OCT 1982

$2.15* NZ $2.50

eti ELECTRONICS TODAY INTERNATIONAL

DIRECT-CONNECT MODEM

Computer to Computer Communication

Signal-powered loudspeaker protector

New amplifier feedback technique explained

Speech synthesiser Interfacing and programming

Vector Research VR5000 FM/AM receiver reviewed

Micro-Professor reviewed


INTELLIGENT
SUPER COMPO
Convenient Computer Control at Your Fingertips
When Sansui mates computers with high performance component systems you get convenience. Like "Compu Edit.," a feature that allows automatic edit recording of songs from disc to tape in any programmed order. And the "Compu-Selector System" for one-touch synchronized play. And memory station selection. Intelligent Super Compo —the smartest hi-fi systems ever designed.
Sansui
SANSUI ELECTRIC CO., LTD. 14-1 Izumi 2-chome, Suginami-ku, Tokyo 168 Japan
VANFI (AUST.) PTY. LTD. 297 City Road, South Melbourne, Victoria 3205. Australia Tel: 690-6200
283 Alfred Street, North Sydney, N.S.W. 2060, Australia Tel: 929-0293

advertisers

features

projects and technical

computing today

electronic lifestyle

news

contests and special offers

general

Cover design: Ali White

Registered by Australia Post — Publication No. NBP0407
ISSN No. 0013-5216

UP TO 56% off top Hi-Fi

3300 Preamp

1000 Noise Reduction Unit

Phase Linear® U.S.A.

3300 Series II Pre-amplifier

The Phase 3300 Series Two takes its place as one of the quietest preamps ever offered on the commercial market, with phono noise 92 dB below full output.

This is impressive performance. And it's nicely augmented by control features such as widerange tone controls with switchable turnover points; twin tape circuits for deck-to-deck copying; and a direct-coupled, high performance headphone amp.

The Phase 3300 Series Two Preamplifier. An inherently musical device because it feeds the purest possible signal to the power amplifier.

— Vanishing harmonic distortion guaranteed less than 0.003% or entire audio bandwidth.
— Intermodulation distortion produces less than test equipment residual levels of 0.002%.
— Two-tone swept intermodulation distortion levels less than 0.008% to 200 kHz.
— Wide bandwidth design, flat to 100 kHz.
— Noise-free performance yielding 98 dB line level and 92 dB phono levels re 2.0 V output (86 dB & 80 dB IHF, respectively)
— High-speed design of 10 volts per micro-second throughout, guaranteeing immunity from slew induced distortion and TIM (IHF Slew Factor greater than 60).
— Versatile tone controls with wide control range and switchable turnover points.
— Two complete taping circuits featuring full monitoring capabilities and deck-to-deck copying.
— Direct-coupled, high performance headphone amplifier.
— Low-profile (2½") human engineered front panel.

Was $690, now reduced to $299

1000 Noise Reduction System

Compare your present music system with and without the 1000. You'll agree, the music sounds a lot better without all the noise and compression.

— Interfaces with any quality high fidelity music system receivers, separates and integrated units.
— Noise Reduction Systems can reduce 10 dB of noise without altering the music and without the need for pre-encoding.
— Dynamic Range Expansion System can increase dynamic range by as much as 7.5 dB.
— Dynamic Low Filter is adjustable to permit removal hum and rumble without any loss of low frequency information.
— Provides an additional tape monitoring circuit.

Was $490, now reduced to $279

1300 A/V Noise Reduction System

Phase Linear's 1300 AV Noise Reduction unit is a thief. It removes up to 12 dB of noise by utilising an ingenious circuitry called the "Correlator".

The 1300 AV leaves the full frequency response.

The 1300 AV reduces noise with any signal source. Records, tapes and even FM broadcasts. And that is sweet music for videotape and disc entertainment.

Was $330, now reduced to $179

ONLY WHILE STOCKS LAST!

Mail Order Accepted

Len Wallis Audio

Bankcard accepted & finance arranged for approved applicants

when you're serious about Hi-Fi

50 Burns Bay Rd, Lane Cove.
Open Thursday night and all day Saturday
Phone 427 1204, 427 1205

SAALEN 58/82

eti

Editor
Roger Harrison VK2ZTB

Technical Editor
David Tilbrook VK2YMI

Assistant Editor
Jennifer Whyte B.App.Sc.

Advertising Production
John Gerrie

Advertising Sales
Bob Taylor (Group Manager)
John Whalen (National)

Editorial Staff
J.B. Scott B.Sc./B.E.(Hons) VK2YBN
Jan Vernon B.A.
David Currie
Geoff Nicholls B.Sc./B.E.

Art Staff
Ali White B.A.
Bill Crump
Githa Pilbrow

Typesetting
Julie Hewlett

Reader Services
Paula Maloney

Managing Editor
Collyn Rivers

Acoustical Consultants
Louis Challis & Associates

Editorial and Sales Office:
4th Floor, 15 Boundary St,
Rushcutters Bay NSW 2011.
Ph: (02)268-9811; Tlx: 27243

Melbourne: Virginia Salmon and Mel Godfrey, 150 Lonsdale St, Melbourne Vic. 3000. Ph: 662-1222; Tlx AA34340.

Adelaide: Admedia Group, 24 Kensington Rd, Rose Park SA 5067. Ph: 332-8144; Tlx AA82182.

Brisbane: Geoff Horne Agencies, 16 Bellbowrie Centre, Bellbowrie Qld 4070. Ph: 202-6813.

Perth: C. Thomas, Adrep Advertising Representatives, 62 Wickham St, East Perth WA 6000.

New Zealand: Frank Hargreaves, Circulation Marketing Manager, c/- ACP, 4th Floor, Sun Alliance House, 42-44 Shortland St, Auckland. Ph: (9)30311.

United Kingdom: Australian Consolidated Press, Ludgate House, 107 Fleet St, London EC4A 2AL. Ph: 353-1040; Tlx: 267163.

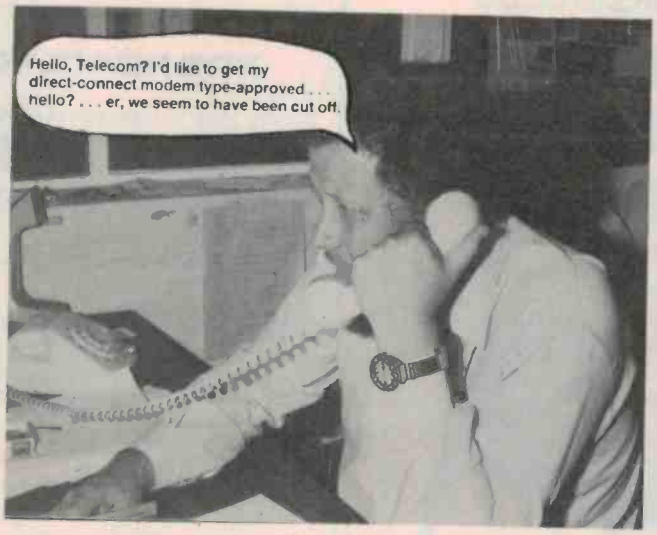
Japan: Genzo Uchida, Bancho Media Services, 15 Sanyeicho, Shin juku-Ku, Tokyo 160. Ph: 359-8866; Cable: Elbanchorito; Tlx: BMSINC J25472 Tokyo.

USA: Australian Consolidated Press, 21 East 40th Street, (Floor 23), New York NY 10016. Phone: (212)685-9570.

Electronics Today International is published by Murray Publishers Pty Ltd, 15 Boundary St, Rushcutters Bay NSW 2011. In 1982, it is printed by Offset Alpine, cnr Wetherill and Derby Sts, Silverwater NSW, and distributed by Australian Consolidated Press.

* Recommended retail price only

comment



Roger Harrison
Editor

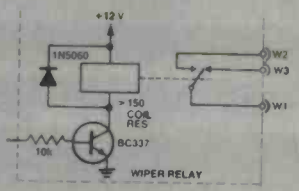
services

Mail enquiries: There is no charge for replies, but a foolscap-sized, stamped addressed envelope must be enclosed. Queries relating to projects can only be answered if related to the item as published. We cannot advise on modifications to projects, other than errata or addenda, nor if a project has been modified or if components are other than specified. We try to answer letters as soon as possible. Difficult questions may take time to answer.

Phone enquiries: We can only answer readers' technical enquiries by telephone after 4.30 pm. The number to ring is: **(02)33-5669.**
In enquiring by telephone about back issues or photostats, please ring **(02)268-9015.**

The publisher accepts no responsibility for unsolicited manuscripts, illustrations or photographic material.

next month



DIGITAL CAR ALARM

Description of the design, construction and installation of a very sophisticated car burglar alarm system.

CIRCUIT FILE — COMPARATORS

Circuit File returns with Ray Marston's very thorough examination of voltage and 'window' comparator circuits — widely used where it is required that an output abruptly change state when an input quantity or voltage varies above or below a reference value.

SERIES 5000 1/3RD-OCTAVE GRAPHIC EQUALISER

The latest in the Series 5000 equipment range. This has been a much-demanded project, not just for the hi-fi buff who wants to correct room resonances, etc but also for sound reinforcement systems.

N.D.F.Ls — PART 2

Professor Cherry continues with his short series on nested differentiating feedback loops in amplifiers. In this article he gets into the nitty-gritty details.

POCKET PROGRAMMER'S FRIEND

A very useful utility program for owners of either the Sharp or Tandy pocket computer.

TACHO CALIBRATOR

Just the thing for the motoring enthusiast. Installing and calibrating a new tacho is a pain in the exhaust. Here's the pill for the pain.

Although these articles are in an advanced state of preparation, circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.

Classifieds : Classified

ETI'S NEW CLASSIFIED SECTION

So you want to clear some of your stock? Maybe you're looking for extra help? Perhaps you're looking for work in the electronic field? You might even be selling your business or looking to buy one. Whatever the reason, ETI's new classified section is the place for you.

COMPUTER CLINIC repairs & services Sorcerer, Pet, Apple, System 80, Super 80, Tandy & others. (07)269 8573, P.O. Box 68, Aspley, Qld.

SORCERER Disk Upgrade Kit with manual. Many Pro features. MICROPOLIS $44.95. EXIDY FDS $39.95. A must! Also free Soft. catalogues. PJB Box 252, Forestville 2087.

Need semiconductors in a hurry? For the best prices and delivery on virtually any semiconductors, call the Applied Technology Semiconductor Hotline: (02) 439 2322.

Books, books, books
One of the world's largest ranges of books on electronics is available from Butterworths. See our ad in this issue for a few examples and the names of our stockists.

Etone & Motorola speakers at the best prices around
Huge range of these popular speakers at the best prices in Australia. Also a huge range of components. Sheridan Electronics: phone (02) 699 6912 & 699 5922.

S100 computer products
Huge range of S100 cards, motherboards, power supplies, keyboards. And the famous MicroBee personal computer. Applied Technology, 1a Pattison Avenue, Waitara 2077. Dial our Hotline for fast phone orders: (02) 487 3798.

REPAIRS to all home, hobby and small business microcomputer systems and peripherals, also all EA & ETI projects. CAE Electronics, 1/27 Forge St, Blacktown 2148. (02)621 4242.

Improve your hi-fi sound with dbx
Adding a dbx processor to your sound system makes more difference than any other single device. For full details and the name of your nearest stockist contact the Australian distributors, Audio Engineers Pty Ltd on (02) 29 6731.

The latest and greatest spreadsheet program
Multiplan from Microsoft ends all the problems with forward reference handling and gives you increased power over other spreadsheet programs: like colour operation, multiple on-screen windows and fully variable column widths. For more information and the name of your nearest Microsoft dealer call Wiser-Microsoft on (02) 451 9445 or see our ad in this magazine.

CLASSIFIED RATES

15¢ per character
Minimum of 32 characters
CHARGES: Cash with order only

MASSIVE BREAKTHROUGH!

CAR COMPUTER BELOW $200

COMPLETELY BUILT AND TESTED – NOT A KIT!!

MADE IN ENGLAND! – QUALITY!!

IDEAL RALLY COMPUTER!

SEE REVIEW OCTOBER EA PAGES: 26,27,28.

CONTAINS EQUIVALENT OF THOUSANDS OF TRANSISTORS – USES MASSIVE CUSTOM LSI CHIP TO ACHIEVE LOW PRICE

only $199 complete

Never before has such a comprehensive car performance computer been offered at such a low price!! Once again miracle microprocessor technology has enabled us to pass enormous savings on to you!!
But don't let the low cost fool you. The "Voyager" car computer IS THE MOST COMPREHENSIVE PRODUCT THAT WE HAVE SEEN. No other car computer matches this one AT EVEN TWICE THE PRICE! You could buy a $20,000 Holden and not get a better car computer!!
Just check the features. We are sure that you will calculate that the "Voyager" represents outstanding value!

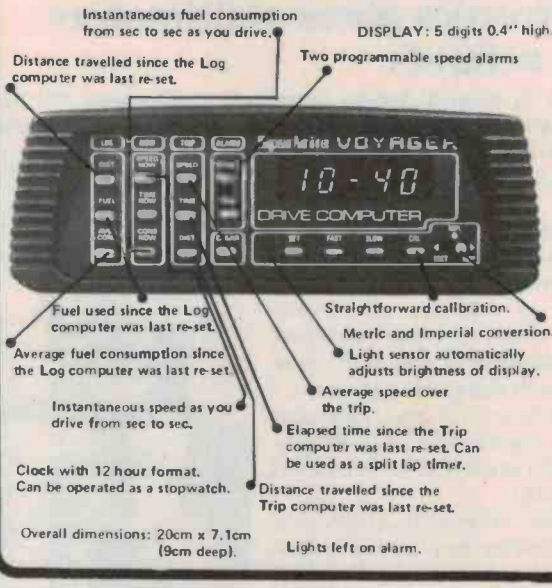
FEATURES

- 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.

INSTALLATION

The "Voyager" comes complete with an unbelievable array of mounting configurations, on dash, under dash or stalk mount. ALL installation hardware is supplied (even a roll of insulation tape!) as well, of course, as the speed and fuel sensors. A lavishly illustrated installation manual is provided as well as a comprehensive operators manual. If you do not want to install the unit yourself we can do this for you for a guaranteed $39.50*. (A few exotic cars excluded!). A typically competent EA/ETI reader would do the job in 3-4 hours.
* Sydney metropolitan area only.

VOYAGER OPERATING FEATURES



JAYCAR

125 YORK ST SYDNEY 2000
Ph. 2646688 Telex: 72293
Mail Orders To:
Box K-39 Haymarket 2000

POST AND PACKING CHARGES
$5-$9.99 ($1.20) $10-$24.99 ($2.40)
$25-$49.99 ($3.50) $50-$99.99 ($4.60)
$100 up ($6.20)

NEW SHOP HOURS
Mon-Fri 8.30 to 5.30pm
Sat 8.30 to 12.00pm
Thurs night to 8.30pm

NEWS digest

Telecom technique gets international recognition

A new technique developed by Telecom Australia's Research Laboratories in Melbourne has received international recognition by being accepted by the International Telegraph and Telephone Consultative Committee (CCITT).

The technique determines a specification called the Crosstalk Noise Figure for a particular repeater and measures the performance of repeaters used in the digital transmission of telecommunications.

Digital transmission systems are being installed extensively by Telecom Australia and many overseas telephone administrations. These systems use pulse code modulation (PCM) for transmitting information such as the human voice.

They operate by taking very frequent samples of the signal level, encoding the level as a binary number and then transmitting this number as a series of very rapid on-or-off pulses.

Using digital transmission over existing cables allows up to 30 voice circuits to be carried on a pair of wires. These systems, however, require repeaters to re-transmit the signals about every two kilometres along the cable. One limitation on the number of systems and on the distance between repeaters is coupled interference or crosstalk between the PCM systems installed on different pairs of wires in the same cable.

The actual limits depend both on the crosstalk characteristics of the cable and on the sensitivity of the digital repeaters to this type of interference.

A specification called the 'Crosstalk Noise Figure' assesses the sensitivity of a repeater to crosstalk interference. It can be measured readily for each repeater and then used directly by Telecom network designers to establish the maximum distance between repeaters and the number of PCM systems that can be installed on a given cable.

A technique to make this measurement has been invented by Dr Alan Gibbs of Telecom's Research Laboratories. Patents have been applied for. The practicability of the crosstalk noise figure concept, amply verified by other workers at the Laboratories, has been widely reported in technical publications around the world.

This work, which provided the basis of contributions to the CCITT by Telecom, led to the international acceptance of the crosstalk noise figure at a recent meeting in Geneva, by the appropriate CCITT working party.

Prior to adoption of the specification, engineers of the Bell Telephone Laboratories in the United States had undertaken their own investigation of the crosstalk noise figure performance measure. During those investigations they loaned several digital repeaters to Telecom Australia as part of a joint program. Local industry has also been involved.

A prototype instrument for measuring the crosstalk noise figure is being developed by Jacobs Radio (Aust) Pty Ltd in Bayswater, a suburb of Melbourne. This work is being carried out under Telecom's Industrial Research and Development Contract Program which fosters indigenous expertise in telecommunications.

The CCITT is part of the International Telecommunication Union, a United Nations agency. It is responsible for the international standardisation of telephone and other telecommunications networks.

Altronics gives multimeters to schools

Five thousand dollars worth of multimeters will be given away to high schools who conduct electronics courses.

Altronics in Perth is making available 200 of their very popular Q1002 20 kohms/volt multimeters completely free to high schools which are running electronics courses. There is a limit of one per school and Altronics intends that the meters be awarded as end of the year prizes to outstanding students.

They are completely free and post free and there is no obligation for the school to Altronics in any way.

High schools who qualify for a multimeter should send in their request, on the school's letterhead, to Altronics, 105 Stirling St, Perth WA 6000.

Apple backs Telidon

Apple, one of the world's biggest manufacturers of personal computers, announced at a computer exhibition in the US that it has decided to back the Telidon viewdata system. Apple will be selling a US$595 add-on circuit board for its computers that will allow them to work with Canada's Telidon viewdata system.

Apple decided this after considering Prestel, and its French rival, Teletel. This will be another setback for the British as they had hoped to establish Prestel as the world standard technology for viewdata terminals.

Telidon's key advantage over the two broadly similar European viewdata display methods is that it can offer far superior on-screen graphics. It also enjoys the support of the giant American Telephone & Telegraph.

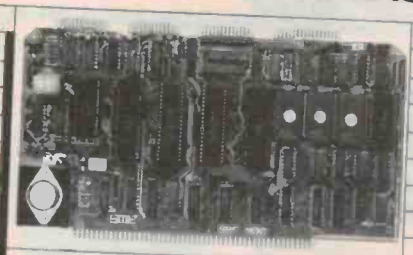
Prestel and Teletel use an 'alpha-mosaic' method of presenting information on a viewdata page. This gives crude, Lego-like graphics.

The Canadian system employs an 'alpha-geometric' technique which needs more sophisticated electronics in the terminal but can deliver properly curved lines.

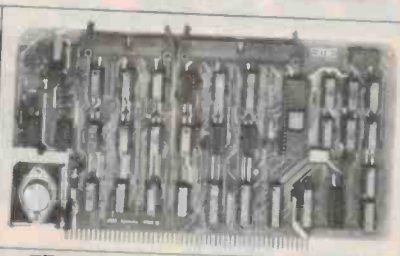
Apple will promote Telidon as a cheap way to create computer graphics. A typical application would be where users compile their own personal 'databases' of graphic and textual information and swap the information with other Apple owners.

If the viewdata facility is successful in North America, Apple says that it will launch it in Europe.

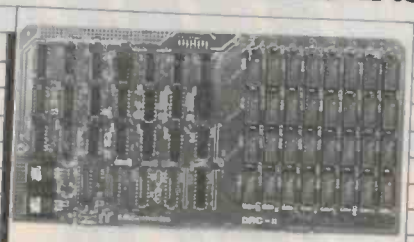
K-NAR COMPUTER CARDS
S100 Z80 SYSTEM CARD SPECIALISTS



SBC-800



FDC-II



DRC-II

You know the SME Systems boards as the most powerful and technically up-to-the-minute manufactured in Australia today.

Using K-NAR's mail order system can save you dollars. Compare our prices on these high performance cards.

SBC-800

4Mhz Z-80 CPU, two serial RS232 ports, software programmable Baud rate gen., Centronics parallel port, 22 prog. I/O lines, real time clock (battery backed), 2K CMOS RAM, power on reset/power fail detect, battery backed as standard, etc. List Price $495. Our Price $395.

SBC-400

4Mhz Z-80 CPU, 1K Static Ram, RS232 I/O with Sync/Async, Centronics interface, 4Ch. counter/timer, Soft. Prog. Baud rate generator, 2K CP/M BIOS EPROM option. List Price $395. Our Price $315.

FDC-II

Enhanced floppy disk controller, IBM 3740 compatible, operates 5 & 8" and single/d. density drives, handles up to 4 drives, runs multi-density CP/M2.2 & MP/M 2. Vectored interrupt operation optional. List Price $465. Our Price $370.

DRC-II

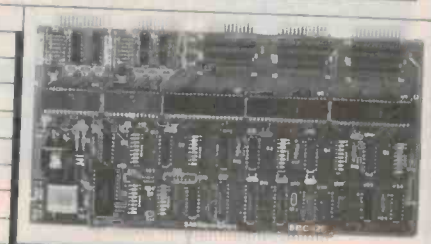
The board for multi-user installations. 64/256K dynamic RAM card, bank select, fast 4Mhz operation, on-board memory prom, dip-switch selectable boundaries, bank mode allows up to 8 boards on bus, hidden refresh, phantom disable. List Price $600. Our Price $475.

CRC-48

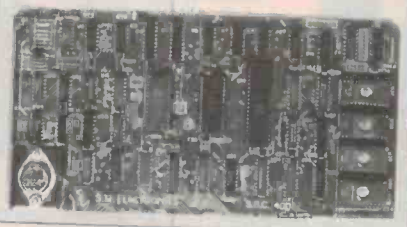
Fool-proof memory system. State-of-the-art CMOS memory card with memory protection. on board battery back-up, compatible with DRC-II, write protection enable/disable, can be used as complete EPROM card or any combinaation of EPROM or CMOS ram. List Price $525. Our Price $420.

VDC-8024

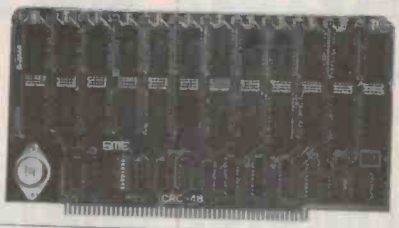
The low cost alternative to stand-alone terminal. Flexible 80x24 memory mapped video display board with full ASCII, semi graphics, Inverse & half intensity video, flicker free screen updating. Battery backed option offers diagnosis of system shut downs. List Price $325. Our Price $265.



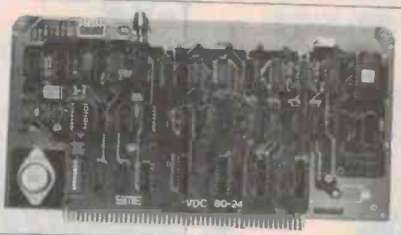
SPC-29



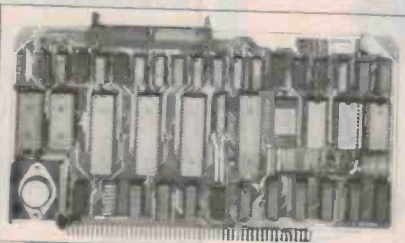
SBC-400



CRC-48



VDC-8024



MPC-6 DARTBAUD

MPC-6 DARTBAUD

For Multi-user systems. Multi-channel RS232 Intelligent I/O card with full I/O buffering and high level input/output drivers. 6 channels, on-board Z80 processor, software programmable baudrates, 6K buffer memory (battery backed). User programmable features for system tailoring. List Price $725. Our Price $575.

SPC-29

High performance dual serial & 9 parallel port I/O CARD, with full I/O address decoding. Switch selectable baud rates. Link patch area, programmable modes for strobed/latched I/O. List Price $295. Our Price $235.

PACKAGE SPECIAL

Try this for value

SBC-800 • FDC-II • DRC-II

& 5-slot motherboard with mini-cage. Monitor/BIOS EPROM.

Special package price $1425*

K-NAR
COMPUTER CARDS

PO Box 412, Dandenong, 3175 Phone (03) 795 5858
Authorised distributor of SME Systems products.

* Prices subject to change without notice. All prices excluding tax. For retail prices add 17.5%.
All boards fully assembled and tested and backed by 90-day guarantee.

To K-NAR Computer Cards

Please send me product data sheets.
(I enclose 4 stamps).

I wish to order
My cheque/order form is enclosed
Please debit my Bankcard No.
Name
Address

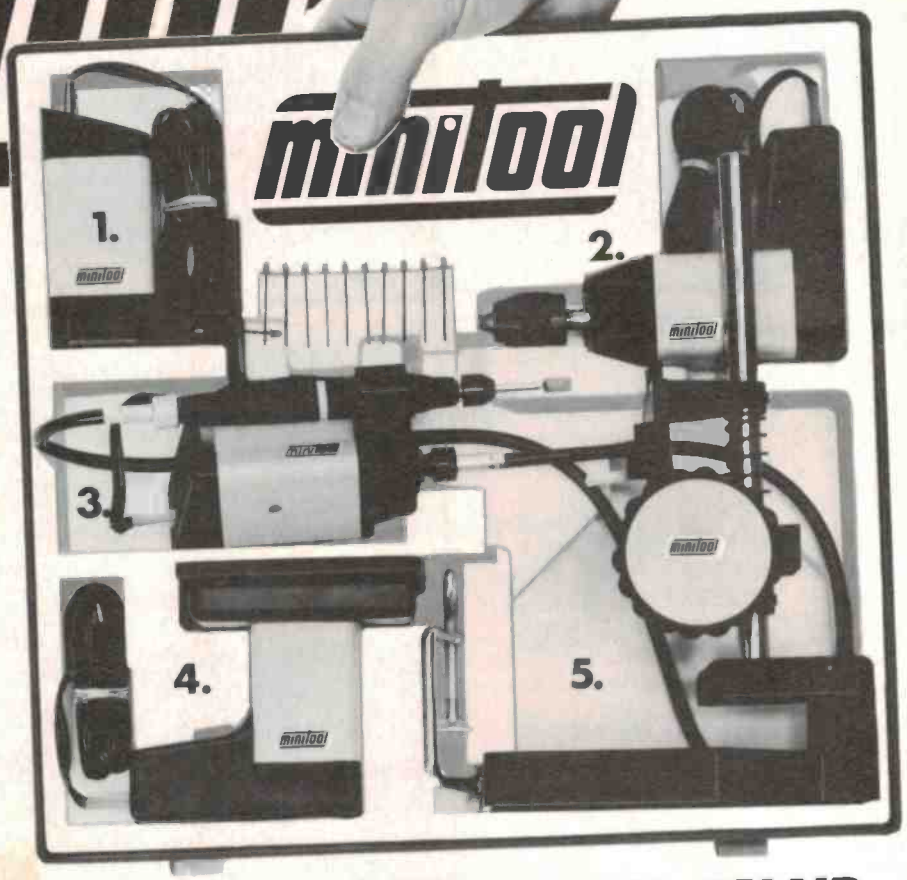
Signature

Please include me on your new product mailing list. I am mainly interested in systems for ☐ Hobby, ☐ Industrial use ☐ Education ☐ Business ☐ Process control ☐ Other

PEN 220

minitool

FO



WORKSHOP KIT

000.62.90X – Carry case, Power supply, Pistol drill, Drill stand, Orbital sander, Jigsaw, flexible Shaft unit, spare Blades, Table clamp, Platform table. R.R.P.

