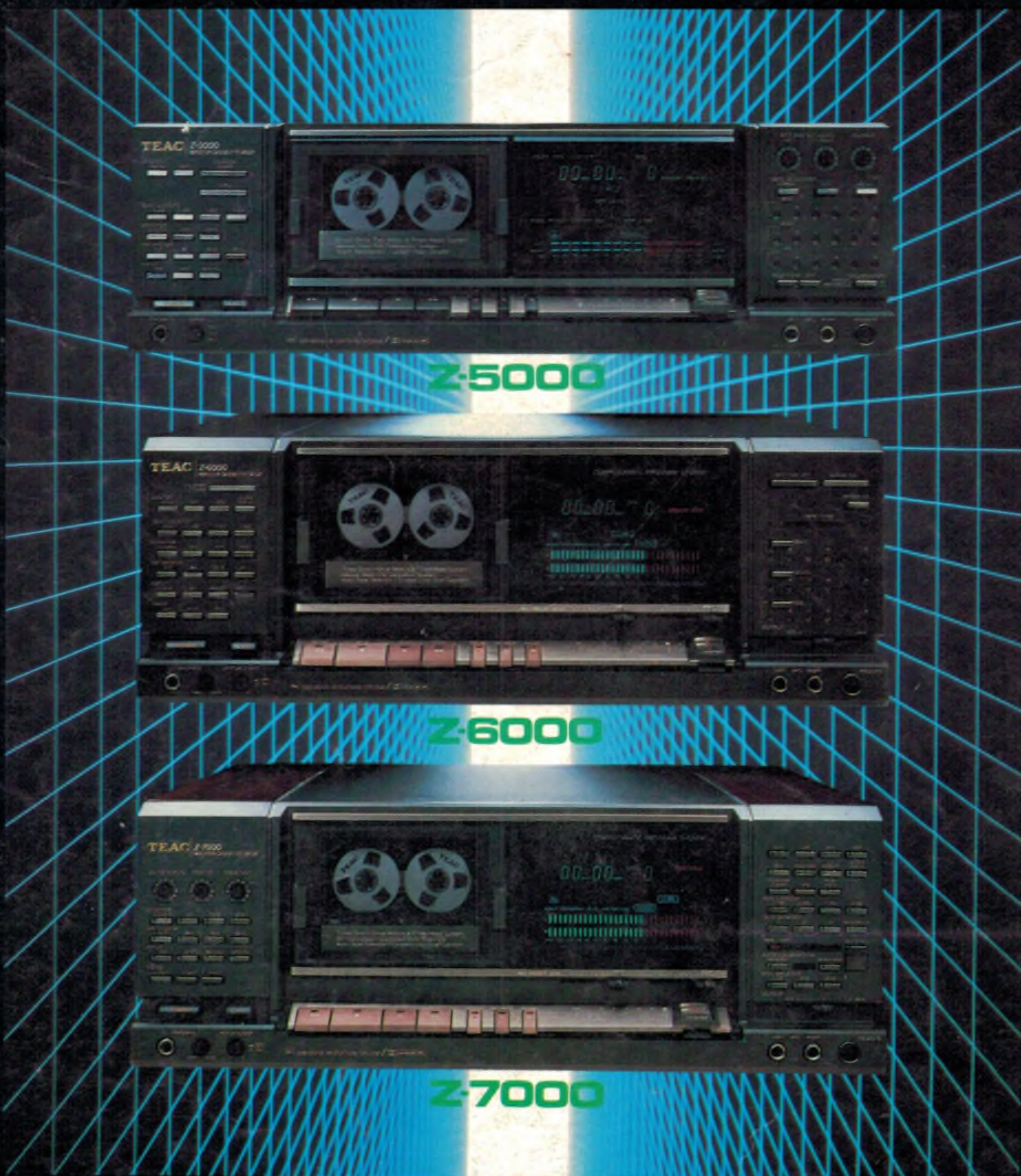
HEWLETT PACKARD

LBV 5237 HEP 90369/SM

WHY DID WE CALL IT THE Z SERIES?

Because nothing can follow it.

The TEAC Z Series. Three cassette decks that are all the cassette deck anyone will ever need. Designed and built to provide absolutely the finest in cassette reproduction quality. In precision of performance. And in operational versatility. The transport and electronics are the pinnacle of TEAC technology, drawing on our know-how in producing superior open reel decks and professional equipment. Operational sophistication is unmatched. Any function worth having on a cassette deck is on the Z-7000. And the Z-6000 and Z-5000 are almost as impressive. In fact, you can tell just by looking that these decks are in a class by themselves. Bigger. Heavier. Without extraneous frills. Built for solid, stable, permanent excellence. The Z Series. Cassette deck performance from A to Z.



Z-5000

- Direct-drive capstan motor
- 3-head system
- dbx and Dolby B–C noise reduction
- Manual recording bias, level and EQ calibration system
- Heavy duty diecast chassis
- Electroload head loading system
- Direct-coupled playback EQ amplifier
- Real-time tape counter
- Memory repeat/play/stop
- CPS (Computomatic Program Search)
- Rec mute with auto spacer
- Standard remote control unit

Z-6000

- 3 direct-drive DC motors
- Direct-coupled playback EQ amplifier
- 3-head system
- dbx and Dolby B–C noise reduction
- dbx disc position
- Manual recording bias, level and EQ calibration system
- Dual-capstan closed-loop transport system
- Real time tape counter
- Automatic tape select
- 30-segment FL peak level meters
- Memory repeat/play/stop
- CPS (Computomatic Program Search)

Z-7000

- 3 direct-drive DC motors
- 3-head system
- dbx and Dolby B–C noise reduction
- dbx disc position
- Automatic recording bias, level and EQ calibration system
- Tape calibration memory
- Block Repeat
- Dual-capstan closed-loop transport system
- Real-time tape counter
- Automatic tape select
- Search To Cue, Search To Zero, Search To Record
- Spot Erase System
- CPS (Computomatic Program Search)

TEAC®

Where Art and Technology Meet

TEAC Australia Pty., Ltd.: 115 Whiteman Street South Melbourne, Victoria 3205 Phone: 699—6000