$187.50

WORKSHOP KIT

000.62.90Y – Same as above but not including flexible Shaft unit. R.R.P.

$149.50

1. JIG SAW

10mm CUT
5,000 S/MIN.

000.62.108 Platform Table inc. in Kit. Extra as individual item. **$37.00**

2. PISTOL DRILL

000.62.402
7,000 R.P.M.
6mm Diameter
$37.00

ANGLE GRINDER*

000.63.605
7,000 R.P.M.
40mm Diameter
$45.00

Circ. Sawblades for Wood & Metal available.

*Not included in Kit.

3. FLEXIBLE SHAFT & GRIND STICK

000.62.804
7,000 R.P.M.
$45.00

4. ORBITAL SANDER

000.62.206
5000 S/MIN.
$37.00

5. DRILL STAND

000.62.493
Accepts Pistol Drill & Angle Grinder.

POWER SUPPLY

240V **$15.00** + TAX **$2.62**

Plug-Pak 12V output 1A

CIGAR LIGHTER ADAPTOR AVAILABLE: 000-62-073

Send Self Addressed Envelope for full price and accessory list.
(Accessories include points, cutters, blades, burrs, brushes, stones, etc.)

minitool
AUSTRALIA PTY. LTD.

134A AYR STREET,
DONCASTER. VIC. 3108
Tel. 850 9887

NAME .....

ADDRESS.....

.....

BANKCARD NO.
OR CHEQUE .....

EXPIRY
DATE .....VALUE.....SIGNED .....

Add Postage $2.50 single item $4.00 for kit.

ACCURACY&PRECISION

TOYO MINI-LATHE

$436.00
+ Sales Tax if applicable.

ACCURACY EQUAL TO LARGER MACHINE TOOLS.

FEATURES:

- ☐ **TOYO MINI-LATHE** made of high quality materials used in the construction of standard large machine tools.
- ☐ **TOYO MINI-LATHE** will give you unparalleled precision and solidity.
- ☐ Although **TOYO MINI-LATHE** is not multi-purpose lathe, it has all the functions of sophisticated large type lathe.
- ☐ Its machining capacity is the largest in the table top class. With maximum working diameter **100mm** length **250mm**.
- ☐ Numerous and well designed accessories are available.

---

minitool

Gravilo®

Self contained hand engraver

18000 R.P.M 12V DC

Engraving points for glass, metal, ceramic & plastics available also patterns.

$29

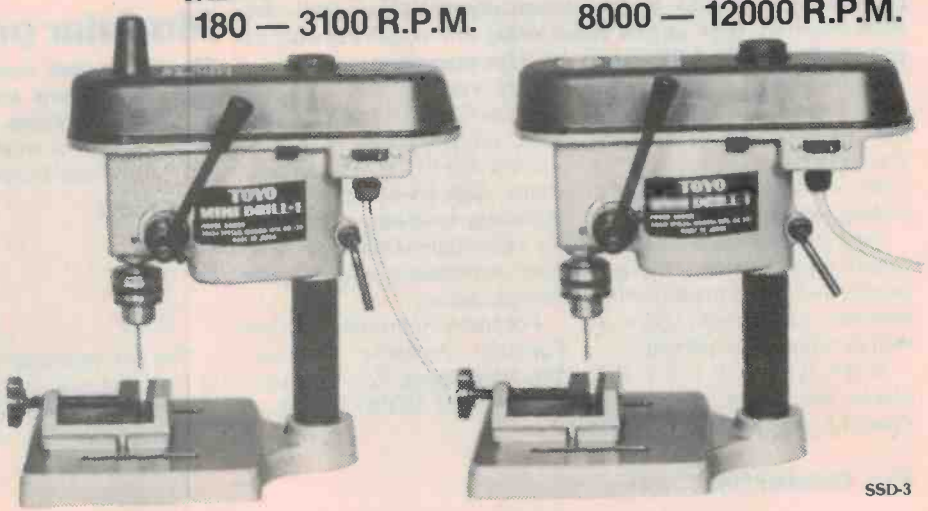
TOYO MINI DRILL

The ultimate for P.C.B. drilling.

$165.00 each
+ Sales Tax if applicable.

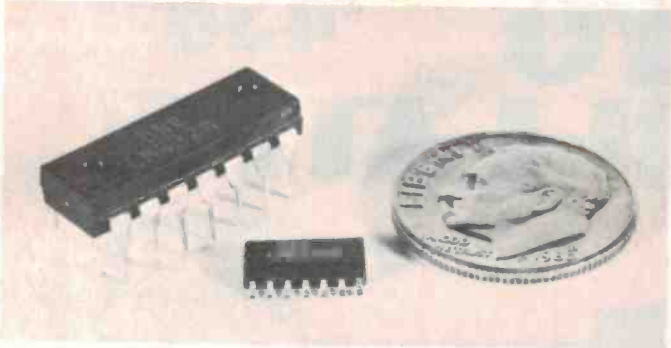
MD-1 — 6 SPEED
180 — 3100 R.P.M.

MD-1H — 2 SPEED
8000 — 12000 R.P.M.



SSD-3

NEWS digest



National low-voltage DNR

National Semiconductor has introduced a low-voltage version of the company's widely-used DNR (dynamic noise reduction) system for use in compact battery-operated portable audio equipment, video cameras and televisions.

The new low-voltage LM832 DNR system is capable of operation within the 1.5 — 9 volt range.

National's DNR system does not require signal encoding, and as a result is a universally-effective noise reduction system for all tape and FM broadcast signals.

No special tolerance devices and very minimal additional components are required for use of the LM832. For example, only twelve external components are required for the use of this device in stereo applications.

The DNR system utilizes a noise reduction method that serves to eliminate noise that may already be present in the source program.

DNR is a single chip-dynamically variable low pass filter that reduces undesirable hiss and noise by varying the audio bandwidth as a function of the high frequency content of the input signal.

As the amplitude of the high frequency sound drops to where background noise could become audible, DNR reduces the bandwidth, thereby decreasing the audible noise level. Up to 14 dB (weighted) of noise reduction is possible when using the DNR system, National Semiconductor claim.

The LM832 is housed in a standard 14-pin dual-in-line package. Production quantities will be available this month, according to National Semiconductor.

Video delay line

Fairchild's CCD323 is an electrically variable, 283½-bit, dual-channel, high speed video delay line requiring only an externally supplied TTL-level clock for operation.

The device incorporates CCD analog shift registers, charge-injection ports and output charge-sensing amplifiers for delay and temporary storage of analog video signals.

An internal sample-and-hold output stage plus on-chip clock drivers and logic circuits reduce external component count as well as required board space.

When used with a 4.4 MHz clock, the device produces a delay of approximately 64 uS, ideally suited for PAL TV applications, Fairchild say. With data rates ranging from 10 kHz to 15 MHz, the CCD323 is useful in many high-speed applications including time-base correction for video-tape recorders, comb filter realisations and dropout compensators.

For more information contact Fairchild Australia Pty Ltd, 366 Whitehorse Rd, Nunawading Vic. 3131. (03)877-5444.

Digital time switches

Wattmaster Sales Pty Ltd claim that their new range of digital electronic time switches will reduce electricity consumption and cut costs.

The 4 channel DIGI 127 released last year has been followed by nine, dual and single channel models. It is claimed that the accuracy of these electronic time switches will produce savings of up to 10 minutes in 10 hours (depending on the installation).

They can be used for accurate switching control of interior lights, heating, cooling, floodlights and controlled lighting of municipal playgrounds and sporting areas.

For further information contact Mr. J. Cronly, Wattmaster Sales Pty Ltd, 11 Rachel Close, Silverwater NSW 2141. (02) 648-1332.

Plug-in modules

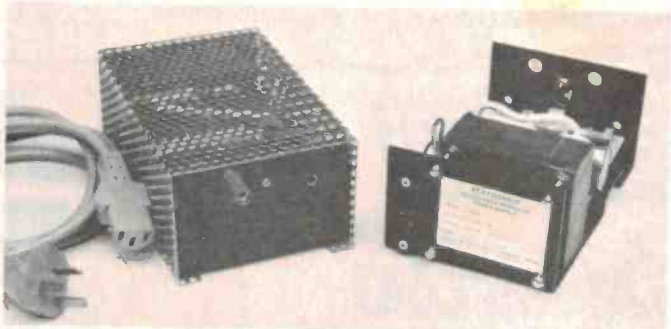
Logcon function and interface modules are designed for a wide range of industrial instrumentation and control applications.

The ac-powered product series includes a proportional switching amplifier, a tachometer amplifier and switch, a miniature four digit counter and a servo-control amplifier.

In the dc-powered function series there is a dual variable gate, a six input cascadable AND/OR gate and a dual relay interface or drive module.

There is also an eight step sequence generator, an eight step to four function selector and an ac-dc power supply to drive these modules.

If you want to know anything more about these modules contact Solid-State Design and Development Pty Ltd, 10 Vista St, Bulleen Vic. 3105. (03) 850-6884.



Modular power supplies

These low cost, compact power supplies from Statronics are current limiting and feature an adjustable crowbar over-voltage protection.

There are four models in the range and, with the exception of the 53/2, they have a crowbar current rating of 5 A.

Model	Current	Voltage
53/2	1 A dual	12-15 V
53/3	3 A	12-15 V
53/4	2.5 A	24 V
53/5	3 A	5 V

The line regulation is quoted as 0.5% and the load is regulated to 1%. The ripple and noise is quoted as 5 mV peak-to-peak.

For further information contact Statronics Pty Ltd, 103 Hunter St, Hornsby NSW 2077. (02)476-5714.

NEW STORE opening October in Carlingford

AT "NEVILLE'S CORNER" CNR CARLINGFORD & PENNANT HILLS RD. NEXT TO KENTUCKY FRIED CHICKEN

Great Products- Great Prices!

LCD panelmeters ..... BACK .....

We have been unable to keep up with the demand for these, that is why you have not seen them in our ads for the last few months.

DPM-200 — 3½ digit display with annunciators (pictured). 0.6" high. 200mV full scale. Each unit supplied with data sheet.

$49.50 DPM-200

DPM-05 (Not illustrated). 3½ digit display with "plus", "minus" and "low batt". Annunciators with 0.5" readout. Both units sample at 3/second.

DPM-05 $39.50

If you want to express any physical measurement in a bright easy to read display these are for you. They contain all analogue-to-digital electronics and LCD drive circuitry. Send SAE for more information.

good news

LOW COST IC INSERTERS EXTRACTORS

Up until now these have cost a fortune!!
Features:
- CMOS SAFE conductive plastic
- Exclusive bent pin alignment guides in handle . 8 to 40 pins.
- Ground strap can be connected.
- One hand operation.

INSERTERS

CIT820	8–20 pin	ONLY $5.95
CIT2428	24–28 pin	ONLY $6.95
CIT3640	36–40 pin	ONLY $8.95

from $2.95

EXTRACTOR
Deceptively simple looking device. One piece metal construction. 8-40 pins
ET–B40 ONLY $2.95

IMPORTANT!!
Don't be conned into buying a non conductive inserter/extractor. The possible static damage to your MOS I.C.'s could cost you a fortune!!

MOVING COIL CARTRIDGE MODEL MC-100

LOW COST BUT HIGH QUALITY!
- ½" standard mount
- Does not need transformer
- Samarium Cobalt magnets for high output
- Frequency Response 15Hz - 35kHz
- Whopping 2.5mVout (1kHz/50mm/s)
- Compliance 8 x 10^{-6} cm/dyne
- 2.0 gram tracking force
- 0.6mil Diamond stylus
- Supplied with mounting hardware

STAGGERING VALUE **$49.50**

AM/FM STEREO CAR CASSETTE

Unbelievably low price! (Pre Budget tax) That's right! An AM/FM Stereo Radio and Cassette! Features:

* 2 x 7 watts * One lever operation (fast forward and eject) * Tape run indicator * FM Stereo indicator * Auto stop * Adjustable pitch controls * Mounting hardware included.

STAGGERING VALUE ONLY **$69.50**

LOW COST WALKIE TALKIES

What can we say?
Only $19.50 for a pair!
Both voice and morse transmission
ONLY
$9.75 ea

INNER EAR MINI PHONE

MODEL MT310
FEATURES: Samarium Cobalt magnets
102dB/mW
Weight 15 grams
Response: 50Hz-20kHz
Impedance: 32 ohms

Unit fits into the cusp of your ear. Can be worn under motorcycle helmets. Unbelievably clean sound.

ONLY $19.50

HI-VOLTAGE HITACHI MOSFETS

V_{DD} 160V

The Hitachi complimentary Power Mosfets are very popular in Hi Fi and PA amplifiers. Up until now the very highest voltage versions have been hard to get. We now have these devices as well as the popular 2SK134 and 2SJ49 (140V) types.
The 2SJ50 and 2SK135 enable you to use higher rail voltages for higher power.

2SJ49 & 2SK134 **$6.50 ea**

2SJ50 & 2SK135 **$8.50 ea**

JAYCAR

Carlingford
Phone: 872 4422

125 YORK ST SYDNEY 2000
Ph. 2646688 Telex: 72293
Mail Orders To:
Box K-39 Haymarket 2000

POST AND PACKING CHARGES
$5-$9.99 ($1.20) $10-$24.99 ($2.40)
$25-$49.99 ($3.50) $50-$99.99 ($4.80)
$100 up ($6.20)

NEW SHOP HOURS
Mon-Fri 8.30 to 5.30pm
Sat 8.30 to 12.00pm
Thurs night to 8.30pm

BWD enter rental market

BWD Instruments of Mulgrave, Victoria have entered the equipment rental market with their comprehensive range of test equipment at what they claim are extremely competitive terms and prices.

BWD's products are widely used in industrial applications by military services, civil aviation and in education establishments ranging from primary schools to tertiary institutions.

For the fields of research, design, education and servicing BWD can provide a wide range of electronic test instruments comprising oscilloscopes up to 100 MHz (including storage and dual-trace models) sine wave generators, signal, pulse and function generators, stabilised dc power supplies, electronic educational aids and equipment and accessories for many applications.

For further details and information on the product range available for rental, contact BWD Instruments Pty Ltd, Miles Street, Mulgrave Vic. 3170. (03)561-2888.

Tektronix FOTDR tester

The new OF150, introduced by Tektronix, has been designed to become the reference 'standard' for FOTDR's (fibre optic time domain reflectometer).

This instrument is rugged, portable and easy-to-use in the areas of field installation and maintenance of fibre optic links, Tektronix say. It provides quantitative and calibrated measurements on multi-mode 125 um OD fibres with a core diameter of 50 um.

Tektronix claim that the new OF150 is the first instrument which can make precise, calibrated loss and distance measurements while offering monolithic, rugged, and portable features. A chart recorder documents the presentation displayed on the CRT. There is also an LCD readout which provides the user with the capability of making calibrated, repeatable measurements.

Primary users will be telephone companies, the military, and broad-band networks providing television, telephone, and two-way data communications to households.

The OF150 applies a pulse of radiant energy to the fibre under test via the optical output connector. As the pulse is travelling through the fibre, some energy is reflected back to the OF150. These reflections are processed and then displayed on the CRT, where distance and loss measurements can be made using the horizontal and vertical markers.

For more information about the OF150 contact Tektronix Australia Pty Ltd, 80 Waterloo Rd, North Ryde NSW 2113. (02)888-7066.

High-transparency drafting film

Known as Herculene Hi-Trans, a new high transparency polyester drafting film has been designed for use in overlay drafting.

The film is single matte but the special anti-static and anti-curl coating on the reverse side of the film will accept ink almost as well as the matt surface, the makers claim.

Two thicknesses are available, 0.08 mm (0.003 inch) and 0.1 mm (0.004 inch). Standard size rolls up to 1.37 m (54 inch) wide will be available. Pre-cut sheets will be available to any size and can be offset-printed to order.

For samples, prices and literature, please contact Jasco Pty Ltd, P.O. Box 135, West Ryde NSW 2114. (02)807-1555.

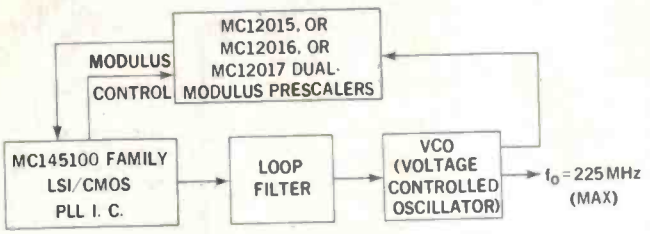
Static protection for CMOS ICs

Static electricity can damage sensitive CMOS semiconductors, as we all know. This problem is aggravated as more and more circuits are crammed in a given size of silicon chip.

Amtex Electronics has available a range of conductive static protection products. The high density 'Statfree' foam is 6 mm thick and comes in two sizes: 300 x 600 mm and 635 x 1900 mm. This non-corrosive foam will not attack IC pins, the makers claim.

The Statfree bags are made of nylon and come in sizes of 150 x 254, 203 x 305 and 254 x 457 mm.

Contact Amtex Electronics, P.O. Box 285, Chatswood NSW 2067. (02)411-1323.



Low power, dual-modulus prescalers

New high-speed prescalers from Motorola have toggle frequencies of 225 MHz at a typical power supply drain of 6 mA which makes these devices ideal for portable and mobile applications.

Designated MC12015P, MC12016P and MC12017P they provide dual-modulus division ratios of 32/33, 40/41 and 64/65 respectively.

The devices are designed to operate from unregulated power supplies over the voltage range of 5.5 to 9.5 Vdc or a regulated supply of 4.5 to 5.5 Vdc.

Signal-input level ranges from 200 to 800 mV peak-to-peak, according to Motorola. The modulus-control input and the prescaler output are TTL-compatible. This allows designers to achieve 'two-chip' frequency synthesizers capable of over 200 MHz operation and requiring less than 10 mA of current drain.

The low current drain makes battery operation feasible and reduces heat generation in the equipment. System divide-by-N ratios of less than 1000 to greater than 65 000 are achievable.

These dual-modulus prescalers are available in small 8-pin plastic DIP packages from Motorola Semi Conductor Products, 250 Pacific Hwy, Crows Nest NSW 2065. (02)438-1955.

Telescope project underway

Work on the construction of the $25 million Australia Telescope would begin before the end of the year, said the Minister for Science and Technology, Mr David Thomson.

The project received an initial grant of $820 000 in CSIRO's allocation of the 1982/83 Federal Budget, and a commitment for funding over the next six years.

"The approval of the project is a shot in the arm for Australia's radio astronomers who faced the prospect of rapidly falling behind the rest of the world as their equipment became outdated," Mr Thompson said.

"But just as importantly, the telescope will mean a similar shot in the arm for Australian technology because the project is an all-Australian undertaking which will inject $20 million into the technology sector."

Mr Thomson said antenna design studies and costing for the project had been undertaken as part of the CSIRO proposals for funding. "This means that detailed tender documents can now be prepared with a minimum of delay," he said.

The telescope consists of new antennas at Culgoora near Narrabri and at Siding Spring near Coonabarabran. These antennas will be linked by microwaves to the existing 64-metre CSIRO Radio telescope at Parkes, 350 kilometres away.

The combination of the antennas creates, in effect, one huge, powerful radio telescope about 300 kilometres across. The telescope will provide high resolution radio images of the southern sky and ensure that Australia remains among the world leaders in radio astronomy.

Mr Thomson said without the instrument, Australian astronomers faced the bleak prospect of not being able to keep up with advances made overseas using superior instruments.

"As well, as the existing instruments aged, Australia would lose some of its most talented young radio-astronomers to overseas research groups," he said.

"But with the Australia Telescope, Australian radio astronomy has an instrument which will carry it into the 21st century."

"The construction of the telescope will provide a stimulus to a range of technological areas. These include antenna design and construction, low noise amplifiers, optical fibres and a range of electronics including very large scale integrated circuits."

The Australia Telescope would be operated as a National Facility by the CSIRO Division of Radiophysics from its Headquarters in Sydney.

PNP and NPN Darlingtons

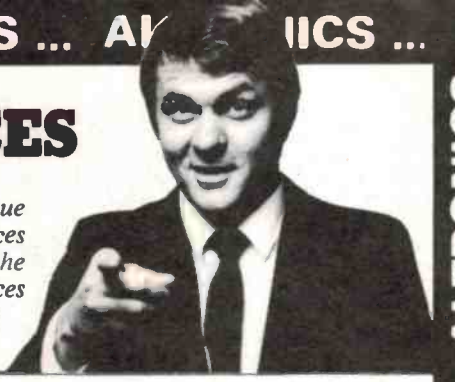
Following last year's introduction of the BDT20 p-n-p high-energy Darlington power transistor, Philips now announce the complementary n-p-n version, the BDT21. Both Darlingtons are designed for driving inductive loads such as motors and relays.

Owing to the inclusion of a monolithic zener protection diode, the transistors can withstand very high energies up to a maximum of 100 mJ at an ambient temperature of 125°C, Philips claim.

The Darlingtons have a V_{CEO} of 130 V and a total power dissipation of 62.5 W at a mounting base temperature of 25°C. At 3 A, the h_{FE} of the BDT20 is given as 500 minimum, and that of the BDT21 750.

For further information contact Elcoma, 67 Mars Road, Lane Cove NSW 2066. (02) 427-0888.

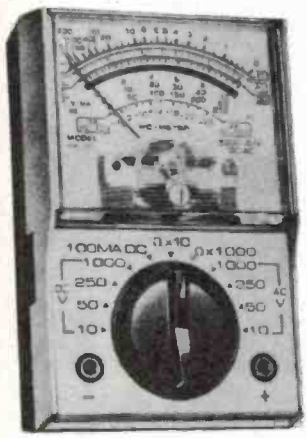
LAST MONTH AT THESE PRICES



DEAR CUSTOMER, All our new incoming stock lines are regrettably costing more due to the steady devaluation of the Australian Dollar together with generally higher prices overseas. So, in November, we will be forced to adjust prices on many items – but the good news is that we still have stocks of these advertised lines at our current low prices SO ACT NOW AND BEAT THE PRICE RISE . . . Cheers Jack O'Donnell

MULTIMETERS 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
Decibals: 10 to +22db. DCA 0-10 MA. OHMS 0-2 meg. OHM in 2 ranges.

Q 1001 **$12.50**

4 or more **$10.00**

UNIVERSAL MULTIMETER

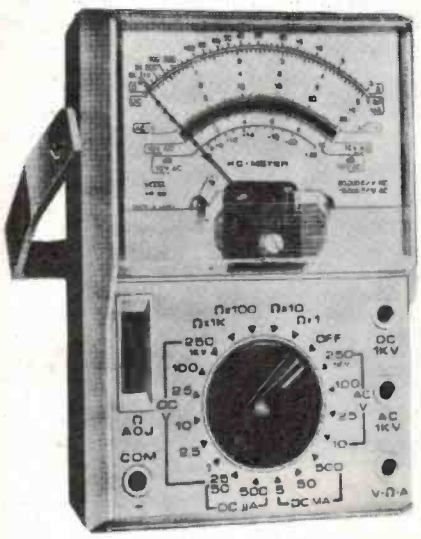
PORTABLE WITH BENCH STAND

23 ranges at less than $1 per range.

* 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 Decibles 20 to + 22db DC Current 0-50, 500 UA, 0-5, 50, 500MA OHM Meter 0-6 megohms in 4 ranges, 30 ohms centre scale. Size 135 x 91 x 39

Q 1002 . . . . . **$22.50**

4 or more. **$21.00**



Direct Import Price!

CARRY CASES "LEATHER LOOK PVC"

Q 1011 for Q 1001 meter **$2.50**

Q 1012 for Q 1002 meter **$3.50**

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.

	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

BULK PACKS INCREDIBLE VALUE!

All computer selected values, ie. you get more of the most used values and less of the least common. All 1st quality factory fresh!

R 3501 .25W RESISTOR PACK

Average contents: 300 $12.00 Value Only $5

R 3510 GREENCAP PACK 100V

Average contents: 50 $12.00 Value Only $5

R 3515 CERAMIC PACK 50V

Average contents: 100 $14.00 Value Only $5

R 3520 ELECTROLYTIC PACK PCB TYPE

Average contents: 40 $14.00 Value Only $5

12 VOLT IRON

Works off 12 V car battery. (Comes fitted with lighter plug). AND just as well off 12V AC. Use M2156 Transformer in H 0442 Box and Presto you have a low cost mains isolated iron!

T 2512 . . . . . **$3.95**

MICRON 30 WATT (240V)

NEW FOR '82

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

T 2430 . . . $ 9.95

REPLACEMENT TIPS

T 2434 Flat Tip 95

T 2435 Conical Tip 95

MOLEX PIN SOCKETS

FOR USE WITH SINGLE PINS UP TO .5mm DIAM. Make your own sockets for IC's, displays, LSI's etc.

P 0700 Pack of 100 . . . . . **$ 2.00**

P 0701 Pack of 1000 . . . . . **$14.50**

Supplied on "Break off" header pre-spaced .1 inch.

HITACHI MEMORY 6116 SUPER FAST

Just Arrived

120 Nano Sec 6116

Z6116 . . . . . **$12.50**

10 or more **$9.90 each**

Z 80A–6800

Cat No.		Price
Z 8001	Z80A CPU	8.50
Z 8005	Z80A P10	8.50
Z 8010	Z80A CTC	8.50
Z 6802	6802 CPU	9.50
Z 6821	6821 PIA	4.95

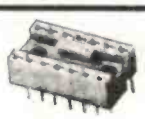
PLESSEY FOSTER 50 watt PA/GUITAR SPEAKERS 12" (300mm) 8 OHM

Huge 50mm Voice Coil. Incredibly efficient.

Were **$69.50 50 only $39.50**

Memo to Mail Order customers We intended restricting these to our Perth shoppers as they are far too bulky and heavy for our normal mail and Jetservice. BUT if you are quick there may be some left for you. Please add $5 per speaker for freight.

IC SOCKETS DIL

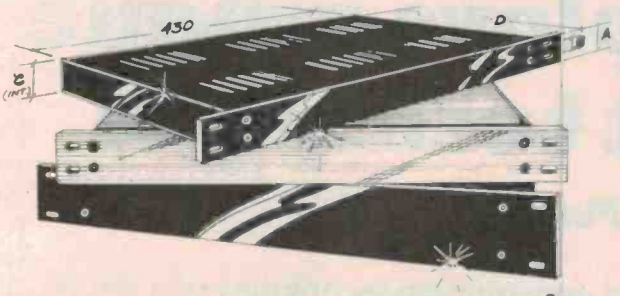


LOW PROFILE

		PRICE	10 Up
P 0550	8 Pin	.25	.20
P 0560	14 Pin	.30	.25
P 0565	16 Pin	.30	.25
P 0567	18 Pin	.40	.35
P 0570	24 Pin	.60	.50
P 0575	40 Pin	.80	.70
P 0580	14 Pin W/Wrap. . . .	.85	.75
P 0585	16 Pin W/Wrap. . . .	.90	.80

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



Cat No.	Finish	A	B	C	PRICE	5 or More
H 0401	Natural	44	34	38	$39.50	$38.00
H 0402	Natural	88	57	82	45.00	42.50
H 0403	Natural	132	89	126	49.50	45.00
H 0411	Black	44	34	38	39.50	38.00
H 0412	Black	88	57	82	45.00	42.50
H 0413	Black	132	89	126	49.50	45.00

Beware of other rack boxes that do not conform to international rack sizing.

THE BRILLIANT MARC NR 82 FI

FEATURING: Digital frequency Display, SSB/CW, FM/AM reception, B.F.O., Double Conversion, Double Super-het, crystal controlled (VHF) Local Oscillator, 4 inbuilt antennas and good looks, you will spend hours just learning how to drive it!

FREE DELIVERY ANYWHERE IN AUSTRALIA OCTOBER ONLY

See Review in Electronics Australia August 1982

3 Way Power ★ Digital Tuning ★ HI FI SOUND ★ 4 Inbuilt Antennae

only $349 C9482

SPECIFICATIONS:

Semi-conductors: 1-LSI, 4 - IC's, 7 - FET, 34 - Transistors, 42 - Diodes

Frequency range:

LW	145-360	KHz	SW3	9-22	MHz	VHF3	88-108	MHz
MW	525-1600	KHz	SW4	22-30	MHz	VHF4	108-136	MHz
SW1	1.6-3.8	MHz	VHF1	30-50	MHz	VHF5	144-176	MHz
SW2	3.8-9	MHz	VHF2	68-86	MHz	UHF	430-470	MHz

Power supply: AC 240V 50Hz. DC 12V (8 x "D" cells). Ext. DC 12V Car/Boat.
Speaker: 12.5cm Permanent Dynamic Speaker (3.2 ohm)
Antenna: Ferrite Bar Antenna for LW, MW and SW1
3 x Telescopic Antenna for SW, VHF and UHF
Controls: Power ON-OFF switch — Digital display ON-OFF switch — Tape-Radio switch, Wide-Narrow band selector switch, AM band selector (LW/MW/SW1/SW2/SW3/SW4), VHF band selector (VHF1/VHF2/VHF3/VHF4/VHF5/UHF), Ant. Selector (Telescopic ANT./EXT. ANT.), Tuning control (direct gear drive), volume control, Bass control, Treble control, Squelch control, BFO pitch control, RF gain control, Antenna adjustor control, Mode switch (USB-NOR-LSB/CW)
Terminals: Ext. Speaker/Headphone Jack, Tape IN-OUT jack, VHF/UHF ANT. connector (coaxial), SW EXT. ANT. terminal (Screw), Ext. battery jack
Meter: Tuning Meter
Digital Frequency Counter Section:
Display: LW/MW/SW-1 KHz SW2-4/VHF1-5 MHz
Control: SW Calibrator Dimensions: 452mm (W) x 288mm (H) x 130mm (D)

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.

SOUTH AUSTRALIA
CITY
ADN Electronics 212 5505
Protronics 212 3111
SUBURBAN
PROSPECT
Jensen Electronics 269 4744
ELIZABETH GROVE
A.E. Cooling 255 2249
CHRISTIES BEACH
Force Electronics 382 3366
KESWICK
Freeway Electric Wholesalers 297 2033

VICTORIA
CITY
All Electronic Components 662 3506
Ellistronics 602 3499
SUBURBAN
FOOTSCRAY
Acron Electronics 689 1911
CHELTENHAM
Talking Electronics 550 2386
HUNTINGDALE
Stewart Electronics 543 3733
SOUTH CROYDON
Truscott Electronics 723 3860
COUNTRY
SHEPPARTON
GV Electronics 21 8866
MILDURA
Electronic and Digital Services 23 3380

NEW SOUTH WALES
CITY
Radio Despatch 211 0191
Electronic Agencies 29 7098
Jaycar 264 6688
SUBURBAN
LEWISHAM
PrePak Electronics 569 9770
CONCORD
Electronic Agencies 745 3077
DEE WHY
David Ryall Electronics 982 7500
WAITARA
Applied Technology 487 2711
MATTRAVILLE
Creative Electronics 666 4000
COUNTRY
BROKEN HILL
Crystal TV 4803
COFFS HARBOUR
Coffs Harbour Electronics 52 5684
PENRITH
Acorn Electronics 21 2409
NEWCASTLE
D.G.E. Systems 69 1625
WINDANG
Madjenk Electronics 96 5066
GOSFORD
Tomorrows Electronics 24 7246
KURRI KURRI
Kurri Electronics 37 2141

QUEENSLAND
CITY
Delsound P/L 229 6155
SUBURBAN
SALISBURY
Colourview Wholesale 275 3188
FORTITUDE VALLEY
St. Lucia Electronics 52 3547
BIRKDALE
Wholesale Sound Accessories 207 2502
COUNTRY
CAIRNS
Thompson Instrument Services 51 2404
TOWNSVILLE
Solex 72 2015
ROCKHAMPTON
Purely Electronics 21058
GLADSTONE
Purely Electronics 72 4321
GYMPIE
TV and Appliance Services 82 1671
IPSWICH
P & P Electronics 281 8001
TOOWOOMBA
Hunts Electronics 32 9677
Down's Radio and TV 32 1044
NAMBOUR
Nambour Electronics 41 1604

NT
DARWIN
Radio Parts Darwin 81 8508
Kent Electronics 81 4749
Ventronics 81 3491
ALICE SPRINGS
Farmer Electronics 52 2967
Ascom Electronics 52 1713

TASMANIA
HOBART
Beta Electronics 34 8232
KINGSTON
Kingston Electronics 29 6802
AVOCA
Freemans TV 84 2166

WEST AUSTRALIA
ALBANY
BP Electronics 41 2681
GERALDTON
Geraldton TV and Radio 21 2777
WYALKATCHEM
D & J Pease 81 1132
MANDURAH
Kentronics 35 3227
KALGOORLIE
Todays Electronics 215 212

ACT
Scientronics 54 8334
Electronic Components 80 4654

RESELLERS WANTED IN ALL AREAS (including WA)

Phone: STEVE WROBLEWSKI (09) 381 7233 for details

NEW 24 HOUR 7 DAYS P/WEEK PHONE ORDER SERVICE FOR BANKCARD HOLDERS

Take advantage of "off peak" low STD phone rates and phone your order to our new recorded 24 hour 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 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 your receive goods. Weight limited 10kgs.

$4 DELIVERY AUSTRALIA WIDE We process your order day received and despatch via Jetservice for delivery next day.

BANKCARD HOLDERS CAN PHONE ORDER 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
105 STIRLING ST., PERTH
FOR INSTANT SERVICE
(09) 328 1599

All Mail Orders:
Box 8280 Stirling St.,
Perth WA 6000

Direct-connect computer modem employs unique new circuit technique

Trevor Marshall

This article describes the design and construction techniques of a direct-connect computer modem to facilitate communications between computers over cables, the telephone network or radio links. It employs a unique 'commutated filter' circuit technique for which a petty patent application has been filed. The way in which this circuit technique is employed overcomes many of the problems associated with conventional modem technology, permitting a very flexible design capable of a range of answer/originate operating modes and 'auto' operation under software control.

IN ORDER to transfer computer and other data of a digital (binary) nature over voice grade (analogue) telephone lines, radio links or cables it is current practice to convert the digital data to a frequency shift keyed (FSK) analogue signal. Data in such a format can be transmitted at up to 1200 bits per second (BPS) over a standard local or STD connection. Either of two frequencies are transmitted, by convention the lower is usually transmitted for a binary *mark*, the higher for a binary *space*. Devices to accomplish this task are called digital data modems. Devices to send analogue data via FSK are called analogue data modems.

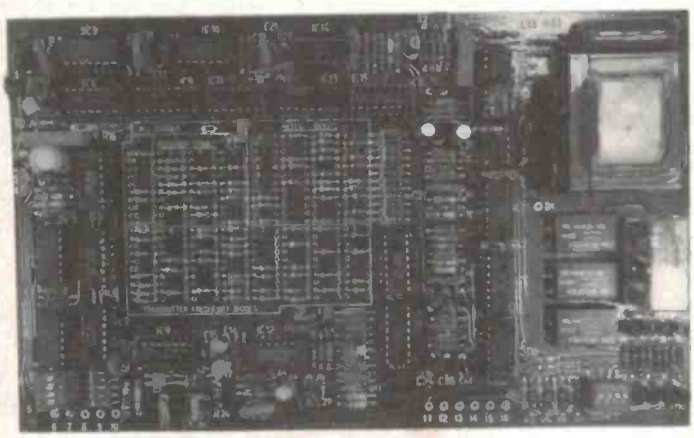
Many different channels for mark and space frequencies are currently used in Australia. Those used purely for data include a full duplex standard 980/1180 Hz and 1650/1850 Hz, a 1200 BPS simplex standard of 1300/2100 Hz and a 75 BPS channel at 390/450 Hz.

Prior Art

It is not common practice to manufacture equipment capable of performing in many (or all) these standard modes. This is due to several factors, but the cost and method of manufacture of the channel filters used to separate the wanted signals from random and impulsive noise or the backward data channel in the receiver has remained the primary consideration. The phase response of these filters is important, as they are being used to process a step frequency signal. Sharp cutoff filters cause a resonance phenomena, reducing the maximum data rate.

Linear-phase or approximately linear-phase filters do not have good selectivity in the frequency domain, and consequently more complex (higher order) filter networks are needed for optimal performance. The prior art has called for different filter network components for each channel to be used. These components, which are required to be manufactured to close tolerances (typically better than 5%), are then switched by electronic or manual means when the new channel is selected.

Alternatively, separate hybrid integrated circuit filter networks, each manufactured to high precision, have been used in a similar fashion.



The invention and the modem

The invention employed in this modem design relates to an improved method of manufacture for these channel filters and associated filters for the recovered data. Only one precision filter network is required to implement all the transfer functions for all current (or any new) mark/space frequency couples. In particular, the same filter can be programmed to the characteristics required for channels used internationally, which vary widely, country by country, from those used in Australia. In addition, many modes of transfer may be supported, such as telephone and radio analogue transmission channels, which require different FSK channel frequencies and data rates.

Further, the programming of the filter's characteristics can be performed adaptively, even synchronously within one period of the waveform being filtered, if necessary. The filter's transfer function with respect to data recovery may also be optimised adaptively during the transmission of a predetermined or random test sequence prior to the commencement of or during the transmission of the data.

Thus, not only is such a filter cheaper to manufacture than multiple discrete filters but its transfer function may be varied adaptively in order to improve data recovery from any given telephone line or other transmission media.

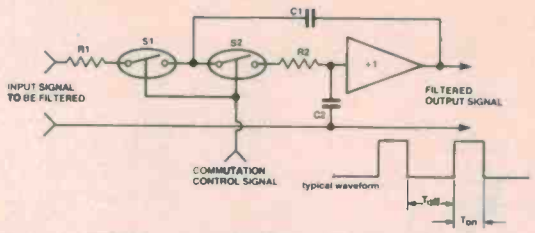


Figure 1. **Typical circuit of a commutated filter. The commutation frequency is typically 50 times the signal frequency being filtered. S1 and S2 may be CMOS switches. e.g: 4016, 4066 or similar.**

The filter uses active or passive filter networks (for example see Figure 1) in which the effective value of the network resistors (R1,R2) is made variable by varying the duty cycle of very fast electronic switches (S1,S2) in series with them. These electronic switches typically are commutated at a frequency greater than 20 kHz. The commutating frequency must be sufficiently large so that intermodulation components of significant amplitude are not generated in the FSK passband.

The transfer function of the circuit of Figure 1 (neglecting intermodulation component generation) is given by:

$$G(S) = \frac{1}{S^2\,C1\,C2\,R1\,R2\left(\frac{T\,on+T\,off}{T\,on}\right) + S\,C2\left(\frac{T\,on+T\,off}{T\,on}\right)(R1+R2) + 1}$$

It can be seen that the cutoff frequency of the filter is the same as if the filter had been made from resistors each of value:

$$R\,effective = \frac{T\,on + T\,off}{T\,on} \times R\,actual$$

The filter networks can be highpass, lowpass or bandpass of any order (some examples are shown in Figure 2) and of widely varying topology.

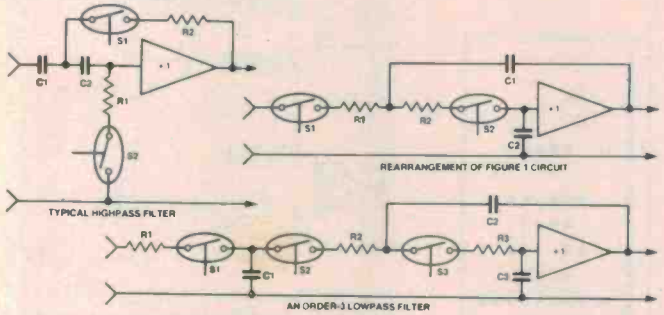


Figure 2. **Examples of different implementations of the commutated filter.**

It is possible to design filter networks in which the capacitors are commutated (switched capacitor filters), but they are harder (and more expensive) to make in discrete or hybrid IC form.

The capacitors in the lowpass networks may be designed to be of equal value, facilitating manufacture further, as only the mismatch between them, and not their absolute value, would be required to conform to the accuracy tolerance (typically 5%).

The recovered data is usually further processed to remove undesired frequency components from it. As the data rate may typically (but not essentially) vary from 75 BPS to 1200 BPS, a variable filter of the type disclosed by this invention, adaptive or not, can be used advantageously in such an application.

Design details

The CCITT Recommendation V.21 contains the specifications for a 200 baud modem for use on the switched public telephone network. Modems following this specification are the most commonly used variety currently in Australia.

Advancing technology has generally increased the reliable V.21 speed from 200 to 300 baud and this unit is capable of performing well at 600 baud (high band) and 450 baud (low band). The low band is 980 Hz (Binary 0, or space) to 1180 Hz FSK. The high band is 1650 Hz to 1850 Hz FSK.

Although this modem can achieve adequate data recovery at 600 baud on low band, the filter networks have been optimised for adjacent channel suppression, rather than high speed.

CCITT V.23 contains the specification for modems operating up to 1200 baud on the switched public network. The frequencies used are 1300 Hz and 2100 Hz. At a modulation rate of 1200 baud the sidebands extend down to about 300 Hz and up to about 2700 Hz, taking up the whole audio channel bandwidth. The only way to achieve faster data rates is to change to the PSK mode (usually with dedicated microprocessor control). This also places greater constraints on the line.

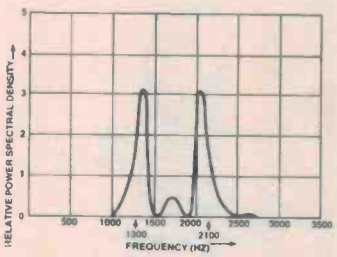


Figure 3. **Relative power spectrum of a 600 baud FSK signal using 1300 Hz and 2100 Hz frequencies.**

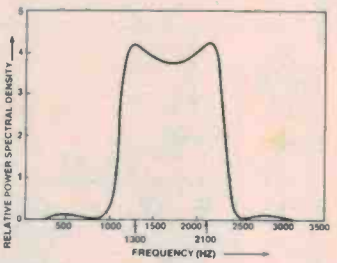


Figure 4. **Relative power spectrum of a 1200 baud FSK signal using the same frequencies — modem receive filter requirements are much more stringent.**

A backward channel 'for error control' has been defined as 75 baud, 390 Hz/450 Hz. Although the sidebands of the forward and backward channels overlap, provided adequate balancing of the line hybrid is achieved at both ends the two channels may be used simultaneously.

A 1200/75 baud modem would seem to be the most efficient means of transfering data primarily in one direction, which is the primary mode of data transfer currently used by hobbyists.

Both 1200/75 baud and 300/300 baud transmission modes are used with acoustically coupled equipment.

Problems with conventional technology

No modems currently available implement all the above modes due to the variety of filter requirements, amongst other things. Lowpass filters with orders of at least four are required at 500 Hz, 1200 Hz, 1950 Hz and 2500 Hz, and similarly complex highpass filters are required at 400 Hz, 900 Hz and 1550 Hz.

Conventional modem designs use a phase-locked loop to decode the incoming FSK signal back into the original binary data. A phase-locked loop uses a feedback signal from a phase comparator to vary the frequency of an internal voltage-controlled oscillator until it matches that of the input signal. Normally, a simple RC filter is employed in the feedback loop. It is the design of the feedback filter that ultimately determines the maximum data rate that can be achieved with such a decoder.

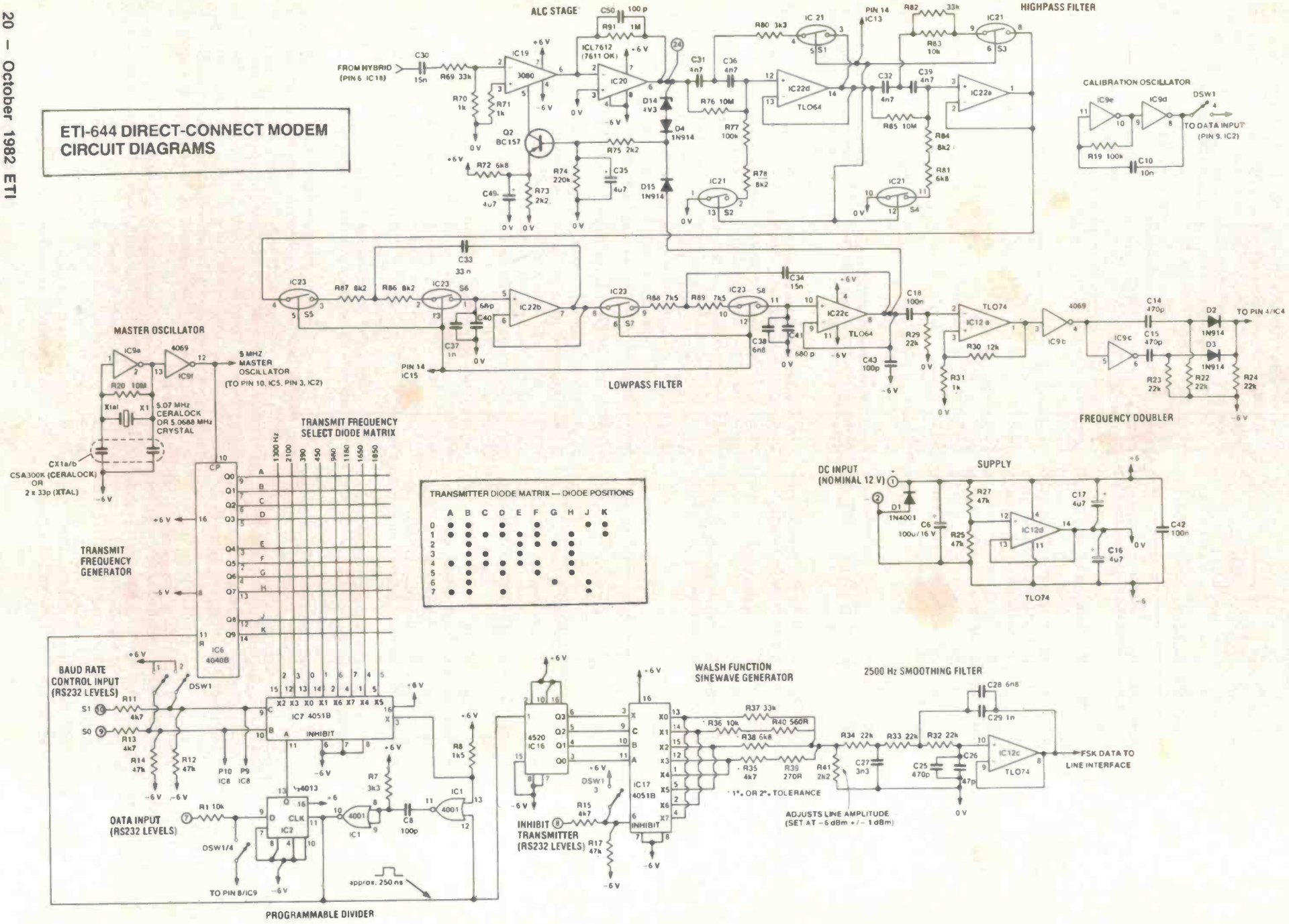
As with most feedback circuitry, the design of the loop gain and feedback transfer function is extremely complex, so optimal performance rarely results. If the gain is too high for a particular feedback network then the circuit will 'ring' and may even oscillate at the wrong frequency whenever the input FSK frequency changes. If the gain is too low the maximum data rate will be reduced. In addition, a frequency counter and much patience is usually necessary to set up a phase-locked loop decoder.

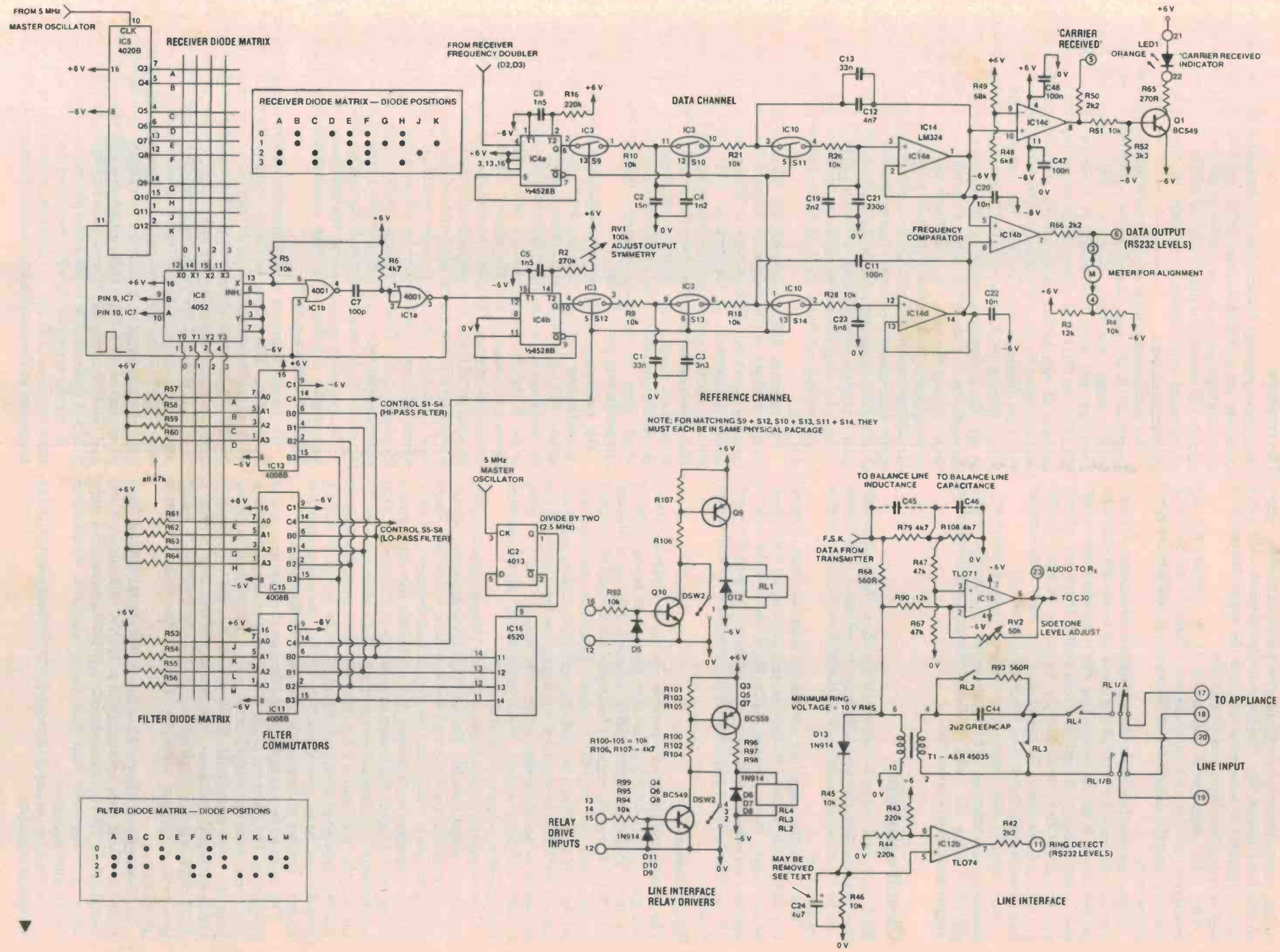
This design has eliminated this problem by employing a simple commutated variable frequency filter for each of the lowpass and highpass functions.

Also, by using a frequency doubling detector this circuit circumvents the necessity for critical design, making the components less critical and ensuring optimal performance.

The input frequency is doubled and used to trigger a mono-▶

ETI-644 DIRECT-CONNECT MODEM CIRCUIT DIAGRAMS




FROM 5 MHz MASTER OSCILLATOR
CLK
IC5 4020B
RECEIVER DIODE MATRIX
RECEIVER DIODE MATRIX — DIODE POSITIONS
FROM RECEIVER FREQUENCY DOUBLER (D2,D3)
DATA CHANNEL
'CARRIER RECEIVED'
LED1 ORANGE
'CARRIER RECEIVED' INDICATOR
IC14 LM324
FREQUENCY COMPARATOR
DATA OUTPUT (RS232 LEVELS)
METER FOR ALIGNMENT
RV1 100k ADJUST OUTPUT SYMMETRY
IC8 4052
PIN 9, IC7
PIN 10, IC7
IC1b
IC1a
C7 100p
IC4a
IC4b
½4528B
REFERENCE CHANNEL
NOTE: FOR MATCHING S9 + S12, S10 + S13, S11 + S14, THEY MUST EACH BE IN SAME PHYSICAL PACKAGE
CONTROL S1-S4 (HI-PASS FILTER)
CONTROL S5-S8 (LO-PASS FILTER)
IC13 4008B
IC15 4008B
IC11 4008B
all 47k
FILTER DIODE MATRIX
FILTER COMMUTATORS
FILTER DIODE MATRIX — DIODE POSITIONS
5 MHz MASTER OSCILLATOR
DIVIDE BY TWO (2.5 MHz)
IC2 4013
IC16 4520
RELAY DRIVE INPUTS
R100-105 = 10k
R106, R107 = 4k7
BC559
BC549
1N914
RL1
RL2
RL3
RL4
LINE INTERFACE RELAY DRIVERS
TO BALANCE LINE INDUCTANCE
TO BALANCE LINE CAPACITANCE
F.S.K. DATA FROM TRANSMITTER
AUDIO TO Rx
TO C30
SIDETONE LEVEL ADJUST
TLO71
MINIMUM RING VOLTAGE = 10 V RMS
2u2 GREENCAP
T1 — A&R 45035
TO APPLIANCE
LINE INPUT
MAY BE REMOVED SEE TEXT
TLO74
RING DETECT (RS232 LEVELS)
LINE INTERFACE

stable. A crystal-derived reference frequency is used to trigger an identical monostable. The filtered ('dc') outputs of these are then compared to determine whether the input frequency is higher than the reference or vice versa.

The only adjustment necessary is to compensate for imbalance in the two monostables. There is no feedback network and the design of the filters can follow conventional procedures.

These approaches have the additional advantage of eliminating the need for critical adjustments to ensure optimum performance. If phase-locked loop discriminators were used, each would require bandwidth and centre frequency adjustment with a CRO and frequency counter — a total of eight critical adjustments. In addition, the eight transmitter frequencies would have to be adjusted individually.

This design uses frequencies derived (phase-coherently) from a crystal reference. The output sinusoid is then generated digitally using the order-8 Walsh function synthesis (best approximation to a sinusoid).

Circuit operation

There are three major sections in the modem: the transmitter, the receiver and the line interface. In addition, a 600 baud (nominal) reference oscillator is provided on-board for setting up purposes.

This is not the place, nor is there the room, for discourses on how data multiplexers, Walsh function generators and linear-phase filters work, so this explanation assumes at least a passing knowledge of circuit techniques mentioned, the overall operation being explained with reference to the circuit diagram.

The transmitter

The master oscillator is a parallel oscillator involving IC9a, one gate from a 4069 hex inverter, the output being buffered by IC9f. Either a 5.0688 MHz quartz crystal or a Murata 5.07 MHz 'Ceralock' ceramic resonator can be used. If a crystal is employed, two 33p NPO ceramic capacitors are required, whereas if a Ceralock is used, the matching loading capacitor pack (CSC300K) is required. Provision has been made on the pc board to accommodate either alternative. The 5.07 MHz master oscillator output, which serves both the transmitter and receiver, is from pin 12 of IC9.

The master oscillator drives a 4040B 12-stage counter (IC6) used as a programmable divider. This counter is reset whenever a terminal count, set by a diode matrix, is reached. There are eight sets of diodes, one for each output frequency. A 4051 8-to-1 analogue multiplexer (IC7) connects the appropriate diodes to the input of the reset monostable in IC6 (pin 11). This multiplexer is controlled by the data input (board terminal 7) via a latch, IC2, and a 2-bit channel select code (labelled S0 and S1) applied at terminals 9 and 10 on the board. S0 and S1 may be 'set' by two switches from DSW1, obviating external control. Table 1 gives the selection logic for S0 and S1.

The reset pulses to IC6 are at 16 times the required output frequency. They are fed to the clock input of one counter of a 4520 dual 4-bit up-counter (IC16, pin 1). This is used to derive polarity and amplitude information for the transmitter sinusoid signal synthesis. The outputs of the 4520 control a 4051 data selector (multiplexer, IC17), the outputs of which generate a stepped sinusoid. This is the Walsh function generator.

A linear-phase filter with a cutoff of 2500 Hz follows. This involves IC12c (one op-amp from a TL074) and surrounding components. This acts as a smoothing filter to remove the steps from the waveform and any out-of-passband components which may be present.

Transmitter output is from pin 8 of IC12c and goes to the line interface circuitry.

The receiver

The centre channel frequencies are derived from the master oscillator via a 4020B counter (IC5) and half of a 4052 dual 4-to-1 multiplexer (IC8), controlled by the 2-bit channel select signals (S0 and S1, to pins 9 and 10 of IC8). The same reset-on-terminal-count scheme as used in the transmitter is implemented here.

The input signal from the line interface is buffered by an amplifier (IC18) and passed to an automatic level control (ALC) stage involving IC19, a 3080 transconductance amplifier, the output of which is buffered by an Intersil ICL7612 (or 7611) low power, high input impedance op-amp capable of rail-to-rail output drive. The transconductance control signal for the 3080 is derived from two feedback paths. The first feedback path is from the output of the receiver filters, from pin 8 of IC22c, via D15. This provides base current to Q2, the collector current of which controls the current through pin 5 of the 3080, the transconductance control pin, thus varying the gain. This feedback path operates for low-level signals up to a certain threshold where the output of IC20 exceeds the zener voltage of D14 and the second feedback path comes into operation, further increasing the collector current of Q2, decreasing the gain of the 3080, IC19. This feedback path acts to prevent clipping on the output of IC20.

The ALC loop adapts the received signal strength such that a signal level of about 1.5 V peak-to-peak results on pin 8 of IC22c.

The receiver filters comprise two 0.5 dB Chebychev commutated filters, one highpass involving IC22 a and d, and one lowpass involving IC22 b and c. These remove unwanted signal components. A comparator with hysteresis, IC12a, squares up the signal for the frequency doubling circuitry. This involves two inverters from IC9 (b and c). Two signals are derived by these gates, 180° out of phase and they drive a two-diode multiplier (i.e: a full-wave rectifier) the output of which goes to the data channel input of the frequency comparator (to pin 4, IC4a).

The commutated filters in the receiver are controlled by variable pulse width signals derived digitally from three 4-bit adders, IC11-IC13-IC15 (all 4008). A scan signal at 2.5 MHz, derived from the master oscillator by IC2, a 4013, is supplied to the B inputs of these adders from a 4520 dual 4-bit synchronous counter (IC16). The adder A inputs are programmed via a diode matrix. The 2-bit channel control signal (S0,S1) is decoded by IC8, the Y outputs driving the diode matrix to the 4-bit adders. If, say, the A inputs of an adder were programmed with 1110 then the carry output would be inactive for scan counts of 0 or 1, but would be active (true) for the rest of the count cycle. Thus, the output pulse width can be preprogrammed digitally via the diode matrix and optimised without the necessity for many high stability components.

The frequency comparator is implemented with a 4528 dual monostable flip-flop, IC4, two commutated filters and a voltage level comparator.

The twice-frequency pulses from the receiver trigger monostable IC4a. The output of this is cleaned up by an order-3 commutated lowpass filter involving IC14a, one op-amp from an LM324, to remove components of the resultant signal other than the data. The reference pulses are processed identically by IC4b and IC14d, to ensure matching over the entire range of input frequencies. IC14b provides the comparator and output is at RS232 levels via terminal 6 on the board. Adjustment of the output symmetry is provided by varying monostable IC4b by means of RV1. Note that, for proper matching of the data and reference channel filters, switches S9/S12, S10/S13 and S11/S14 must each be in the same physical package.

A 'carrier received' signal is provided via IC14 and Q1. The latter drives a LED which lights whenever a tone above 350 Hz is present at the input of the modem. Terminal 5 on the board

provides a 'carrier received' signal output for external use.

Line interface

The line interface couples the modem to the line and provides line switching, answer and dialling facilities.

Signals are coupled to and from the line via an Arlec 600 ohm to 600 ohm line isolating transformer, type 45035 (Telecom approval No. RA81/144). The isolated winding of T1 (pins 6 and 10) is in one 'leg' of a bridge hybrid which separates transmit and receive signals. This consists of R68 and the isolated winding of T1 on one side, and R79/R108 on the other side. The transmit signal is applied to the 'top' of the bridge at the junction of R68 and R79. The received signal is taken from the nodes of the bridge at the junctions of R68/T1 and R79/R108 via a TL071 op-amp, IC18. Sidetone level is adjusted by varying the negative feedback via RV2 which may be a front panel control if desired, to cope with week-to-week variations in line balance.

A full bridge network is used to balance lines of uncertain impedance, particularly those exhibiting capacitive or inductive reactance. A capacitor may be added to compensate for either case. Usually, lines will be found to be capacitive, in which case C46 should be added. The exact value should be determined experimentally. A value of 10n is a good starting point. For inductive lines, C45 should be added. Again, start with a value of 10n. One or other of these capacitors should be added and the value found which gives the deepest sidetone null when adjusting RV2. This is best done using an audio monitor (see later) or an ac voltmeter connected to the output of IC18 (terminal 23) and *must be performed while the modem is on.*

Line switching is provided by a DPDT relay, RL1. This connects the line to a standard telephone, or whatever appliance is installed in cases where a telephone line is not used (e.g: a radio transceiver), whenever the modem or computer is de-powered. (Note: Telecom approval is required before attaching the modem to Telecom lines.)

Relay RL4 is normally closed and relay RL3 is normally open, except when dialling. When dialling under computer control RL3 is first closed, then RL4 is pulsed with the appropriate sequence. RL3 is opened after dialling is completed.

Relay RL2 is used to 'answer' a call. It is normally open, but when a ring is detected by the ring detector circuit, RL2 closes to 'answer' the call.

The ring detector circuit consists of a rectifier and voltage comparator. Diode D13 rectifies the ring pulses coming via T1, and charges C24. When the charge on C24 exceeds 3 V, the output of IC12b goes towards the positive supply rail (high), providing a 'ring detect' signal at terminal 11 on the board. If so desired, C24 may be omitted, in which case the 'ring detect' output will toggle high and low when ringing pulses are received.

Adjustments

A 600 baud (nominal) reference oscillator is provided on-board for setting up purposes. This is a simple two-inverter oscillator using two gates from IC9 (e and d). This connects to the transmitter data input, at pin 9 of IC2, via DSW1/4.

In setting up the modem, the transmitter and receiver are both programmed for 300 baud operation (high channel, 1750 Hz) and DSW1/4 turned on. A dc voltmeter is connected between terminal 3 (data output) and terminal 4 (which provides a reference of about −0.5 V). Trimpot RV1 is then adjusted until the dc voltmeter reads close to zero. If a CRO is available, then the data output should be adjusted such that the output signal has 50-50 symmetry.

The sidetone level adjust trimpot, RV2, is set whilst the modem is 'on line' so that the level of any signal present at the output of IC20 (terminal 24) due to the transmitted signal is nulled. This can best be done by connecting a dc voltmeter across C35 (across the emitter resistor of the ALC control transistor, Q2). Adjust RV2 such that this voltage is minimised. This procedure should be done in conjunction with the line balance.

The transmitter line level is best set at around −12 dBm, from experience. This can be effected by varying the value of R41. If you wish, a multiposition switch can be used to provide line levels of −6, −12 and −18 dBm to cope with differing line conditions.

Computer control

It is expected that this modem will be controlled by a computer. Hence, modem control algorithms need to be developed for effective use of the modem. There are two modes of operation: answer and originate. (Note: Telecom approval is required before attaching the modem to Telecom lines.)

Answer mode

It is expected that the computer will energise RL1 and RL4, and de-energise RL2, RL3 and the transmitter and wait for an output from the ring detector. When a valid ring has been obtained RL2 will be closed to answer the call.

Each baud rate will be selected in turn until a valid carriage return signal has been obtained. The transmitter will then be energised and another two valid carriage returns sought. If they are not obtained within a time-out period it will be assumed that the transmitter has 'blanketted' the receiver signal and the remote user will be notified to try another line (at the current baud rate) and then disconnected.

If all is OK the communication session can begin.

Originate mode

The computer will energise RL1, RL4 and RL3. RL4 will then be pulsed in the proscribed 2:1, 100 msec nominal manner until the number to be dialled has been completed. RL2 will then be energised, RL3 de-energised and the transmitter enabled.

Monitoring

Two monitors are recommended: an audio monitor and a signal meter. Both are quite simple to implement, but have not been included on the printed circuit board.

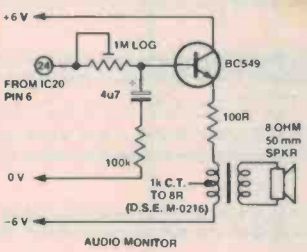


Figure 5. **Suggested circuit for an audio monitor.**

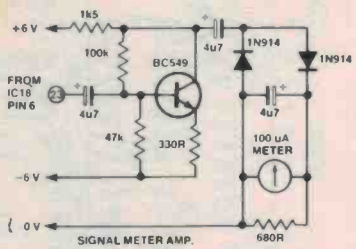


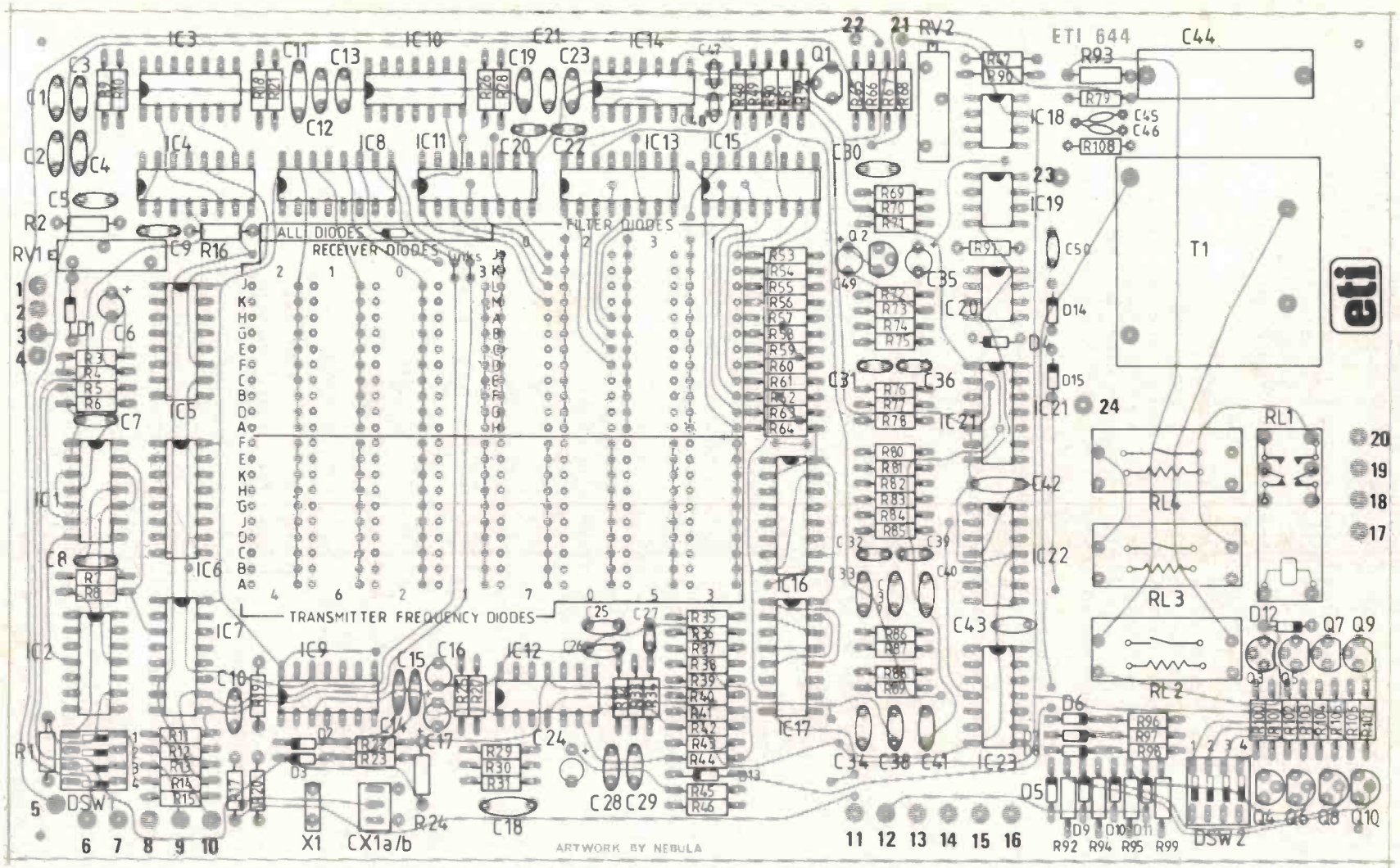
Figure 6. **Suggested circuit of a signal strength meter.**

The circuit of a suitable audio monitor is shown in Figure 5. This is invaluable in monitoring the status of dialling software and to assist when balancing the line hybrid (selecting C45/C46). A simple emitter follower takes output from terminal 24 (ALC stage output), gain being adjustable via the 1M pot. A 50 mm diameter speaker is coupled via a small 1k-to-8 ohm 'transistor output' transformer (such as the Dick Smith type, No. M-0216, or similar).

A signal meter circuit is shown in Figure 6. This comprises a simple ac amplifier and voltage doubler rectifier driving a 100 microamp meter. Input comes from terminal 23 (audio to receiver). This circuit is very useful for setting the line balance pot. (RV2). A low cost miniature meter can be used.

Construction

As the circuitry is complex, construction on a double-sided plated-through hole pc board is recommended. In fact, the final ▶



ETI-644 DIRECT-CONNECT MODEM COMPONENT OVERLAY

Note: only the top-side tracks are shown for the sake of clarity.

S1	S0	TRANSMIT CHANNEL	RECEIVE CHANNEL
0	0	75 BAUD	1200 BAUD
0	1	1200 BAUD	75 BAUD
1	0	300(600)	300 BAUD 'ANSWER' MODE
1	1	300	300(600) 'ORIGINATE' MODE

TABLE 1.
BAUD RATE
CONTROL LOGIC

DSW1/1	S0	BAUD RATE
DSW1/2	S1	SELECT (ON=HI)
DSW1/3	INHIBIT TRANSMITTER (ON=INHIBIT)	
DSW1/4	CALIBRATION OSC. (ON=CALIBRATE)	
DSW2/1	OPERATE RL1 (MODEM ON LINE)	
DSW2/2	OPERATE RL2	
DSW2/3	OPERATE RL3	
DSW2/4	OPERATE RL4	

TABLE 3. DIP SWITCH FUNCTIONS

PARTS LIST — ETI-644

Resistors ..... all ½ W, 5% unless noted

R1	10k
R2	270k
R3	12k
R4	10k
R5	10k
R6	4k7
R7	3k3
R8	1k5
R9	10k
R10	10k
R11	4k7
R12	47k
R13	4k7
R14	47k
R15	4k7
R16	220k
R17	47k
R18	10k
R19	100k
R20	10M
R21	10k
R22	22k
R23	22k
R24	22k
R25	47k
R26	10k
R27	47k
R28	10k
R29	22k
R30	12k
R31	1k
R32	22k
R33	22k
R34	22k
R35	4k7, 2%
R36	10k, 2%
R37	33k, 2%
R38	6k8, 2%
R39	270R
R40	560R
R41	2k2
R42	2k2
R43	220k
R44	220k
R45	10k
R46	10k
R47	47k
R48	68k
R49	68k
R50	2k2
R51	10k
R52	3k3
R53	10k
.	.
. to	.
.	.
R64	10k
R65	270R
R66	2k2
R67	47k
R68	560R
R69	33k
R70	1k
R71	1k
R72	6k8
R73	2k2
R74	220k
R75	2k2
R76	10M
R77	100k
R78	8k2
R79	4k7
R80	3k3
R81	6k8
R82	33k
R83	10k
R84	8k2
R85	10M
R86	8k2
R87	8k2
R88	7k5
R89	7k5
R90	12k
R91	1M
R92	10k
R93	560R
R94	10k
R95	10k
R96	560R or link
R97	560R or link
R98	560R or link
R99	10k
.	.
. to	.
.	.
R105	10k
R106	4k7
R107	4k7
R108	4k7
RV1	100k 10-turn trimpot.
RV2	50k 10-turn trimpot. (or rotary pot.)

Capacitors

C1	33n greencap
C2	15n greencap
C3	3n3 ceramic
C4	1n ceramic
C5	1n5 styro or mica
C6	100u/16 V RB electro.
C7	100p ceramic
C8	100p ceramic
C9	1n5 styro or mica
C10	10n ceramic
C11	100n greencap
C12	4n7 greencap
C13	33n greencap
C14	470p ceramic
C15	470p ceramic
C16	4u7/16 V RB electro.
C17	4u7/16 V RB electro.
C18	100n greencap
C19	22n ceramic
C20	10n ceramic
C21	33p ceramic
C22	10n ceramic
C23	6n8 greencap
C24	4u7/16 V RB electro.
C25	470p ceramic
C26	47p ceramic
C27	3n3 greencap
C28	6n8 greencap
C29	1n ceramic
C30	15n greencap
C31	4n7 greencap
C32	4n7 greencap
C33	33n greencap
C34	15n greencap
C35	4u7/16 V RB electro.
C36	4n7 greencap
C37	1n ceramic
C38	6n8 greencap
C39	4n7 greencap
C40	68p ceramic
C41	680p ceramic
C42	100n ceramic (blue chip)
C43	100p ceramic
C44	2u2 greencap or PETP type, 100 V
C45	10n greencap (see text)
C46	10n greencap (see text)
C47	100n ceramic (blue chip)
C48	100n ceramic (blue chip)
C49	4u7/16 V RB electro.
C50	100p ceramic
CX1a/b	2 x 33p NPO ceramic if xtal used, or CSC300K Ceralock loading capacitor (see text).

Semiconductors

D1	1N4001
D2 to D13,D15	1N914
D14	4V3, 400 mW zener

(note, 1N914 diodes will be needed for programming the diode matrices)

IC1	4001
IC2	4013
IC3,10,21,23	CD4016CN or MM5616AN
IC4	4528B
IC5	4020B
IC6	4040B
IC7,IC17	4051B (not Motorola type)
IC8	4052
IC9	4069
IC11,13,15	4008B
IC12	TL074, uA774 etc.
IC14	LM324
IC16	4520
IC18	TL071, uA771 etc.
IC19	CA3080, LM3080
IC20	ICL7612 or 7611
IC22	TL064 (preferred, otherwise use TL074, uA774)
LED1	TIL220 orange LED
Q1	BC549
Q2	BC157
Q3,5,7,9	BC559

Miscellaneous

DSW1,DSW2	4-way SPST DIP switches.
RL2,3,4	Fujitsu FRL644E05/1AK (5 V) or FRL644E12/1AK (12 V) micro reed relays, Telecom approval RA81/130.
RL1	Fujitsu FRL621D012, 12 V DPDT pc mount relay.
T1	Arlec 600:600 ohm isolating transformer 45035, Telecom approval RA81/144
X1	5.0688 MHz HC18/U crystal or CSA5.07MT Ceralock resonator.

ETI-644 pc board; 12 Vdc plugpack, 200 mA or greater rating or similarly rated power supply.

Price estimate
$160 — $170
(excludes power supply)

TABLE 2. TERMINAL DESIGNATIONS

TERMINAL	USE
1	+VE INPUT, 12 V SUPPLY
2	−VE INPUT, 12 V SUPPLY
3	TO METER +VE > OUTPUT
4	TO METER −VE > SYMMETRY ADJUST
5	'CARRIER RECEIVE' OUTPUT
6	DATA OUTPUT (RS232 LEVELS)
7	DATA INPUT (RS232 LEVELS)
8	INHIBIT TRANSMITTER (HI=INHIBIT)
9	S0 > BAUD RATE CONTROL
10	S1 > INPUT (RS232 LEVELS)
11	'RING DETECT' OUTPUT
12	0 V (BOARD COMMON)
13	DRIVE RL4 (HI TO OPERATE)
14	DRIVE RL3 (HI TO OPERATE)
15	DRIVE RL2 (HI TO OPERATE)
16	DRIVE RL1 (HI TO OPERATE)
17	TO APPLIANCE NORMALLY CONNECTED TO LINE
18	TO APPLIANCE NORMALLY CONNECTED TO LINE
19	LINE INPUT
20	LINE INPUT
21	LED 1 ANODE > 'CARRIER RECEIVED'
22	LED 1 CATHODE > INDICATOR
23	RECEIVED AUDIO (TO SIGNAL STRENGTH MONITOR)
24	AUDIO MONITOR OUTPUT

(Note: Telecom approval required before attaching modem to Telecom lines.)

prototype boards employed this sort of construction with the addition of solder masking, tinned tracks and a silk-screened component overlay. The board measures 223 x 136 mm and mounting holes are located near each of the four corners.

As some 23 ICs, 50 capacitors and over 100 resistors plus quite a number of other components are used, the component overlay has an orthogonal numbering scheme so that components are readily identified and located with the aim of considerably reducing errors in assembly. Component numbering commences at the top left hand corner of the board. Numbers are allocated in ascending order from top to bottom, left to right across the board. Revisions of earlier prototypes, necessitated from experience in actual use, have required minor changes to be made and there are several exceptions to this component numbering convention. Components out of order are as follows:

R47 right of RV2	**C49** left of Q2
R79 below R93	**C50** right of IC19, 20
R108 below R79	**D13** between R44,45
C45,46 right of IC18	**D14** right of IC20
C47,48 right of IC14	**D15** right of IC21

The relays are numbered to correspond with the switch numbers on DSW2. Twenty four terminals are provided for data input, data output, programming control, monitoring and supply. These are located around the edge of the board, numbered clockwise from the left hand side, with the exception of terminals 23 and 24. Terminal 23 is located to the right of IC19, 24 to the right of IC21.

The three diode matrices are located adjacent to the relevant circuitry with the numbered columns running vertically and the lettered rows running horizontally. All diodes inserted should have their cathode (banded) ends facing toward the left. Details on programming the matrices are given later.

Prototypes were constructed using sockets for the ICs to facilitate debugging and performance checking. They aren't essential but can be handy.

Actual assembly is fairly straightforward. A temperature-controlled soldering iron with a narrow wedge tip is recommended for best results with soldering. If you're using IC sockets, these should be assembled and soldered in place first. All the resistors and capacitors can follow, otherwise, they come first. Watch orientation on the electrolytic capacitors. The component overlay indicates the positive lead with a small '+'. Note that links may be needed in lieu of resistors for R96, R97 and R98 — see relay mounting details later.

Leave out C45 and C46, these won't be necessary until actually setting up the modem. You'll only need one or the other anyway. Alternatively, as most lines seem to exhibit a capacitive reactance (from experience), you could take a punt and put in a 10n at C46.

Leave C44 till last. Note that this should be a metallised

MODEMS AND THE LAW

At present, the Australian Telecommunications Commission ("Telecom"), by virtue of the Telecommunications Act 1975 ("The Act"), has control of what may be connected to the public telephone network. It is an offence under the Act to attach any apparatus other than an approved device or an appliance rented from Telecom to a telephone line. There is nothing wrong with constructing and using the modem described here provided you do not attach it to Telecom lines without approval from Telecom. It could be used by radio amateurs for computer communications by radio, for example, or the modem could be used over an internal intercom or other cable system. Here is what the Act has to say about the subject:

"Section 3 (1)

"telecommunications installation" means —
(a) a line; or
(b) any equipment, apparatus, structure, tower, antenna, tunnel, man hole, pit or pole used, or intended for use, in connexion with a telecommunications service;

"telecommunications service" means —
(a) a service for transmitting, by means of electric or electro-magnetic energy —
(i) sounds, including speech and music;
(ii) visual images;
(iii) signals for the communication, whether as between persons and persons, things and things or persons and things, of any matter otherwise than in the form of sounds or visual images; or
(iv) signals for the actuation or control of machinery or apparatus; or

(b) a service for receiving any such sounds, images or signals that have been transmitted by means of electric or electro-magnetic energy;

"telecommunications system" means a system controlled by the Commission in connexion with the provision of a telecommunications service

Section (11)

(1) The Commission may, from time to time, make, with the approval of the Minister determinations fixing or varying —
(a) The rental payable in respect of standard telephone services provided by the Commission;
(b) The charges for telephone calls made within Australia, other than charges for special services provided by the Commission in connexion with those calls; and
(c) .....

(2) The Commission may, from time to time, make determinations fixing or varying rentals and charges, other than rentals and charges referred to in Sub-Section (1), for Telecommunications services and other services that the Commission provides under this Act.

Section 13

(1) The Commission —
(a) may authorise a person to erect, maintain or operate a telecommunications installation other than an installation for the purpose of transmitting or receiving messages by means of wireless telegraphy; and
(b) may authorise the attachment of a line, equipment or apparatus, including equipment or apparatus for the purpose of transmitting or receiving messages by means of wireless telegraphy, to a telecommunications system.

(2) The Commission may specify, in an authorisation issued under Sub-Section (1) the period in respect of which, and the terms and conditions subject to which, the authorisation is to operate.

Section 87

(1) .....
(2) A person shall not, by means of an apparatus or device connected to a telecommunications installation belonging to the Commission or used in connexion with a telecommunications system —
(a) defraud the Commission of any rental, fee or charge properly payable for the use of a telecommunications service; or
(b) cause the Commission to provide a telecommunications service to some other person without payment by that other person of the appropriate rental, fee or charge.
Penalty: Imprisonment for five years.

Section 90

A person shall not wilfully damage, deface, interfere with, remove or destroy a telecommunications installation or any part thereof belonging to the Commission.
Penalty: Imprisonment for two years.

Section 94

(1) Subject to Sub-Sections (2) and (3) a person other than the Commission
(a) Shall not erect, maintain or operate a telecommunications installation within Australia; or
(b) Attach a line, equipment or apparatus to a telecommunications system
Penalty: Imprisonment of two years.

(2) .....

(3) Sub-Section (1) does not apply to the attachment of a line, equipment or apparatus to a telecommunications system to the extent that the attachment is authorised by the Commission under Section 13 and the terms and conditions subject to which it is so authorised are complied with.

(4) The Commission may authorise a person to take possession of, remove or destroy the whole or any part of a telecommunications installation established, maintained or operated in contravention of this section and may enter on premises at any reasonable hour of the day for that purpose."

Those wishing to seek approval for the use of this modem on the public telephone network should contact the Telecom head office in the capital city of their state. A fee is payable for type approval testing.

mylar ('greencap') or metallised polyester (PETP) type rated at 100 V or 250 V with a 'self-healing' breakdown characteristic.

Special mention must be made of CX1a/b. If a quartz crystal is used, then two 33p NPO ceramic capacitors are required. These mount to the right of X1, parallel to the long axis of the board — you'll see two component pads to the right of the box marked 'CX1a/b'. If you are using a Ceralock resonator (made by Murata), then its accompanying loading capacitor pack — CSA300K — mounts inside the box marked 'CX1a/b'.

All the diodes and transistors may be assembled next, but take care with diode orientation. The two ten-turn trimpots, RV1 and RV2, may be mounted next, followed by X1 (quartz crystal or Ceralock resonator) and the two 4-way DIP switches (DSW1 and DSW2). Watch which way around you mount these last two components.

The three micro reed relays may now be mounted. Note that their connections are marked on the case and the pc board component overlay shows the same markings to indicate correct orientation. These relays are available with coils for either 5 V or 12 V operation. If you have the 5 V types, then resistors R96, R97 and R98 will be necessary (560R each), otherwise links should be inserted in these resistor positions on the board.

With the micro reed relays in place, you can mount the double-pole changeover relay and the line isolating transformer, T1, last of all.

Note that there are two links required. These are located in the receiver diode matrix area, at the top of column 3.

Having completed this phase of construction, check the board thoroughly, *both sides*. Correct any errors you may find and see that all soldered joints are properly made and that there are no solder bridges between adjacent pads. A solder-masked board generally obviates the latter problem.

If all is OK, plug in IC12 *only*, set all switches in DSW1 & 2 open, and apply power. Check the power supply rails with a multimeter for correct operation. Operate each of the switches in DSW2 in turn and see that the corresponding relay operates: DSW2/1 operates RL1, DSW2/2 operates RL2 etc. Trace and correct any faults.

Power down and then insert all of the ICs, taking care to orient them correctly — all 'vertical' ICs have pin 1 facing the top of the board, all 'horizontal' ICs have pin 1 facing the left hand side. Use the usual handling precautions with the CMOS ICs. The modem can then be tried out by carrying out the operations listed under the heading 'Adjustments'. ●

PRINTED CIRCUIT BOARDS

Readers wishing to construct this modem can purchase printed circuit boards by mail order direct from ETI. We have retained copyright on the pc board design and boards have been manufactured for us. Note that a number of electronics retailers are stocking complete kits for this project — see the Shoparound page in this issue.

If you wish to purchase a board only, they cost $50 each (post free). Send a cheque or money order for the number of boards you require to:

ETI-644 pc board
ETI Magazine
154 Clarence St
Sydney NSW 2000.

Please allow up to four weeks for delivery.

NEW STORE opening October in Carlingford

AT "NEVILLES'S CORNER" CNR CARLINGFORD & PENNANT HILLS RD. NEXT TO KENTUCKY FRIED CKICKEN

AUDIO KITS - -JAYCAR IS No1

sub woofer sensation

Ref: Electronics Australia June-August 1982

THE SUB-WOOFER

MODEL SW 250

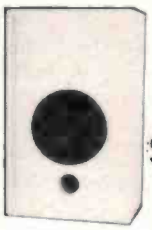
ONLY $79.50

RECALL NOTICE:
Some Sub-Woofers sold in August, did not conform to our published specs. The free air resonance maybe over 32 Hertz. If your unit was supplied before the 1st September and DOES NOT have a silver label on the back magnet, please return it to use for free replacement.

This unit has been extremely popular with audio enthusiasts right across Australia! EA have designed a special crossover/booster amp just for this unit. Now you have no excuse to build a subwoofer system to enjoy those thrilling low notes from pipe organs, synthesisers, 1812 cannons etc!!

SPECS:
Diameter 10" (250mm) Cast Frame. QT=0.39. VAS=631 Power Handling = 100WRMS. Free-air Resonance 32Hz ±1Hz Voice Coil = 2" (51mm). Dia. Magnet Assy = 3kg (6.6lbs).
A FREE SUB-WOOFER CABINET DESIGN IS PROVIDED WITH EACH UNIT!!

THE ENCLOSURE



ONLY $79.50

This compact 63 litre vented enclosure was specifically designed around the parameters of the SW250 Sub-Woofer. It follows the theory pioneered by the work of Thiele, Small and Snyder. The Jaycar enclosure is easy to build and is made of high quality durable materials. The heavy walled cabinet is covered with an attractive black vinyl veneer. All timber is pre-cut and the black grille is already made. Assembly takes less than one hour.
NB. The photo shows the prototype which was finished in white. The production units are only available in black
Freight anywhere in Australia only $10.00.

AMPLIFIER/FILTER UNIT

AMPLIFIER/FILTER UNIT.
Amplifier Module $79
Transformer to suit $39.50
Metal case specially made to suit including front panel, hardware etc. (not a twin 25 case). Only $29.50
$148.00

Buy the lot for only $125.00 if you purchase the enclosure and woofer at the same time.

ONLY $79

REF. EA JULY 1982
State-of-the-art power Mosfet technology combined with an active low pass filter results in a sub-woofer amp without equal anywhere!!
FEATURES: Around 100WRMS Drive capability.
Low pass (sub-woofer) filters on board.
Can hook-up to pre-amp out or power-amp out.
Power supply on board.
(Transformer needed. ONLY $39.50)

KITS

EA KITS

Le Gong — Electronic Doorbell Ref: EA3/81	$14.95
PC Birdies — Dueling Canary Sound Ref: EA5/81	$14.50
Cudlipp Cricket — Circuit drives you crazy Ref: EA2/82	$12.50
Vocal Canceller — Insert your voice onto records Ref: EA4/82	$19.50
VOX Relay — Open doors with a handclap Ref: EA4/82	$14.50
Metronome — Stick to the beat when learning Ref: EA2/82	$16.95
Fuzzbox — Funky guitar sound Ref: EA1/81	$18.50
EPROM Programmer — Cheap EPROM programming Ref: EA1/82	$59.00
Guitar Booster — Play your guitar on the Hi Fi Ref: EA6/82	$14.50
Onscreen Graphic Analyser — a must for the audiophile EA9/81	$105.00
Cassette Deck Audio Test Unit Ref: EA10/81	$45.00
Musicolour IV — Coloured lighting for your Hi Fi	$85.00
Photon Torpedo — Alien invaders game Ref: EA9/81	$29.50

ETI KITS

445 — General Purpose Preamp	$8.50
449 — Balanced Microphone Preamp	$9.50
581 — ±15V @ 200mA Power Supply - Tranny included	$17.50
330 — Car Alarm - works well	$29.50
492 — Sound Bender - Dalek!!	$24.50
446 — Audio Limiter	$12.00
479 — Bridging Adaptor ETI3/82	$9.95
499 — 150W MOSFET P.A. Amplifier ETI3/82	$79.50
498 — Preamp for above	$39.50
480/50 — 50W Economy amplifier — quality version	$23.00
480/100 — 100W Economy amplifier — quality version	$27.00
158 — Low Ohms Meter ETI11/81	$29.50
729 — UHF Masthead Amplifier	$35.00
735 — UHF Convertor	$32.50
477 — 5000 Series MOSFET Module — Quality	$59.00
478MC — 5000 Series Moving Coil Preamp	$29.50
478MM — 5000 Series Moving Magnet Preamp	$19.50
458 — 5000 Series Peak Reading Level Meter	$29.50

HOBBY ELECTRONICS KITS

HE102 — Guitar Phaser August 1981	$26.50
HE103 — Transistor Tester July 1981	$9.50
HE104 — Simple AM Tuner July 1981	$7.50
HE105 — Basic Amplifier July 1981	$9.75
HE106 — Wireless Microphone July 1981	$6.50
HE107 — Electronic Dice August 1981	$5.95
HE108 — Power Supply August 1981	$11.95
HE110 — Unmistakabell September 1981	$6.95
HE111 — Ohmmeter September 1981	$19.95
HE112 — Micromixer September 1981	$12.00
HE113 — Water Alarm September 1981	$9.50
HE114 — Digital Counter/Display October 1981	$13.95
HE115 — Reaction Timer ******** November 1981	$6.95
HE116 — OP Amp Tester October 1981	$3.95
HE117 — House and Car Alarm October 1981	$16.95
HE121 — Scratch and Hiss Filter October 1981	$9.50
HE123 — Alien Invaders November 1981	$13.95
HE126 — NiCad Charger November 1981	$9.95
HE127 — Siren September 1981	$3.95
HE128 — Foghorn September 1981	$5.95
HE129 — Simple Timer November 1981	$6.95

******** HE114 also required for complete operation.

JAYCAR STOCKS QUALITY KIT VERSIONS OF MOST EA, ETI & HOBBY ELECTRONICS

MARC NR82 MULTIBAND RECEIVER

AS REVIEWED IN ELECTRONICS AUSTRALIA AUGUST 1982
Virtually continuous coverage from 145kHz to 470MHz in all modes. AM, FM, SSB, CW. Built-in VFO, Squelch, RF Gain, Antenna trim and dozens more features!!
Measures a huge 484(H)x355(W)x165(D)mm and weighs 5 kilos (plus batteries!!) Fantastic performance from one radio.

$10 freight anywhere in Australia.

12 * band
GREAT VALUE
only $349

Fluoro Light STARTER *

*** * NEW KIT * ***

Ref: Electronics Australia October 1982.
Simple little circuit fits into an old plastic fluoro lamp starter. Lights turn on without a flicker. Great for bathrooms.

ONLY **$4.95**

magazine binder

LOW IMPORT PRICE
ONLY $4.95
4 up $4.50

Keep your precious (and expensive) magazines in order for easy reference. Smart blue colour with gold lettering. Heavy gauge and richly chromed metal fittings.

CARLINGFORD PHONE 872 4472

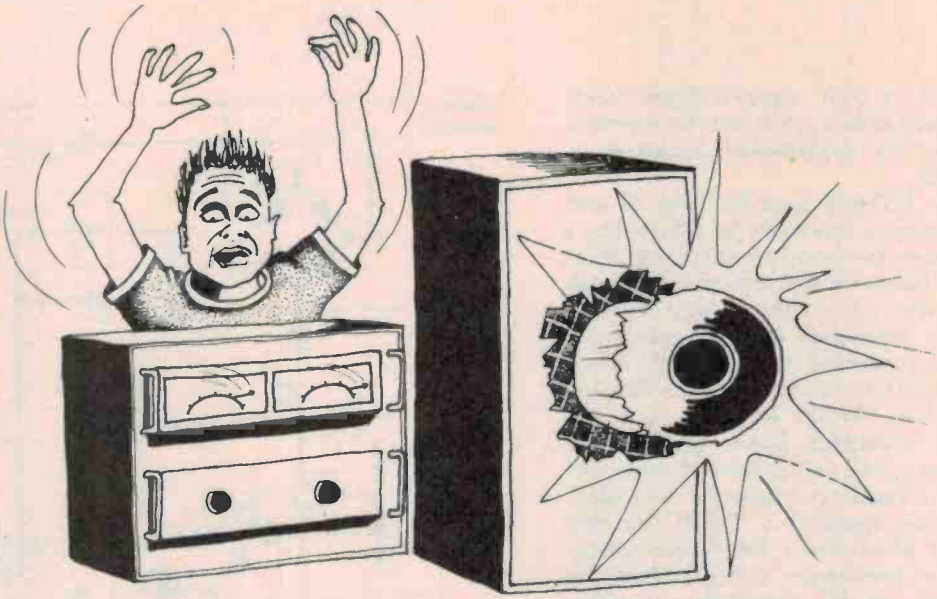
JAYCAR

125 YORK ST SYDNEY 2000
Ph. 2646688 Telex: 72293
Mail Orders To:
Box K-39 Haymarket 2000

MINIMUM MAIL ORDER $5.00

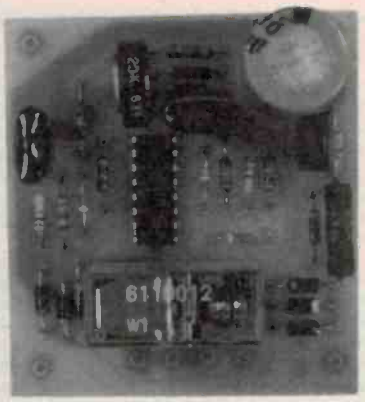
POST AND PACKING CHARGES
$5-$9.99 ($1.20) $10-$24.99 ($2.40)
$25-$49.99 ($3.50) $50-$99.99 ($4.60)
$100 up ($6.20)

NEW SHOP HOURS
Mon-Fri 8.30 to 5.30pm
Sat 8.30 to 12.00pm
Thurs night to 8.30pm



Signal powered loudspeaker protector

David Tilbrook



This unit affords both dc and over-power protection of loudspeakers or loudspeaker systems rated at up to 1500 watts! The unit requires no power supply and has no discernible audible effect on sound quality making it suitable for both hi-fi and sound reinforcement applications.

THE ETI-455 loudspeaker protector has proved to be a very popular project. It was published in March 1980 and since then we have had numerous phone calls from readers with stories of how the unit had saved their loudspeakers from almost certain disaster. Usually the power amplifier had gone faulty and applied the full dc supply rail to the loudspeaker terminals. Without the loudspeaker protector in circuit the result would be at least an open circuit bass driver and probably worse. The protector prevents this by monitoring the loudspeaker lines for the presence of dc, opening a set of relay contacts if this occurs, disconnecting the loudspeaker from the faulty amplifier.

The ETI-455 works well but requires its own power supply, either batteries or a small regulated mains supply. Another disadvantage results from the type of filter used to distinguish between dc and the audio signal. This was a conventional passive filter set to around 10 Hz. The problem is that it is still possible with very large amplifiers to trigger the protector on low frequency audio content. So the circuit, although perfectly satisfactory for its quoted maximum power of around 100 watts or so, is unsuitable for very high powered amplifiers.

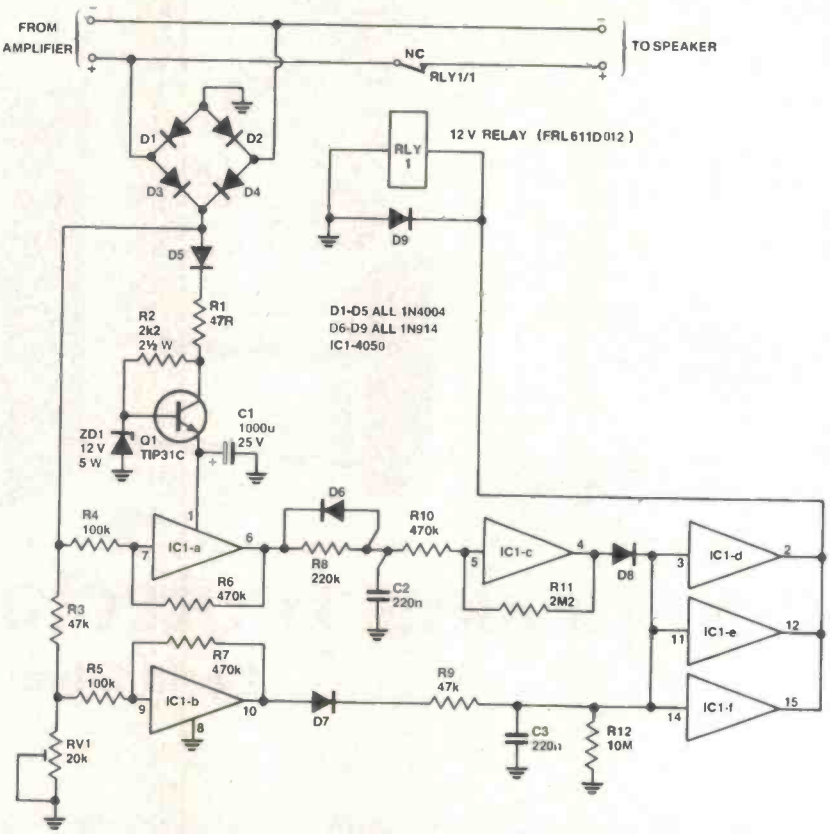
We decided to overcome these limitations in this new loudspeaker protector, the ETI-494. Since the old one was published we have had numerous requests for a circuit that could be mounted inside a loudspeaker enclosure. These requests have come largely from the sound reinforcement industry although the unit would obviously be applicable to all loudspeakers. The protector would not be able to be powered from a mains supply since it is not always desirable or even possible to run mains to the loudspeakers. This is particularly true in a sound reinforcement or public address system. Similarly, batteries are unsuitable since access would have to be provided to facilitate testing and changing them when required. In addition, when we published the ETI-499 MOSFET P.A. Module (March 1982), we promised to follow up with a loudspeaker protector. This is it. The solution, used in this project, is to power the unit from the audio signal itself.

This is done in this case by placing a fullwave rectifier across the speaker lines and charging a 1000u capacitor through a 47 ohm resistor. The worst possible load presented to the speaker line is therefore 47 ohms and this is only while charging the capacitor and for signal voltages in excess of 12 V. This ensures that the unit has no discernible effect on audio quality but makes ▶

possible a truly 'set-and-forget' loudspeaker protector that can be mounted inside the loudspeaker enclosure if desired.

The ETI-494 tests for both dc and over-power, which can be adjusted by a preset on the board to suit a particular loudspeaker or application. The circuit also uses a new filter design with an almost 'brick wall' response enabling it to be connected to very high power amps. This is discussed in more detail in the 'How it Works' section.

The maximum power that can be applied to the unit is determined by the type of regulator transistor (Q1) used. We have specified a TIP31C for this device which has a 100 V collector-to-emitter breakdown voltage. Since the emitter is at 12 V, the maximum voltage that can be applied to the unit is 112 V. This is equivalent to an amp capable of

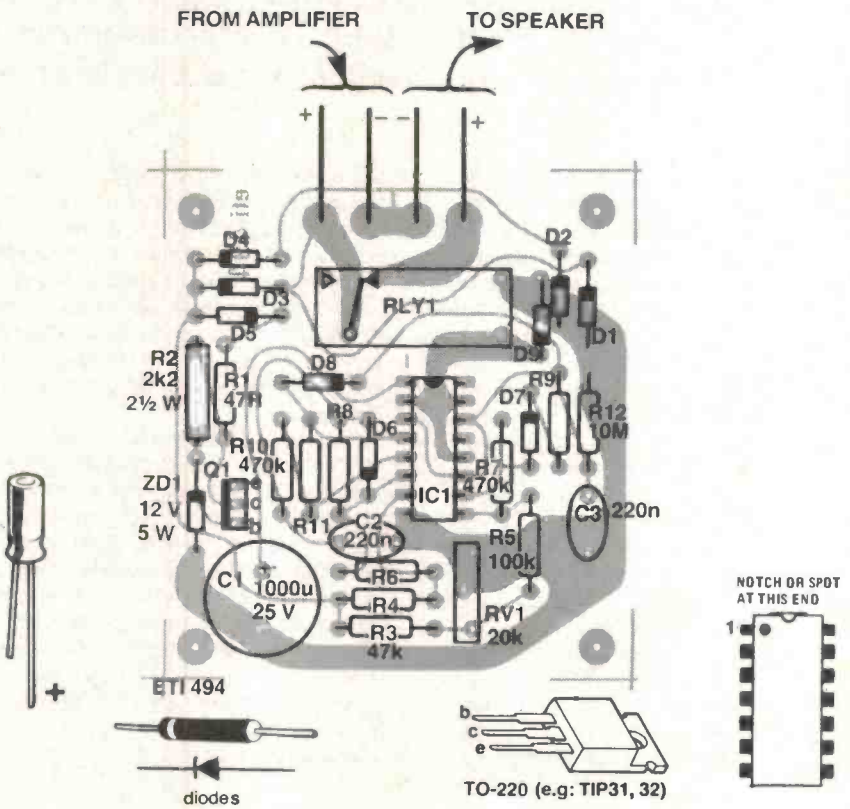


HOW IT WORKS — ETI 494

The signal from the power amp is rectified by the fullwave rectifier formed by D1-D4. The output of this is fed through a 12 V regulator circuit formed by Q1 and its associated resistors and zener diode, and charges the electrolytic capacitor, C1. The output of the rectifier is also fed to the input of the dc sense and over-power detection circuitry.

IC1 gates a and c form the dc filter. Resistors R4 and R6 form a Schmitt trigger with a small deadband. When the signal goes above the trigger voltage the output of the trigger swings hard to the positive supply rail of the IC, charging C2 through the 220k resistor, R8. Resistors R10 and R11 with gate c form a second Schmitt trigger monitoring the voltage across C2. If the voltage across C2 reaches the trigger voltage of this second Schmitt, gates d, e and f are activated, pulling in the relay contacts and disconnecting the loudspeaker. It takes about 100 ms to charge C2 through R8, and on normal audio content the output of gate 'a' will be driven low before this occurs, discharging C2 rapidly through D6. Only signals which do not have a zero crossing for longer than 100 ms will trigger the protector.

The over-power protector consists simply of a voltage divider feeding a third Schmitt trigger. Whenever the signal voltage exceeds the trigger voltage the output of gate 'b' is driven high and C3 starts to charge. If this condition persists for long enough the output gates are turned on and the relay pulls in. Note that both the dc and over-power sense circuits charge C3 when activated. The circuits are decoupled from this capacitor by diodes so that, once charged, C3 can only be discharged by the parallel resistor R12 (the effect of the input impedance of the gates is negligible). Since it takes about one second to discharge this capacitor, the relay will hold in for this time. The protector therefore reconnects the loudspeaker approximately one second after the fault condition has been removed.



PARTS LIST — ETI-494

Resistors ..... all ½ W, 5% unless noted
R1 ..... 47R
R2 ..... 2k2, 2½ W
R3, R9 ..... 47k
R4, R5 ..... 100k
R6, 7, 10 ..... 470k
R8 ..... 220k
R11 ..... 2M2
R12 ..... 10M
RV1 ..... 20k min. trimpot

Capacitors
C1 ..... 1000u/25 V RB electro.
C2, C3 ..... 220n greencap

Semiconductors
D1-D5 ..... 1N4004, EM404
D6-D9 ..... 1N914, 1N4148
IC1 4050
Q1 ..... TIP31C
ZD1 ..... 12 V, 5 W zener

Miscellaneous
ETI-494 pc board; RL1 — Fjuitsu FRL611D012, 12 volt SPDT 10 A contacts or similar relay (pc mount type).

Price Estimate
$20-$24

supplying approximately 784 watts into an 8 ohm load or 1568 watts into a 4 ohm load. If the amplifier to be used is capable of powers greater than these the regulator transistor should be substituted for a device with a higher V_{ceo} rating. The relay pulls around 40 mA when operated, so power dissipation in the regulator transistor will be around 4 watts when dropping 100 volts. Although this is not a particularly high dissipation it is high enough to lie outside the SOAR rating of many high voltage transistors, so be careful when choosing an alternate regulator transistor.

Construction

Construction is straightforward since all of the components are mounted on the pc board. The usual precautions should be taken to ensure that all polarised components have been mounted with the correct orientation. The IC used is a CMOS type and is therefore static sensitive. Solder this last and preferably using an earthed soldering iron. It is a wise precaution to discharge yourself before handling the device by first touching an earthed metal appliance. For a more detailed description of precautions when handling CMOS refer to our article 'Electrostatic discharge — nemesis of electronic systems' in the June edition, 1981.

It is a wise precaution to space the 2.5 W resistor, R2, off the pc board slightly. In the case of a high powered loudspeaker going faulty with dc this component will get quite hot and spacing improves ventilation around the component and prevents the possibility of charring the pc board. If you can't obtain a 2.5 watt type (e.g. Philips PR52), then a 5 W type may be substituted.

Before mounting the unit check operation by connecting around 20 V dc across the speaker input terminals on the pc board. The relay should cut in after about one tenth of a second. If the protector passes this test connect the speaker wiring. If the preset is turned fully down (turn it anticlockwise when viewing the board with the components on top and the relay to the right) the relay will cut in when the power exceeds around 20 watts for an extended period. The protector allows transients to the full supply rail to pass but will prevent a continuous 20 W from being applied to the loudspeaker. To increase this, turn the preset clockwise until the desired response is achieved.

Performance

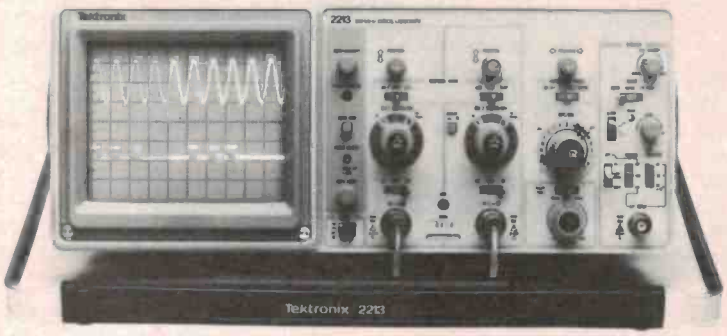
We tested the loudspeaker protector for its effect on audio performance as well as its reliability. A variety of power amps were used to ensure that the load represented by the protector would not affect audio performance. Even a very low power amplifier, with a comparatively small damping factor (high output impedance) could drive the unit with no degradation to the sound quality. During every test the protector worked well and cut in at the correct time to prevent damage to the loudspeakers.

NOTE. *Some amplifiers are unstable when driven into an open circuit. This is particularly true of valve power amplifiers some of which destroy themselves the moment the speaker is disconnected. Loudspeaker protectors are however, not usually required for use with valve power amps since the possibility of dc on the speaker lines is remote, but over-power protection may be required.* ●

R EXCLUSIVE ETI READER OF

TEKTRONIX DUAL-TRACE HIGH PERFORMANCE 60 MHz PORTABLE OSCILLOSCOPES

Here is an excellent opportunity to buy a high performance 60 MHz oscilloscope from the world's leading oscilloscope maker at a very special price — exclusive to ETI readers.



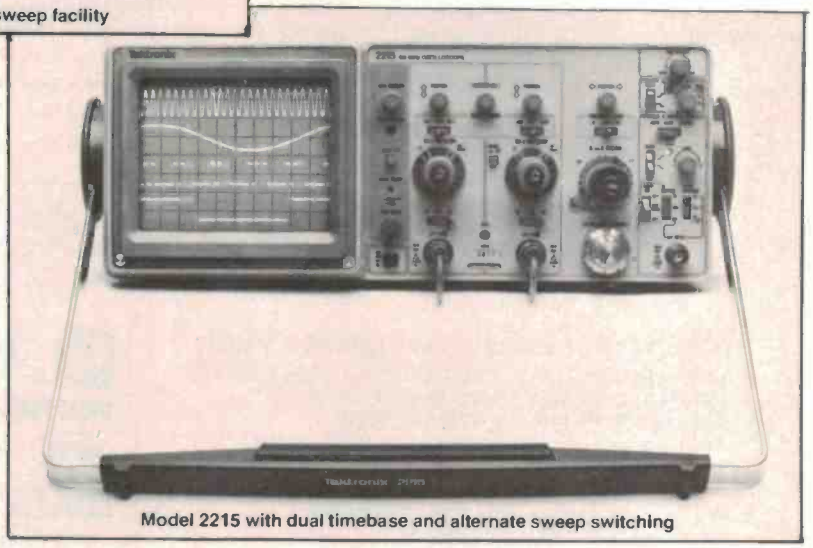
Model 2213 with single timebase and delayed sweep facility

THROUGH THIS SPECIAL DEAL TEKTRONIX IS OFFERING THE MODELS 2213 AND 2215 PORTABLE OSCILLOSCOPES (REVIEWED LAST MONTH) AT SAVINGS UP TO HUNDREDS OF DOLLARS OFF. ORDERS WILL BE ACCEPTED ONLY WHILE STOCKS LAST AND IN ANY EVENT NOT AFTER 31 OCT. '82. ORDERS MUST BE PLACED BY COMPLETING THE COUPON OPPOSITE.

FEATURES

See review, pages 15 to 18, July issue.

- Tektronix' two-year standard form of warranty.*
- 8 x 10 cm display, internal graticule
- dc to 60 MHz bandwidth
- 2 mV sensitivity
- 5 ns/div (x10) to 0.5 s/div sweep speed range
- advanced trigger system
- delayed sweep measurements
- multiple vertical display modes
- multiple horizontal display modes
- easy to use
- light weight — 6.1 kg (w/out accessories)
- new x10 probes with IC grabbers included
- a variable trigger hold-off
- TV line and field triggering at any sweep speed
- enhanced auto mode
- Z-axis input (brightness modulation)



Model 2215 with dual timebase and alternate sweep switching

You cannot walk into a Tektronix sales office and buy one of these oscilloscopes at this price — it can only be purchased at this special price through ETI.

* The standard "Corporate Warranty Statement" of Tektronix Australia Pty Ltd is available for inspection at any of the offices shown opposite.

ER EXCLUSIVE ETI READER O

SPECIAL OFFER PRICES

☆ **Model 2213**
$1139 excl. sales tax
$1348.58 inc. sales tax

☆ **Model 2215**
$1422 excl. sales tax
$1683.65 inc. sales tax

Both models are supplied as illustrated and come complete with two P6120 x10, 60 MHz probes and instruction manuals. Cover and accessory pouch not included. (Usual cost $65.)

● Prices including sales tax have had to be increased owing to sales tax increases in the recent budget.

Tektronix currently list the 2213 at $1392 ($1648.13 inc. tax) and the 2215 at $1758 ($2081.47 inc. tax), which includes probes, manuals, cover and pouch.

Anyone purchasing a 2213 or 2215 through this offer may later obtain accessories, but only directly from Tektronix. Tektronix accessories for these oscilloscopes include: cover and accessory pouch (020-0672-00); viewing hood (016-0566-00); C-5C Opt 04 scope camera; Model 200C SCOPE-MOBILE cart; rack adaptor kit (016-0466-00).

INSPECTION

You can inspect one of these oscilloscopes during office hours at the following places:

Sydney:	Melbourne:	Adelaide:	Brisbane:	Perth:
ETI Offices 15 Boundary St Rushcutters Bay NSW	Murray Publishers Offices 22nd Floor, 150 Lonsdale St Melbourne	Tektronix 128 Gilles St Adelaide (Phone 223-2811)	Tektronix 737 Logan Rd Greenslopes (Phone 394-1155)	Tektronix 66 Wellington St East Perth (Phone 325-8433)

HOW TO ORDER YOUR OSCILLOSCOPE

Fill out the coupon here and enclose a cheque, bank cheque or money order for the amount required made out to TEKTRONIX.

If you are not paying sales tax, please quote your sales tax number on the coupon, where indicated, or for schools, colleges or other educational institutions, enclose a sales tax declaration on your letterhead. The completed coupon, together with your cheque, bank cheque or money order should be sent to:

TEKTRONIX SCOPE OFFER
c/o ETI, 15 Boundary St
Rushcutters Bay NSW 2011

DELIVERY Tektronix will endeavour to deliver the goods inside four (4) weeks from receipt of payment. Delivery (or acknowledgement of coupon) should occur within two weeks.

Please supply, on the terms outlined in this offer and in the standard "Corporate Warranty Statement" of Tektronix Australia Pty Limited.

..... Model 2213 CRO(s) @ $1139 each, excl. tax or @ $1348.58 each, inc. tax.

..... Model 2215 CRO(s) @ $1422 each, excl. tax or @ $1683.65 each, inc. tax.

Sales Tax No ..... (if applicable). **I enclose $ ..... total.**

Name .....

Address ..... Postcode .....

Cheque or Money Order No ..... Signature .....

Send completed coupon with cheque or money order to:
TEKTRONIX SCOPE OFFER, c/o ETI, 15 Boundary St, Rushcutters Bay NSW 2011
This offer is made by Tektronix Australia Pty Limited (Incorporated in ACT).

NEW STORE opening October in Carlingford

AT "NEVILLE'S CORNER" CNR CARLINGFORD & PENNANT HILLS ROAD, NEXT TO KENTUCKY FRIED CHICKEN

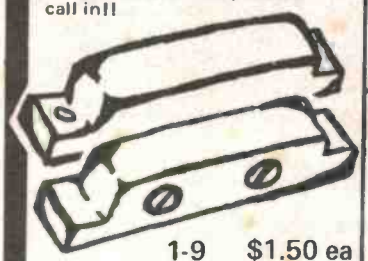
MR HOWARD-

* * * * *

DESPITE TWO SAVAGE INCREASES IN SALES TAX AND HEAVY DEVALUATION OF THE AUSSIE DOLLAR, WE ARE STILL PASSING ON GREAT SAVINGS! OUR GREAT PRICES CAN'T LAST FOREVER SO ACT NOW! (BEFORE MR. HOWARD DOES – AGAIN!)

Reed Switch/ Magnet Assy.

Grab some of these before the Canberra boys grab the shirt off your back!!
A bulk buy of these has enabled us to pass on great savings!!
Quality dry reed insert in tough plastic housing with screw terminations. Matching magnet assembly closes SP-ST reeed contacts when near reed.
– 10 million operations
– Comes with instructions
– Double sided foam tape inc.
– Screw mount as well!
Staggering value.
Jaycar has a complete range of Burglar alarm components – call in!!

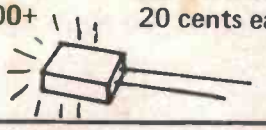


1-9 $1.50 ea
10-99 $1.40 ea
100+ $1.25 ea

Rectangular LEDs * * *

These are quality 2mm thick polished LEDs (similar to Siemens) – not the cheaper 3mm thick unpolished LEDs. Colours available: Red, Yellow Green. Normally $0.60 for this quality
BUT NO!!
Not $0.40 not $0.30 but as low as $0.20 each!

1-9 25 cents ea
10-99 22 cents ea
100+ 20 cents ea



Zener Diodes

Improve your Dowry with these! The following values only (5% 1 watt).
9V1, 10V, 13V, 16V, 20V, 22V 24V, 30V, 39V & 56V.

15¢ each
$1 for 10!

DPDT * * Footswitches

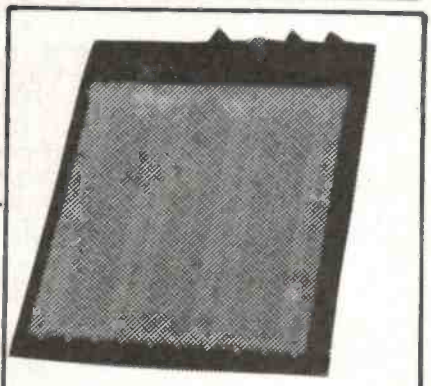
Double-Pole Double Throw Footswitches.
We had to import these ourselves to get the quality at a reasonable price.
Heavy duty. Ideal for any musical effects-pedal application.

$6.95

EXPERIMENTER BREADBOARDS

Ample stocks of these boards plus the range has been extended.

WBDN	100 holes $2.50
WBTN	640 holes $8.95
WB2N	840 holes $12.95
WB4N	1680 holes $24.50
WB6N	2420 holes $39.50



Weller SPARES

We stock genuine factory spare parts for the famous Weller temperature controlled soldering irons.

SW-60D	Switch assembly	$29.50
HE-60D	Heater element 24V	$27.50
HO-60	Handle	$5.95
BA-60	Barrel/Nut assembly	$7.50
TC-20B	Plug socket	$7.50

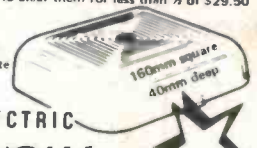
TRULY GREAT BARGAINS – * * * *

FROM GENERAL ELECTRIC

Smoke Detector

CONSUMER FLOP – CONSUMER FLOP
CLUB, HOTEL, HOSTEL & MOTEL MANAGERS
PLEASE NOTE
One of the greatest consumer flops of the last decade was the Ionization Chamber Smoke Detector. Even though it is a brilliant product (reliable compact, easy installation, fail-safe etc) it just did not sell. Human nature being what it is finds safety-oriented products just not worth the investment. We all know that accidents and fires never happen to US!! As smoke is the greatest killer in a fire, the market research gurus thought that such a product would have wide appeal.
When they were $49.50 no-one wanted them. The price fell to a very reasonable $29.50 and still they stayed on the suppliers shelves.
We have now been in instructed to clear them for less than ⅓ of $29.50

– Contains Americium 241 Ionization Chamber
– 9V Mallory Duracell included
– Contains very loud solid state buzzer
– 12 month factory warranty



GENERAL ELECTRIC

Grab One NOW $14.50

* FAMOUS * GENERAL ELECTRIC
BURGLAR ALARM SLASHED!!!
HUGE SCOOP PURCHASE – ONCE SOLD FOR OVER $100

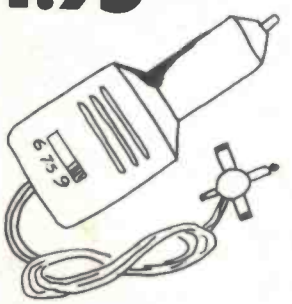
* *Slashed to* $29.50 *

Amazingly low price for a full feature ultrasonic proximity/burglar alarm. + Completely self contained + 12 month manufacturer guarantee + Instant or delayed alarm + Handsome imitation woodgrain + Cabinet measures 180Wx85Hx100D + Programmable multi-code disable switch + Single 9V Alkaline battery * lasts one year + Unit beeps when battery gets low + Contains receiver element designed for greater sensitivity without false triggering + Uses State-of-the-art LSI circuitry + Worth the money in parts alone + Comprehensive 24 page manual included + Comes complete with 4 window deterrent stickers + Absolutely no installation needed. * Battery extra
SAVE A FORTUNE – COMPARES WITH UNITS OVER $100
Below cost distress stock – Factory orders to sell.

car DC-DC inverter

Very low cost 12V DC/DC Inverter. Plugs into car cigarette lighter and powers 6V, 7½ and 9V equipment @ 800mA.

$4.95 ½ PRICE!!



MUFFS SCARCE – GRAB NOW!!

ONLY $5.95 for a set of two
(One for each ear)

The Sennheiser HD414 Earmuffs are now back in stock. Who needs a pair of mangy muffs around the ears?
Spruce up your Headphones with these bright Blue earmuffs.

CARLINGFORD PHONE 872 4422

EAT YOUR HEART OUT!

NEW STORE opening October in Carlingford

AT "NEVILLE'S CORNER" CNR CARLINGFORD & PENNANT HILLS ROAD, NEXT TO KENTUCKY FRIED CHICKEN

JAYCAR VALU-PACKS. QUESTIONS RAISED IN PARLIAMENT

In the last few months Jaycar's valu-packs have become legendary. Trimpot packs sold out in days. Photocells – well we THOUGHT we had a lot! We kept the pot packs going for about 6 weeks but the staff threatened to go on strike! (We ran out anyway).

Now we have more!!

The Treasury are wondering how we can do it! Could we be getting them from the bottom of the harbour? Are we applying the right sales tax? The Opposition is demanding a Royal Commission but we think the Government will tough it out. Subscribe to Hansard for further news!

Lamp Bezel Pack

– IT HAD TO HAPPEN

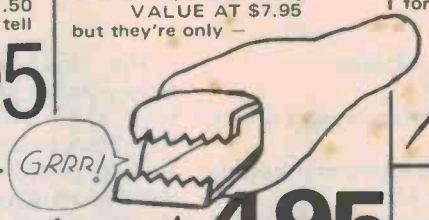
Only Jaycar would have the audacity to offer a Lamp Bezel Pack!!
This fantastic pack contains an assortment of Incandescent bezels (MES and Lilliput) neon bezels and LED bezels. Over 20 in all!! The average price of each bezel is $1.50 So you will gasp when we tell you the price –

$7.95

Alligator Clip Pack

HEATH ROBINSON EZ HOOKS

These are'nt on the protected list! A bulging bag of gorgeous grippers. From gnat-like nippers to finger chompers. Grab a bag now before they grab you!
Over 25 clips in each bag.
VALUE AT $7.95
but they're only –



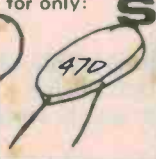
$4.95

Great for battery chargers, paper clips and 000's other uses!

Silver Mica Pack

SUPERB VALUE

Probably the most stable capacitors of the lot. Pack of 100 SM's in values ranging from 33pF to 1000pF @ 100V.
Silvered Micas are hard to get now and are normally VERY expensive.
Worth well over $40 but yours for only:



$8.95

Thermistor Pack

NEW LOW PRICE

470 ohms @ 25 degrees C NTC THERMISTORS – were $0.20 each (which was cheap) now:

$1 for 10

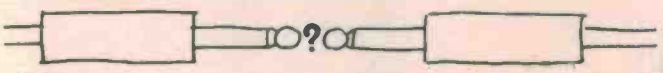
NIXIES * *

If you are over 30 you will know what these are. To the uninitiated they are basically a valve version of a 7 segment LED display!
In the 60's they were the ONLY type of electronic display around Grab one for your kids. Great curiosity value.

ONLY $1.00 each

Useless adaptors *

We have double female. We also have the opposite! And some weird combinations In between.*Each adaptor is solid metal and high quality and we can't see the reason why some were over made and we're sick of looking at 'em.
You get 12 in a bag and if you only use ONE once they will owe you nothing. Once sold for $3 each, but we won't insult you by claiming $36.00 'value'. A bag will cost you $3.95.
MR HOWARD – EAT YOUR HEART OUT!



TAKE CARE OF TO-3 MONTH

Spruce up those hard working TO-3's with our upgrade pack. Each pack consists of the following:
– 6 quality McMurdo TO-3 Covers
– 6 quality McMurdo TO-3 Sockets
– 2 Beryllium Oxide high conductivity TO-3 washers

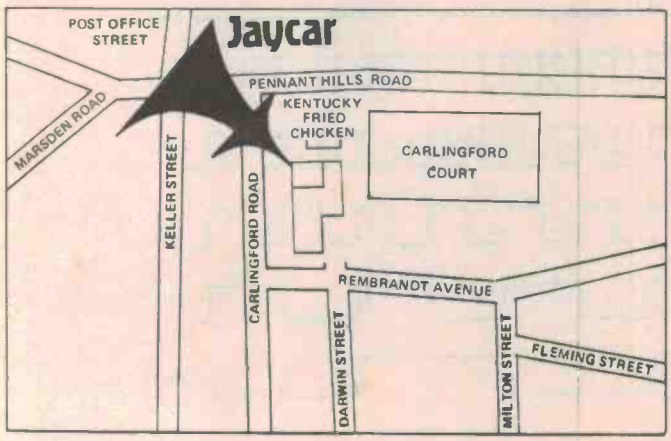
OVER $8 VALUE FOR **$3.95!!**

SO 239

UHF PANEL SOCKET

½ Normal Price ~~$1.20~~

1-9 75c
10+ 59c



Factory Seconds YOU come FIRST

We have secured a smallish quantity of 5 pin DIN to 4 RCA audio leads that are on the wrong side of the Q.C. inspection. Shame though. Because the DIN plug is ALL METAL and GOLD plated. So are the RCA plugs. Problem is that the gold plating is bubbling on the gold DIN plug. (As far as we can see the 4 gold RCA's are PERFECT.)
An ordinary NICKEL PLATED lead set like this costs around $4.75. The gold versions normally are around $9.95. You can have one of these for $3.95 and that's better than Nickel any day! Worth it for the 4 x RCA's alone!

$3.95

JAYCAR

125 YORK ST SYDNEY 2000
Ph. 2646688 Telex: 72293
Mail Orders To:
Box K-39 Haymarket 2000

MINIMUM MAIL ORDER VALUE $5.00

POST AND PACKING CHARGES
$5-$9.99 ($1.20) $10-$24.99 ($2.40)
$25-$49.99 ($3.50) $50-$99.99 ($4.80)
$100 up ($6.20)

NEW SHOP HOURS
Mon-Fri 8.30 to 5.30pm
Sat 8.30 to 12.00pm
Thurs night to 8.30pm

Lab Notes

Super timer — from μs to days

Timing long periods has always been a problem because of the high leakage characteristics of the timing capacitor. This is no longer true! The XR-2240 IC is a programmable timer capable of producing ultra-long time delays without sacrificing accuracy.

Barry Davis

THIS IC can generate time delays from microseconds up to five days, and with a little ingenuity can generate a delay of a couple of years! A functional block diagram of the IC is shown in Figure 1.

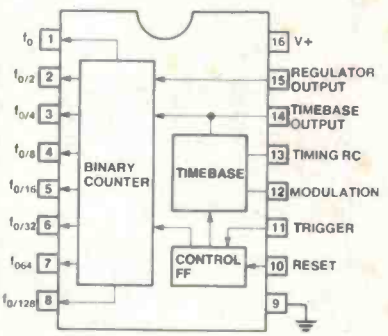


Figure 1. Functional block diagram of the XR-2240.

The circuit consists of an internal timebase generator, a programmable 8-bit counter and a control flip-flop. The time delay at the output is set by an external CR network and can be any period from 1.CR to 255.CR. Herein lies the secret. The CR timebase generator can be set to give a very accurate short period, and binary multiples of this short period are then programmed and taken from the output. Each output is capable of sinking approximately 5 mA of load current.

The features of the IC are:

1. Timing from microseconds to days.
2. Programmable delays: 1.CR to 255.CR
3. Wide supply voltage range: 4 V to 15 V
4. TTL compatible inputs and outputs
5. High accuracy: 0.5%
6. Excellent temperature stability
7. Period T = C x R

Circuit operation

The timing cycle is initiated by a positive-going pulse on pin 11. This trigger pulse performs three functions:

1. Activates the timebase generator
2. Enables the counter
3. Sets all counter outputs to the *low* state

The timebase generator produces timing pulses with a period, T, equal to 1.CR. These clock pulses are counted by the binary counter inside the IC and the timing period is complete when a positive-going pulse is applied to pin 10 (i.e: the circuit is reset). In most applications one or more of the output terminals are connected back to the reset input. The circuit will commence timing when the trigger pulse is applied, and automatically reset on the completion of the timing period.

Remember, the outputs are normally high and are set to low when timing is initiated, returning again to the high level on completion of the timing period.

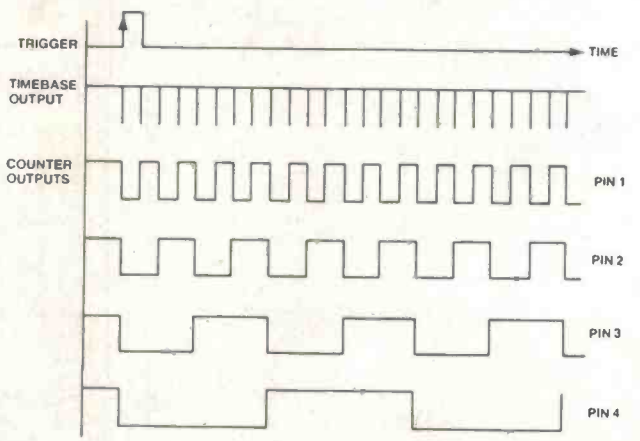


Figure 2. Output waveforms and timing diagram.

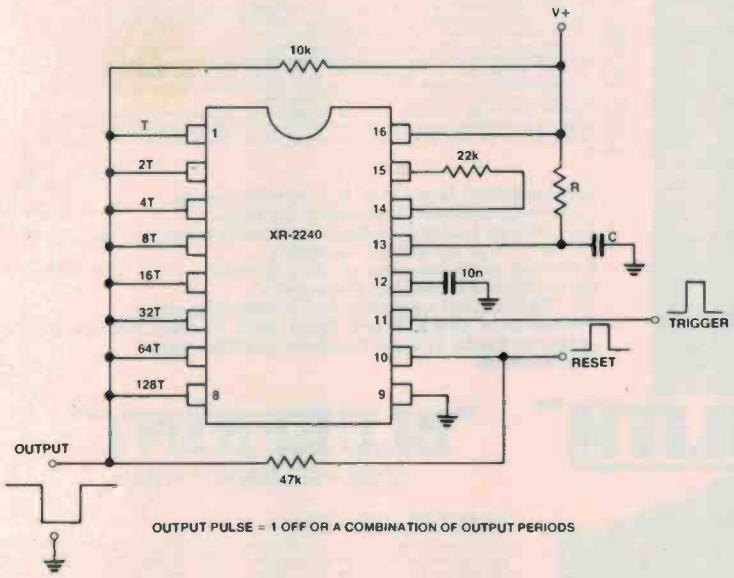


Figure 3. Connections for a practical circuit.

Circuit construction

The binary outputs, pins 1 to 8, are open collector and can be connected together to a common pull-up resistor. The output of the timer will be low as long as any one output is low. In this manner the time delays associated with each output can be added by simply connecting them together to a common bus. The outputs can be used individually or wired together.

For example, the output at pin 4 is 8 x CR = 8T. If pins 4 and 3 are connected together the output will become 12 x CR = 12T.

Figure 3 shows the actual connections for a practical circuit. When the power is applied, with no trigger or reset inputs, the circuit sets up to the initial state of all outputs high. Once triggered, the circuit is totally immune to any additional trigger inputs until the timing period is completed, or a reset pulse is applied.

Choice of timing components

Once a signal timing period, T, is established, the output can be determined by 'wiring-in' periods of T following a binary progression. However, the procedure may have to be reversed when a certain accurate output period is required.

For example, if a timing period of 6 hours 30 seconds is required, firstly convert the time to seconds:

$$= 6 \times 60 \times 60 + 30$$
$$= 21630 \text{ seconds.}$$

The maximum number of timing periods available with one IC is (1+2+4+8+16+32+64+128)T = 255 T. Therefore the period of T can be calculated:

$$T = \frac{21630}{255}$$
$$= 84.82 \text{ seconds}$$

With a low-loss capacitor (such as tantalum) as one timing component, R can be calculated. If C = 100 uF:

$$T = CR$$

Therefore:

$$R = \frac{T}{C}$$
$$= \frac{84.82}{100 \times 10^{-6}}$$
$$= 848.24 \text{ k}\Omega$$

This can be tailored precisely for very accurate timing with a resistive network or potentiometer, or simply rounded off to 850k.

Figure 4 shows two graphs which will assist you in choosing:

1. The recommended range of timing component values.
2. The time period, (T) up to 100 seconds, to be expected from combinations of C and R values.

An example of output periods to be expected using a 100 uF capacitor (tantalum) and 1M resistor as the timing components is shown in Table 1.

T = CR = 100 μF x 1 M = 100 seconds	Period of Output
T	100 secs = 1.7 min
2T	200 secs = 3.3 min
4T	400 secs = 6.7 min
8T	800 secs = 13.3 min
16T	1600 secs = 26.7 min
32T	3200 secs = 53.3 min
64T	6400 secs = 1.8 hours
128T	12800 secs = 3.6 hours
255T	25500 secs = 7.1 hours

Table 1. Example of accurate time available using the XR-2240.

The type of circuit operation discussed to this point has been monostable i.e: the output goes low on triggering, stays low for the timing period and returns to a high level. It will not time again until it is retriggered. An XR-2240 can also be used in a free-running or astable mode.

Astable operation

To operate in this mode the reset line to pin 10 is disconnected from the output. ▶

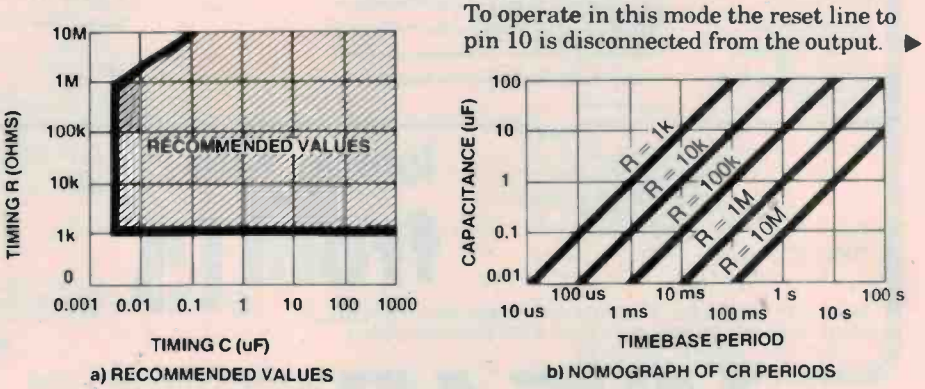
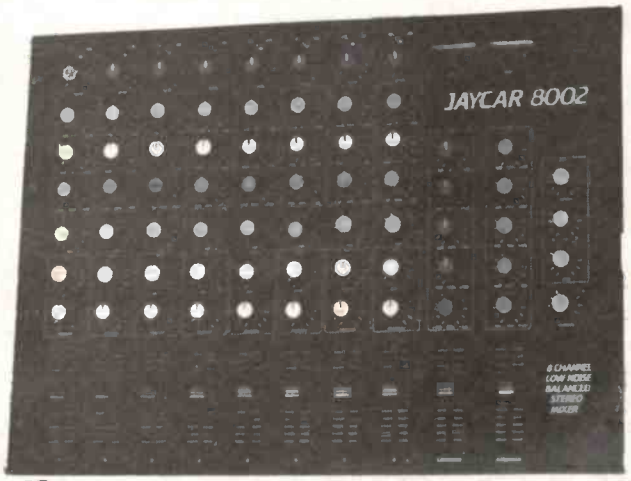


Figure 4. Graphs to assist in the choice of values of C and R.

JAYCAR QUALITY MEANS PERFORMANCE RESULTS

FROM $495



8 CHANNEL MIXER KIT

The Jaycar 8002 Mixer was originally conceived to be the successor to the very popular ETI414 Master Mixer. The 414 was basically configured as a 'stage' mixer and suffered from a number of severe technical limitations – notably poor signal-to-noise figures. Enormous advances in Audio IC's have occurred since the 414 was designed. Jaycar engineers have taken advantage of this. The incredibly low noise and distortion figures of the 8002 are a testimony to the sound basic design of the mixer coupled with the performance capability of these IC's. Whilst the 8002 is the ideal 8 channel compact stage mixer, other applications have been kept in mind.

AS A "STUDIO" MIXER. The prime requirement of a studio mixer is that it must be quiet – i.e. have good S/N. Due to the fact that the "miracle" 5534 IC's are used in the 8002 studio applications are entirely feasible. In addition to this, metal film resistors are used in critical signal areas.

AS A DISCO MIXER. The balanced input feature of the 8002 is not really necessary for disco use. This section can easily be bypassed with either a moving magnet (Dynamic Cartridge) preamp, or a moving coil preamp. The sensible format of the 8002 and tremendous equalization facilities should make this mixer popular for disco use.

- Balanced (600 Ohm) Mic. Inputs/Line Inputs.
- Cannon Connectors included in the price.
- Bass, Mid & Treble Equalization on each Input.
- "Effects" (i.e. Echo etc.) capability.
- Foldback and Stereo Pan on ALL 8 Inputs.
- 60mm Slide Faders used throughout.
- 19" Rack Mount capability (or Console Mount).
- Professional Black Front Panel with Format borders & multi-coloured knobs to assist function identification.
- VU Metering.

Send SAE for full details + details on use as stage mixer

"BLACK MONOLITH"

ONLY $299

Once again, imitation is the sincerest form of flattery. The Black Monolith 5000 Mosfet Power Amp has the following EXCLUSIVE features:

- Beryllium Oxide (Space Age ceramic) TO-3 washers. (Not flimsy mica)
- Jig drilled and extruded heavy gauge, anodised heatsink bracket.
- SUPERFINISH front panel. STILL THE BEST now with blind tapped holes.
- New heavy duty heatsinks for the driver transistors. 100% extra heatsink area and black anodised for greater efficiency. (Not in original design).
- Ventilation holes in metalwork at critical points. (Not in original design).
- Extra 3 pin OIN socket on rear panel (total 2) to power new 5000 components. (1/3rd Octave 5000 series Equaliser coming soon!). Not in original design but now a must with the new additions in the family.

IF YOU THINK THAT YOU CAN SAVE MONEY ON THESE KITS ASK YOUR SUPPLIER IF HE WILL GIVE YOU ALL OF THESE FEATURES AT THE PRICE. MAKE SURE THAT YOU GET IT IN WRITING!!

A PRICE RISE ON BOTH KITS (i.e. SALES TAX AND METALWORK ETC.) IS EXPECTED SOON! BUY THE BEST FOR NO MORE.

Write in (SAE) for a new glossy leaflet on both amps.

SPECIFICATIONS

POWER OUTPUT	Around 100W RMS into 8 ohms
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 NOISE	– 100dB below full output (flat) –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

"BLUEPRINT"

5000 PREAMPLIFIER

"One Swallow does not make a spring"
– Neither does a few gold RCA sockets!

Several of our competitors are imitating our "Blueprint" preamp by adding a few bits and pieces, notably gold plated RCA sockets to their standard kits. Unfortunately they have missed the point. We supply gold plated sockets in our "Blueprint" preamp but only where it makes sense to do this, i.e. on the inputs – NOT the outputs. 16 gold sockets are provided by us. This, however, does not make a "Blueprint". THIS DOES:

- Low capacitance screened cable - 12 metres of it, NOT Taiwanese cable as supplied in other kits. Our cable costs us NEARLY 5 TIMES MORE than the Taiwanese stuff.
- Original ETI designed front panel. Not an "ADAPTION". Our front panel is by far the nicest.
- Factory pre-tinned PCB's to reduce chances of dry or noisy solder joints.
- Quality LEDs, polished finish, multicoloured display.
- IC sockets on line amp board.
- Special rear panel.
- Special low noise selection LM394H NOT CH device in M.C. preamp.
- Thermalloy (U.S. made) heatsink on 7805 regulator.
- English Lorlin selector switches.
- Apart from the 16 gold RCA's we throw in a pair of gold plated line RCA plugs – worth $5.
- Special Nylon rear panel grommets.

So don't "Swallow" the facts before they are properly digested!!

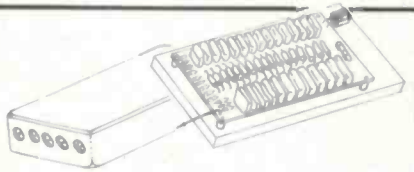
You can't make a silk purse out of a sow's ear. Send SAE for full specs.

BLUEPRINT $275

SPECIFICATIONS

Frequency Response	High level input: 18Hz-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 ratio	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 290uV input signal 71dB flat 75dB A-weighted

ETI-478MM Moving Magnet input stage	1kHz
Gain	Conforms to RIAA Equalisation +0.2dB
Frequency Response	0.001%, 1kHz, 10mV RMS input
Total Harmonic Disorder	28dB with respect to 5mV RMS input signal, i.e. 135mV RMS
Headroom	Total equivalent input noise, 122nV 'A', input shorted, 216nV flat, input shorted
Noise	1mV 5mV 10mV
Flat	73dB 87dB 93dB
S/N ratio	A-weighted 78dB 92dB 98dB
ETI-478MC Moving coil input stage	24
Gain	70dB – 12kHz, +0, – 1dB
Frequency Response	0.003%, 1kHz, 3mV input
Total Harmonic Disorder	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
Noise	



Ioniser Kits from $15

Bulk component purchasing has enabled us to permanently reduce our prices.

SHORT FORM KIT Get up and running at low cost. Capable of generating intense electric fields from 240V supply. Parts supplied include, PCB, all capacitors, diodes, resistors, mains plug, cord, fuse stand-offs and baseboard. Will work as ioniser but case and higher efficiency emitter head not supplied.

WAS $24.50 NOW ONLY $15.00!!
SAVE NEARLY 40%

FULL KIT Similar to above except that fully pre-drilled quality ABS case and high efficiency emitter head included! Construction takes less than 2 hours and you end up with a built-up unit that compares with units well over $100!! We sold 00's at $45 but now – $29.50. Save nearly 35%.

SAVE NEARLY 35% – ONLY $29.50

NOW AT "NEVILLE'S CORNER" CNR CARLINGFORD & PENNANT HILLS RD. NEXT TO KENTUCKY FRIED CHICKEN – PHONE 872 4422

JAYCAR

125 YORK ST SYDNEY 2000
Ph. 2646688 Telex: 72293
Mail Orders To:
Box K-39 Haymarket 2000

POST AND PACKING CHARGES	
$5-$9.99 ($1.20)	$10-$24.99 ($2.40)
$25-$49.99 ($3.50)	$50-$99.99 ($4.60)
$100 up ($6.20)	

NEW SHOP HOURS
Mon-Fri 8.30 to 5.30pm
Sat 8.30 to 12.00pm
Thurs night to 8.30pm

Lab Notes

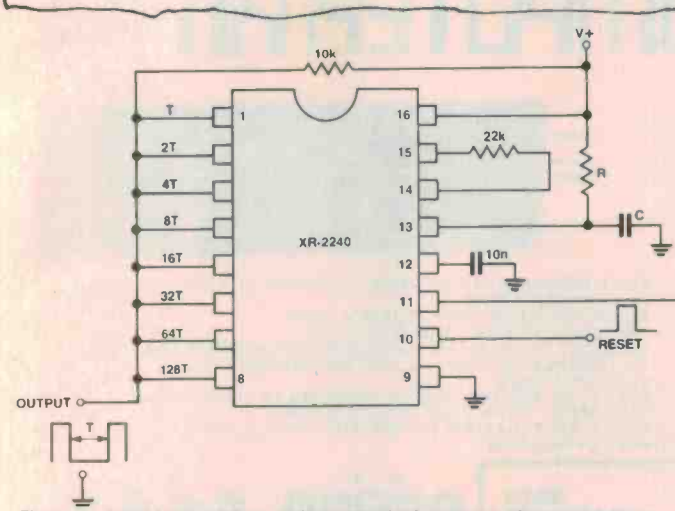


Figure 5. Astable operation under control of external trigger and reset controls.

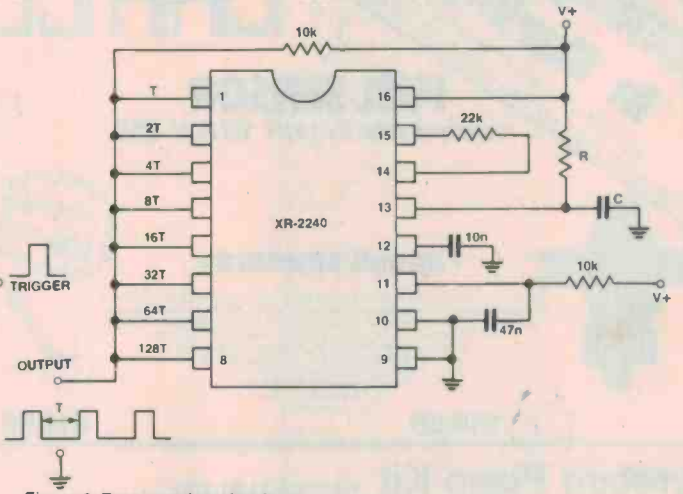


Figure 6. Free-running circuit.

Figure 5 shows an astable circuit under the control of the external trigger and reset signals. It will start timing when an external trigger pulse is applied, and will not stop until a reset pulse is applied.

Alternatively, the circuit can be made truly free running. The circuit in Figure 6 self-triggers automatically when the power is switched on, and continues to operate in its free running mode indefinitely.

When the timer is used in this mode, each counter output can be used individually as synchronised oscillators, or they can be connected together to provide complex pulse patterns.

Ultra-long delays

In some applications delays of four days may be required. This is particularly useful in electronic farming for controlling the rate of supplementary feeding. The timing components required can be calculated thus:

4 days = 96 hours
= 5760 minutes
= 345 600 secs.

Maximum number of T combinations = 255

Therefore

$$T = \frac{345600}{255}$$

= 1355.3 secs
= 22.6 minutes

Incidentally, 20 minutes is about the longest time recommended for 1.CR as anything beyond this suffers from leakage problems.

$T = CR$

if $C = 500\ \mu F$ (low leakage)

$$R = \frac{T}{C}$$

$$= \frac{1355.3}{500 \times 10^{-6}}$$

$= 2M7$

Two XR-2240 ICs can be cascaded to generate extremely long time delays. When used in this format the reset and trigger terminals of the ICs are tied together and the timebase of unit 2 disabled as shown in Figure 7.

The output is normally high. When a positive-going trigger pulse is applied the output goes low and stays in the low state for $(256)^2 = 65\,536$ periods of the timebase oscillator. Therefore the total timing period of two cascaded units can be from 256.CR to 65 536.CR. The output is available in 256 discrete steps by selectively connecting one or a combination of the outputs from unit 2 to the output bus.

With T = 20 minutes an example of an ultra-long delay can be given.

$CR = T = 20$ mins.

$65\,536T = 1\,310\,720$ min
$= 21\,845$ hours
$= 910$ days
$= 2.5$ years!

This article highlights the use of an XR-2240 as a precision timer. Other application suggestions are:

1. Sequential timing
2. Binary pattern generation
3. Frequency synthesis
4. Pulse counting or summing
5. A/D conversion
6. Digital sample and hold

Further information on the IC can be obtained from Exar Integrated Systems or their agents (Total Electronics).

This article was made possible by the courtesy of Exar Integrated Systems. Data was taken from their publication 'XR-2240/2340 Programmable Timer Counter'.

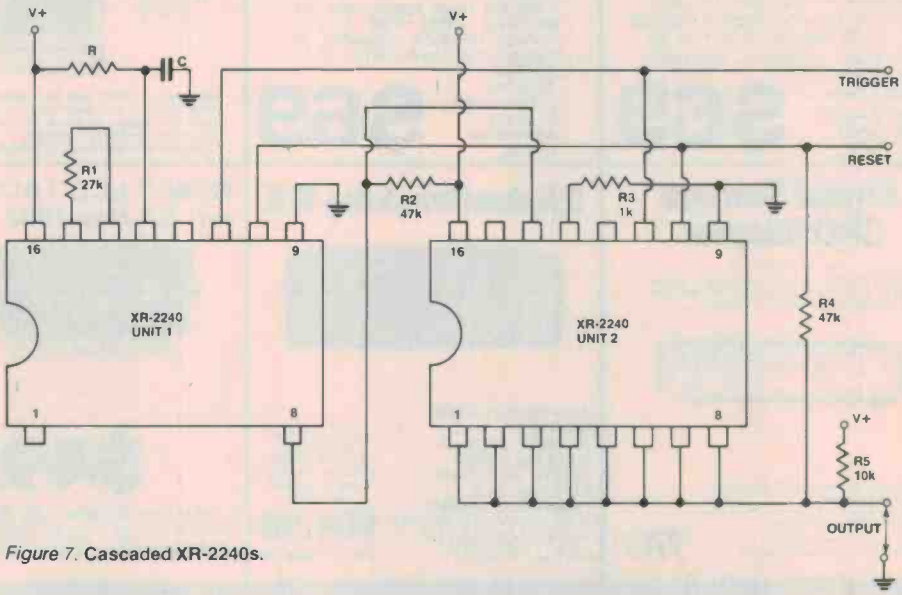


Figure 7. Cascaded XR-2240s.

NEW STORE opening October in Carlingford

AT "NEVILLE'S CORNER" CNR CARLINGFORD & PENNANT HILLS RD. NEXT TO KENTUCKY FRIED CHICKEN

JAYCAR KITS

CAR COMPUTER KIT

FUEL SENSOR

GENUINE MORAY UNIT ONLY $59

speed sensors

Two types available. Both operate with the EA Car Computer and give much the same results. The speedo cable unit is handy for front-wheel-drive or cars which have no tailshaft. This unit does require the speedo cable (outer sheath) to be cut. It does not affect the operation of the speedometer in any way and can be used with tailshaft cars also. The magnet/coil unit is only really suitable for cars fitted with tailshafts, but the speedo cable is not touched.

$19.50

FROM $99.50

$14.50

- FUEL ECONOMY (INSTANTLY AS YOU TRAVEL ALONG) IN LITRES/100KM.
- AVERAGE ECONOMY OVER A TRIP.
- AMOUNT OF FUEL USED SO FAR
- AMOUNT OF FUEL NEEDED (BASED ON AVERAGE USE) TO COMPLETE TRIP. ALSO TIME REMAINING.
- ELAPSED TIME
- SPEED IN K'S/HR. MORE ACCURATE THAN CAR
- DISTANCE TRAVELLED/REMAINING
- HOW FAR YOU CAN GO ON THE FUEL LEFT

Ref: JULY/AUG 82

Lyrebird Piano Kit

REF: EA 11/81-1/82

NEW LOW PRICE...

$475

SAVE $50!!!

BOTH PIANO KITS FEATURE I.C. SOCKETS PROVIDED AT NO EXTRA CHARGE!!!

7¼ OCTAVE (88 NOTE) VERSIONS $589

* Stand $75 extra

Because we are shipping keyboards and other expensive components in bulk due to high demand, we can pass savings onto YOU.
You can now have a magnificent "Lyrebird" six octave touch sensitive piano for only $475!! That's a staggering $50 off the old price.
REMEMBER!! THE LYREBIRD OUTPERFORMS READY BUILT PIANOS COSTING UP TO THOUSANDS OF DOLLARS MORE. WHY PAY MORE WHEN YOUR CONSTRUCTION KNOWLEDGE CAN SAVE YOU A FORTUNE?

pricing * * * * information

All Electronics including both PCB's plated-through, programmed EPROM, 1% metal film resistors, high spec components and YOUR CHOICE of either speedometer cable speed sensor OR tailshaft sensor. (Please specify) $99.50
Pre-Punched case with, special silk screened panel and multi-way connector. $29.50
'MORAY' High resolution Fuel Sensor $59
IF PURCHASED TOGETHER ONLY $159
– WITH EXCLUSIVE LITRE/100KM–MPG CONVERSION CHART

Digital EA2/82 Thermometer

Ref: EA Feb 1982
Read the temperature in your room (or outside) from 0 degrees C to 100 degrees C in fact to within 0,1 degree C. Fantastic resolution on a bright easy-to-read display. INC CASE

$69

DIGITAL CAPACITANCE METER

Ref: EA March 1982

This kit once again uses the amazing DPM 200 LCD /driver module. Capable of measuring capacitance from 1pF to 19.99uF. It is a must in every workshop or lab.

$69

HEART RATE MONITOR

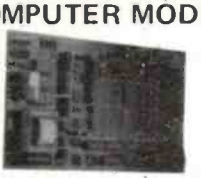
Ref: EA 7/82

NOW $69

WAS $79
SAVE $10

This unit enables you to measure your own pulse instantly and accurately. It is light enough even for joggers to carry. A must for people who may have heart problems. Complete kit including LCD Display.

NEW!!! ETI 644 DIRECT-CONNECT COMPUTER MODEM



Ref: ETI SEPTEMBER 82
Switchable BAUD RATE, more reliable and faster than most acoustic modems All components for this unit including plated-thru PCB's and Telecom approved line coupling transformer.

ONLY $ 159

Digital Storage CRO Adaptor

Ref: Feb 1982 EA

Not only can you avoid buying an expensive CRO but you can have the features of the REALLY expensive ones!!!

- Can display very slow waveforms
- One shot triggering
- Inbuilt graticle shows on TV screen
- Crystal locked timebase
- DC-100kHz bandwidth
- capable of storage operation

$110

EA dual tracking P/S

1% resistors used NOT 2%
At last!! A dual-tracking power supply with fixed +5V reg. at a reasonable price!! YOU PAY NO MORE FOR A QUALITY JAYCAR KIT!!

EXCLUSIVE!! US-MADE 10 TURN .25% LINEARITY POT used for greater accuracy

$84.50

Ref: EA March '82

NEW!!! LCD TACHO KIT ref: EA May 1982

$49.50

- USES NEW DPM-05 DISPLAY
- FITS INTO YOUR DASHBOARD
- RPM, DWELL DISPLAY

NEW!! EA STEREO SYNTHESISER

Ref: EA SEPT 82

Creats a very realistic stereo sound from AM tuners, TV or video. Very easy to build
SHORT FORM KIT
ONLY $39.50

CARLINGFORD PHONE 872 4422

-QUALITY RESULTS

NEW STORE opening October in Carlingford

AT "NEVILLE'S CORNER" CNR CARLINGFORD & PENNANT HILLS RD. NEXT TO KENTUCKY FRIED CHICKEN

500MHz Digital Frequency Period Meter

REF: EA Dec '81 – Feb '82

Tilting Bail to suit ONLY $4.95

NOW BACK IN STOCK!!!
The best version of this kit in Australia is now back in stock. Why settle for an inferior kit at the same price as ours?
Other people may appear to be selling this kit for less. But you GET less!! Exclusive Jaycar features:

- Heavy gauge front panel. Pre-punched and silkscreened. (NOT Scotchcal).
- All metal film resistors used 1% 50ppm)
- Thermalloy heatsink for +5V regulator

Beware of advertised units that do not conform to the original design. They may have inferior performances.

500MHz option only $26 extra
50MHz Version $119

ONLY $119

Function Generator

Ref: EA April 1982

"Pigeon Pair" companion to the new 500MHz DFM. Low distortion generator of sine, square and triangular waveforms. From below 20Hz to over 160kHz. Inbuilt 4 digit frequency counter in de-luxe Pac-Tec case. Only $85

JAYCAR EXCLUSIVE – 1% 50ppm metal film resistors used for stability and it's still only $99!!!

Unit pictured with EA Panel

Only $99

SPECIAL JAYCAR PANEL SUPPLIED

19" RACK–MOUNT GRAPHIC EQUALISERS

10 band (octave)

$139 STEREO MODEL 2010 MkII (A)

19" Rack Mount. Matches the ETI 5000 series components Makes a logical addition to your 5000AMP/Preamp combination. Based on the ETI 485 Graphic Equaliser but updated with state-of-the-art IC's. Incredible Performance.
Only $139 which includes the 19" rack cabinet.

(1/3 OCTAVE) 28 BAND

MONO MODEL 2801 MkII (A) **$225**

This professional instrument is used for total control of acoustic problems. Many hundreds of these are in use by live P.A. operators, Disco installations, recording studios and even the audiophile who demands the ultimate in control.
The kit uses state of the art I.C.'s for low noise, high slew rate and sharp band pass filters. Because it's a kit you save a fortune over built-up units which generally cost over three times the price of this unit.
NOW INCLUDES CANNON INPUT/OUTPUT CONNECTORS.

syntom

As used by Warren Cann of 'Ultravox'

Original design from the UK magazine "Electronics and Music Maker" April 1981. Self-contained unit produces a variety of fixed and falling pitch effects. Trigger by tapping the unit itself or by striking a drum to which the unit is attached. The Jaycar "SYNTOM" comes complete with high quality pre-drilled moulded all ABS box 152 x 80 x 47mm with professional silk-screened front panel.
FEATURES: Decay from less than 0.1 second to several seconds, pitch control, sweep control and volume on/off.

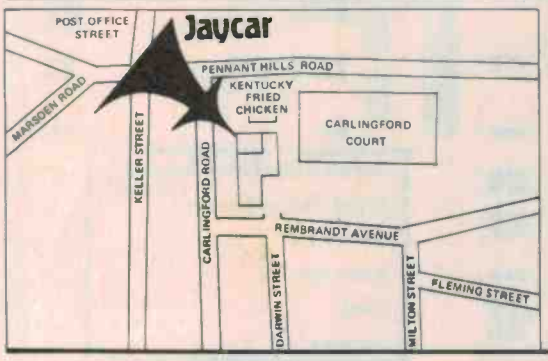
Only $36.50

GOOD-BYE 3002

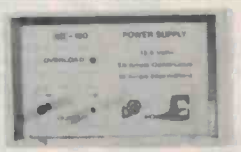
This 2x300WRMS P.A. Head is a classic road amp. Ruggedly constructed, 19" rack mount makes an ideal main P.A. or foldback unit. Great for Disco use as well.
We are discontinuing this amp because it is becoming too expensive to make. The metalwork costs alone now account for well over 50% of the unit. Because of this we have reluctantly decided to discontinue the unit.
You can grab one now while they last for only $399

~~$489~~ **$399**

Send SAE for full spec. sheet.



ETI 160 POWER SUPPLY 13.8V @ 10A



Oodles of regulated high current! Great for powering your high power mobile or linear at home!! Can also charge up a car battery pretty smartly too!! The Jaycar kit comes with Beryllium Oxide washers to help get the heat out of the two MJ15004 series regulator transistors. Complete kit includes box.

ONLY $79

ETI 330 CAR ALARM

This 'current sensing' car alarm is almost immune from false triggering. The latest Jaycar kit includes a predrilled diecast box (not a flimsey plastic box supplied by others). Don't be misled by cheap "versions". Ours is the original.

Only $ 29.50

JAYCAR

125 YORK ST SYDNEY 2000
Ph. 2646688 Telex: 72293
Mail Orders To:
Box K-39 Haymarket 2000

MINIMUM MAIL ORDER VALUE $5.00

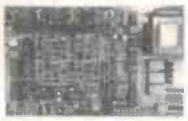
POST AND PACKING CHARGES	
$5 $9.99 ($1.20)	$10 $24.99 ($2.40)
$25 $49.99 ($3.50)	$50 $99.99 ($4.80)
$100 up ($6.20)	

NEW SHOP HOURS
Mon Fri 8.30 to 5.30pm
Sat 8.30 to 12.00pm
Thurs night to 8.30pm

ROD IRVING ELECTRONICS

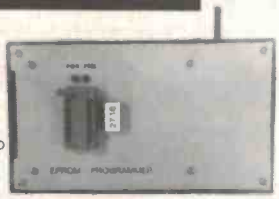
425 HIGH STREET, NORTHCOTE 3070. MELBOURNE. (03) 489-8131.

ETI-644 MODEM



ETI-494 SIGNAL-POWERED LOUDSPEAKER PROTECTOR

Protects your loudspeaker from dc or overpower damage. Suits amplifiers/speakers rated at up to 1500 watts! No power supply required and it has no discernable effect on sound quality. Suits hi-fi and PA applications.



ETI-686 PPI-BASED EPROM PROGRAMMER

Has your computer got a programmable peripheral interface (PPI) or three parallel ports? Here's a cheap, simple and reliable EPROM burner for blowing 2516s, 2716s or 2732s.

	PCB PRICE			KIT PRICE
ET 014	4.50	Dual Voltage Power Supply	Dec 71	
ET 043	2.00	Head or Tails	Oct 76	$3.50
ET 044	1.90	Two Tone Doorbell	Oct 76	$4.50
ET 047	1.90	Morse Practice Set	Dec 76	$3.50
ET 048	1.90	Buzz Board	Dec 76	$3.50
ET 061	2.20	Simple Audio Amp	Oct 76	$8.50
ET 062	2.50	Simple AM Tuner	Mar 77	$8.50
ET 063	2.50	Electronic Bongos	Nov 79	$5.00
ET 065	2.20	Electronic Siren	Dec 79	$5.00
ET 066	1.90	Temp Alarm	Dec 79	$4.00
ET 068	2.20	Led Dice	Oct 76	$6.00
ET 071	2.50	Tape Noise Limiter	Jne 79	
ET 072	1.90	Two Octave Organ	Jne 78	$8.50
ET 083	1.90	Train Controller	Dec 79	
ET 084	2.50	Car Alarm	Jan 77	$12.00
ET 085	1.90	Car over Rev Alarm	Oct 79	
ET 130	1.90	Temp/Volts Converter	Feb 76	
ET 132	2.90	Experimentor Power Supply	Feb 77	
ET 134	2.90	R.M.S. Voltmeter	Aug 77	
ET 135	2.50	Digital Panel Meter	Oct 77	
ET 136	2.50	Linear Scale Cap. Meter	Mar 78	
ET 137A	3.90	Frequency Meter Lcd	May 78	
ET 137B	3.90	Audio Oscillator	May 78	
ET 139	1.90	Power Meter	May 78	
ET 147	3.50	Electronic Dummy Load	Oct 80	$60.00
ET 149	3.50	2 Tone Generator	Jul 80	$34.00
ET 152	2.90	Capacitance Meter	Feb 80	
ET 157	4.50	Crystal Marker	Oct 81	$34.00
ET 158	3.50	Low Ohms Meter	Nov 81	$29.00
ET 159	2.90	10-15V Exp. Scale Voltmeter	Dec 81	$23.00
ET 245	2.90	White Line Follower	Nov 77	
ET 250	3.50	House Alarm (262)	Aug 80	
ET 255	2.90	Thermometer	Nov 80	
ET 256	2.90	Humidity Meter		$10.50
ET 257	2.50	Universal Relay Board	May 81	$12.00
ET 258	2.50	Mini Drill Speed Controller	Jul 81	$ 6.00
ET 259a		Versatile 'Incremental' Timer	Jan 82	$30.00
ET 259b				
ET 260	2.60	Photo Lamp Flasher	Dec 79	
ET 261	2.90	Fog Horn	Dec 79	
ET 262	2.90	Intercom	Dec 79	
ET 263	2.90	Simple Egg Timer	Dec 79	
ET 264	2.90	Simple Siren	Mar 80	
ET 316	3.50	Transistor Assisted Ignition	May 77	
ET 317	3.50	Car Rev Monitor	Jul 77	
ET 324		Led Tacho	Aug 80	
ET 325	2.50	Car Auto Electric Probe		
ET-326	2.50	Exp. Scale Led Voltmeter	Spt 80	$12.00
ET 327	2.90	Turn/Hazard Indicator	Oct 80	$22.00
ET 328	2.90	Led Oil Temp Meter	Jan 81	$15.00
ET 329	2.50	Exp. Scale Vehicle Ammeter	Feb 81	$10.00
ET 330	3.90	Car Alarm	Jul 81	$27.00
ET 332	2.90	Electronic Stethoscope	Aug 81	$34.00
ET 333		Reversing Alarm	Jan 82	$10.00
ET 363	3.50			
ET 417	2.90	Overload Indicator	Aug 73	
ET 438		Led Level Meter		$11.00
EET 440	8.50	25 Watt Stereo AMP	Mar 75	
ET 445	2.20	General Purpose Preamp	Jly 76	$8.00
ET 446	3.50	Stereo Limiter	Jly 76	
ET 449	2.90	Mike Amplifier	May 77	
ET 450A	3.50	Bucket Brigade	Dec 77	
ET 450B	3.20	Bucket Brigade	Dec 77	
ET 452		Guitar Practice Amplifier	Jan 80	
ET 453	2.90	AMP Class B. Gen Purpose	Apl 80	
ET 454	3.50	Fuzz Box	Apl 80	
ET 455	3.90	Loud Speaker Protector	Mar 80	$25.50
ET 457	2.90	Scratch & Rumble Filter	Spt 80	
ET 458	4.90	Led Level Meter	Jne 81	$27.00
ET 459A	3.50			
ET 466	7.50	300W AMP Module	Feb 80	$83.00
ET 467	6.90	4 Input Mike Preamp	Jly 80	$27.00
ET470	2.90	60 Watt Amp Module Series 4000	TPV 6	$25.00
ET 471	9.90	Audio Preamp Series 4000	TPV 6	$48.00
ET 472	2.90	Power Supply For Series 4000	TPV 6	$24.00
ET 473	5.90	Moving Coil Preamp Series 4000	TPV 6	$54.00
ET 474	2.90	Interface 60W Amp	Jan 80	
ET 475	4.90	AM Tuner	Spt 80	$66.00
ET 476	6.90	Series 3000 AMP 25W Stereo	Nov 80	$54.00
ET 477	4.90			
SERIES 5000 POWER AMP COMPLETE KIT				
ET 478MB	15.00	Series 5000 Preamp Main Board	Oct 81	
ET 478MC	3.90	Moving Coil Preamp (5000)	Spt 81	$24.00
ET478MM	3.90	Moving Magnet Preamp (5000)	Spt81	$10.00
ET478SA	2.50	Series 5000 Preamp Switch Brd	Oct 81	
ET478SB	1.90	Series 5000 Preamp Switch Brd	Oct 81	
ET478SC	1.90	Series 5000 Preamp Switch Brd	Oct 81	
ET478SD	1.90	Series 5000 Preamp Switch Brd	Oct 81	
SERIES 5000 PREAMP COMPLETE KIT				$220.00
ET 480	2.90	50 Watt Amp Module	30 Ap	$17.00
ET 480	2.90	100 Watt Amp Module	30 Ap	$22.00
ET480PS	2.90	50-100 AMP Module Pwr Supply	30 Ap	$22.00
ET481M	2.75	Hi-Power P.A./Guittar Amp Mod.	30 Ap	
ET481PS	4.90	12V / 100 P.A. Inverter	30 Ap	
ET 483	3.90	Sound Level Meter	Feb 78	
ET 484	4.90	Expander Compressor	Jly 77	
ET 485	4.50	Graphic Equaliser	Jne 77	
ET 486	3.90	Howl Round Stabilizer	Nov 77	
ET 489A	3.50	Audio Spectrum Analyser Mk2	Apl 78	
ET 489B	3.50	Audio Spectrum Analyser Mk2	Apl 78	
ET 496		Series 4000-1 Speaker Kit	Feb 80	$620.00
ET 528	2.90	Intruder Alarm	Jan 75	
ET 539	2.90	Touch Switch	Mar 76	
ET 541	2.90	Train Controller	May 76	
ET 547	3.50	Telephone Bell Extension	Jne 77	
ET 549A	2.90	Metal Detector	May 77	
ET 560	1.90	240V Mains Locator	May 80	
ET 561	2.90	Metal Detector	Mar 80	$34.00
ET 562	3.90	Geiger Counter	Apl 80	
ET 563	3.50	Nicad Fast Charger	Jly 80	$54.00
ET 566A	2.90	Pipe & Cable Locator	Apl 80	
ET 566B	3.90	Pipe & Cable Locator	Apl 80	
ET 567	3.50	Core Balance Relay	Apl 81	$42.00
ET 568	2.90	Photo Flash Trigger	Oct 80	$25.00
ET 570A		Infrared 'Trip' Relay TX	Jan 82	
ET 570b		Infrared 'Trip' Relay RX	Jan 82	
ET 572	4.90	Digital PH Meter	Dec 80	$80.00
ET 573	3.50	Universal Timer	Oct 79	
ET 576	5.90	Electromyogram	TPV 6	$80.00
ET 577	3.50	General Purpose Power Supply	TPV 6	$36.00
ET 578	2.90	Simple Nicad Charger	Jne 80	
ET 581	2.50	15V Dual Power Supply	Jne 76	$8.50
ET 583	2.90	Marine Gas Alarm	Aug 77	
ET 585R	1.90	Ultrasonic Receiver	TPV 6	$16.00
ET 585T	1.90	Ultrasonic Transmitter	TPV 6	$8.00
ET 585	3.90			
ET 591A		Up/Down Digit Counter	Jly 78	
ET 591B		Up/Down Digit Counter	Jly 78	
ET 596	2.90	White Noise Generator	Nov 81	$8.00?
ET 598		Touch Switch	Feb 81	$10.00
ET 598B	2.50	Touch Switch	Feb 81	
ET 599A	2.50	Infra Red Remote Control TX	May 80	
ET 599B	2.50	Infra Red Remote Control	May 80	
ET 599C	2.90	Infra Red Remote Control	May 80	
ET 599D	2.20	I.R. Remote Cntrl Power Supply	May 80	
ET 603	4.90	Music Synthesizer Sequencer	Aug 77	
ET 604	604	Metronome	Spt 77	
ET 606	3.90	Electronic Tuning Fork	Nov 79	
ET 607A	2.90	Sound Effects Generator	Aug 81	
ET607nl	2.90	Sound Effectis Generator	Aug 81	
ET607nl	2.90	Sound Effects Generator	Aug 81	
ET631-2	7.50	Keyboard Encoder	Apl 77	
ET 635	3.90	Train Steam Whistle	Apl 81	
ET 636	16.90	7 Slott $100 Mother Board	May 80	
ET 637		Cassette Interface	Jan 78	
ET 638A	4.90	Eprom Programmer	Jly 78	
ET 640	65.00	Memory Mapped VDU		$140.00
ET 650A	4.50	Stac Timer	Nov 78	
ET 650B	4.50	Stac Timer	Nov 78	
ET 650C	4.50	Stac Timer	Nov 78	
ET 660	19.00	Learners Microcomputer	Oct 81	$90.00
Key Set (18) To Suit ET660				$30.00
Colour Option Kit to Suit 660				$14.00
ET 682	69.00	Versatile Eprom Card	Mar 81	$110.00
ET 708	2.90	Aerial Amp	Mar 76	
ET 713	4.90	FM Tuner add on	Spt 77	
ET 717	4.50	Crosshatch Generator	May 78	
ET 726	3.50	R.F. Amp 70W 6/10 Meter	Feb 80	
ET 729		UHF TV Masthead amp	Apl 81	$30.00
ET 730		UHF TV Converter	May 81	$37.00
ET 731	4.50	Teletype Modulator	Oct 79	
ET 735	3.90	UHF to VHF Convertor	May 81	
ET 760	2.50	Video Mod. To Suit 660 Micros	Spt 81	$14.00
ET 824	2.90	Slot Car Power Supply	Dec 81	$18.00
ET 825	5.90	Slot Car Controller	Dec 81	$70.00
		Without Case		$55.00
ET1501A	2.50	Negative Ion Generator	Apl 81	$30.00
ET1501B	2.50	Negative Ion Generator	Apl 81	
ET1501C	1.50	Negative Ion Generator	Apl 81	
ET 1503	3.90	Battery Charger	Aug 81	
E.A				
Dream 6800	12.50			$100.00
Dream 6802	12.50			$100.00
Power Supply to Suit Dream Micro Kit				$29.50
HEX Keypad 19 keys				$29.50
75CD7	3.50			
75L11	2.50			
76E04	1.00			
76PC9	5.50			
78TM8	2.90			
78C5	4.90			
78A06	3.90			
78N6	3.50			
78T3	4.50	Photo Timer	Mar 78	
78NG4	2.90	Pink/White Noise Gen.	Apr 78	
78UT4	4.50	Low Cost VDU Keyboard	Apr 78	
78UP10	9.50	2650 Extra Ram	Oct 78	
79SB10	3.90	Bass Filter	Oct 79	
79FE11	2.50	Photo Flash Exposure MTR	Nov 79	
79PC9	3.90	Pulse Generator	Sep 79	
79SE3	3.90	Train Model Sound	Mar 79	
79TI11	2.90	Transistor Assisted Ign	Nov 79	$34.00
79PS11	2.90	Experimentors Power Sup.	Nov 79	
79PC12	2.90	Fan Speed Control	Dec 79	
79SF10	2.50	Photo Slave Flash	Oct 79	
79SF9	2.90	Photo Sound Trigger	Sep 79	
79UPS6	2.50	Universal Power Supply	Jun 79	$29.00
80ST10A	3.50	Stylus Timer	Oct 80	
80ST10B	2.50	Stylus Timer	Oct 80	
80TC12	2.90	Bipolar Train Controller	Dec 80	$29.00
80CMSA	4.50	Digital Capacitance MTR	Mar 80	$52.50
80CM3B	2.50	Digital Capacitance MTR	Mar 80	
80PG6	6.50	T.V. Pattern Generator	Jun 80	$52.00
80TV8	3.90	T.V. Cro Adapter	Aug 80	$29.00
80F3	3.20	Audio Prescaler	Mar 80	
80PP3	2.50		Mar 80	
80LL7	2.90	Leds & Ladders	Jul 80	$10.00
80B7	2.50	Beat Frequency Oscillator	Jul 80	
80BM10	2.90	Car Battery Monitor	Oct 80	$8.50
80SA10	9.90	Stereo Amp. Mosfet	Jan 81	$100.00
80DC10	6.50	Digital Storage Cro Ad.	Nov 80	$78.00
80GA12	6.50	Guitar Amplifier	Dec 80	
80HLA5	2.90	Car Headlight Alarm	May 80	
80LS12	3.50	SELECTALOTT	Dec 80	$22.00
80LBR12	2.90	Light Beam Relay	Nov 80	$13.00
80MA4	2.50		Apr 80	
80PC4	2.90	Power Heat Controller	Apr 80	
80HHS6	2.50	Hee Haw Siren	Jun 80	
80PC7	3.50	Power Saver Induction MTR	Jul 80	
80FB12	2.90	Guitar Fuzz Box	FEB 81	$10.00
80G6	5.90	Musical Tone Generator	Jun 80	
80GPS3	2.90	Voltage Regulator Multi	Mar 80	
80AD12	3.00	Autodim Light Dimmer	Dec 80	
80AU3	3.50	Hi Fi Auto Turn Off	Mar 80	
80AW4	4.50	Receiver All Wave	Apr 80	
80TM8A	5.90	Digital Engine Analyser	Aug 80	$40.00
80TM8B	2.50	Digital Engine Analyser	Aug 80	
80PP7A	6.50	Eprom Programmer	Jul 80	$72.00
80PP7B	2.50	Eprom Programmer	Jul 80	
80RF5	2.90	Rumble Filter	May 80	
80RM12	2.90	Cylon Voice Simulator	Dec 80	$10.00
80SA3	4.90	Playmaster Stereo Amp	Mar 80	?????
80CH7	6.50	240 V.A.C. Light Chaster	Jul 80	
80RAM12	3.90	Ram Expansion for Dream	Dec 80	$0.00
80PA6	7.50	Playmaster 300W amp. Module	Jun 80	$63.00
80CL4	3.50	Time Controller	Apr 80	
80TRS11	2.90	TRS 80 Printer Serial In.	Nov 80	$15.00
81DC2	2.20	Le Gong Doorbell	Feb 80	$15.00
81DT5	3.00	Dream Tape Controller	May 81	
81GA3	11.50	Colour Graphic Analyser	Mar 81	$80.00
81UC8	4.50	Universal Timer and Stopwch.	Aug 81	
81MP6	2.90	Microprocessor Power Sup.	Jun 81	
81IR4A	4.50	Infra-Red Relay	Apr 81	$30.00
81IR4B	2.90	Infra-Red Relay	Apr 81	
81SP1	2.90	RS232 TRS80 System 80 In.	Jan 81	
81S13	7.90	TRS80/System 80 Serial In.	Mar 81	
81SW1	3.90			
81MC7	2.90	Moving Coil Preamp	Jul 81	
81RM2	2.50		Feb 81	
81DC3B	8.50	Digital/Analog Store. Cro.	Mar 81	$100.00
81DC3A	9.50	Digital/Analog Store. Cro.	Mar 81	
81WS10	2.90	Wind Speed Indicator	Oct 81	$43.00
				$43.50
81P6	2.90	Pool/Lotto Selector	Jun 81	$24.00
81A010	3.50	Audio Test Unit Cass.Deck	Oct 81	
81AD10	3.50	Audio Test Unit Cass.Deck	Oct 81	$47.00
81MC8	9.50	Musicolour IV	Aug 81	$75.00
81SG9	4.20	Led Sandglass	Sep 81	$22.00
81P19			Sep 81	
81C19		Digital Clock Thermometer	Sep 81	$60.00
81SS11	4.90	Slide Cross Fader	Nov 81	$60.00
81GA9	3.90	Photon Torpedo Game	Sep 81	$23.00
81UC8		Universal Timer	Aug 81	
81MC7	9.50	Moving Coil Preamp	Jul 81	
81SW7		Train Steam Whistle	Jul 81	$17.00
81SM7	2.90	Bagatelle	Jul 81	
81VM2	2.90	High Impedance DC Voltmtr	Feb 81	
81HB4A	7.50	Heart Rate Monitor	Apr 81	$64.00
81HB4B	2.90	Heart Rate Monitor	Apr 81	
81AM4	2.50	Touch Sensitive Alarm	Apr 81	
81RC4A	3.50	Infra Red Remote Control	Apr 81	
81RC4B	2.50	Infra Red Remote Control	Apr 81	
81RC4C	2.75	Infra Red Remote Control	Apr 81	
81SP5	2.50	Sound Pressure Meter	May 81	$37.00
81OR7	9.50	Electronic Organ	Jly 81	$30.00
81CH12	3.50	Christmas Decoration	Dec 81	$15.00
81fm10a	4.90	500MHZ Digital Freq.Mtr.	Dec 81	$130.00
81fm0a	4.90	500MHZ Digital Freq.Mtr.	Dec 81	$130.00
81fm0b	3.50	500MHZ Digital Freq.Mtr.	Dec 81	
811d12	3.90	Led Bar Graph Display	Dec 81	
82epl	3.90			
82epl	7.90	Easy to use Eprom Programmer	Jan 82	$30.00
		With Plugpac		$31.50
81mll	2.50	Metronome (Low Current)	Jan 82	$15.00
81wd12a	2.50	Wind Direction Indicator	Jan 82	$24.00
81wd12b	2.50	Wind Direction Indicator	Jan 82	
HOBBY ELECTRONICS				
HE102	2.50	Guitar Phaser	Jun 81	$25.00
HE103		Transistor Tester		$8.00
HE104	$2.20	A.M. Tuner	May 81	$7.50
HE105	$2.50	Basic Amplifier	May 81	$8.50
HE106	2.90	F.M. Radio Microphone	May 81	$8.50
HE107	3.50	Electronic Dice	Jun 81	$8.95
HE108	2.90	Power Supply		$11.95
HE110		Umistakabell		$8.00
HE110		Ohmeter		$10.00
HE112	2.20	Micromixer		$11.00
HE113	2.50			$8.45
HE115	2.50			
HE117		House and Car Alarm		$10.00
HE121	2.50	Scratch and Hiss Filter		$8.00
HE123	3.90			
HE125	2.50			
HE126	2.50			
HE127		Siren		$3.00

Bankcard Mail Orders Welcome

ETI 10/82/2

Please debit my Bankcard

Bankcard No. .....

Expiry Date .....

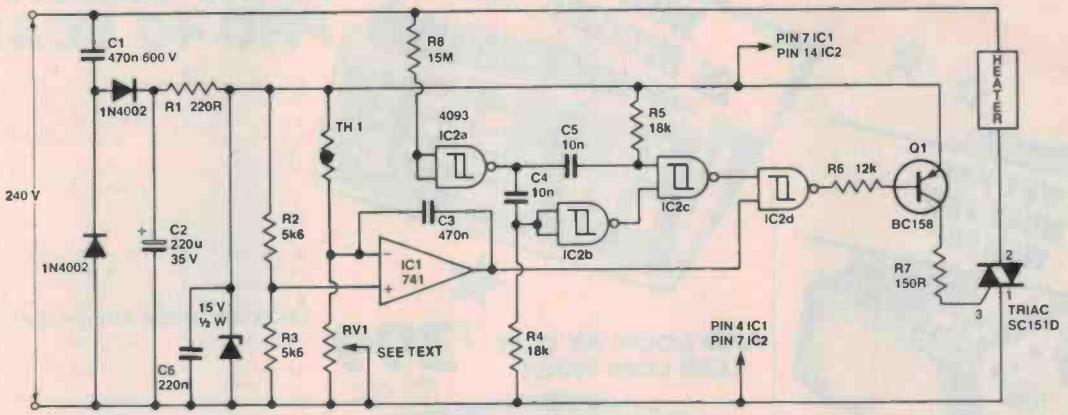
Name .....

Signature .....

TO ORDER. Heavy items sent Comet Freight on. Mail Order phone 481-1436. Wholesale Customers phone: RITRONICS WHOLESALE 489-7095
Mail Orders to P.O. 235 Northcote 3070 Minimum P&P $2. Add extra for heavy items, registration and certified mail.
Prices spec. subject to change without notice.

Ideas for Experimenters

These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.



Electronic thermostat

This circuit, designed by **Steve Gagen of North Balwyn Victoria,** has been used for several months to control the temperature in an incubation room. According to Steve it has performed well, achieving drift-free temperature regulation with an accuracy of ±0.5°C.

The low voltage supply to the ICs is taken directly from the mains, via capacitor C1. The thermistor (T) should be of the bead type and, if necessary, may be sited at some distance from the rest of the circuit. RV1 should be chosen so that its mid-range resistance is approximately equal to the resistance of the thermistor at the desired temperature.

The difference signal between the thermistor in the RV1 network and the voltage divider R2-R3 is amplified by IC1 and used to gate the output of the pulse generating circuit formed by IC2. Capacitor C3 prevents the amplification of any extraneous ac.

When the output from IC1 is high, 90 mA pulses of about 200 us length are applied to terminal 3 of the triac at the beginning of each mains half cycle, turning it on.

The circuit tends to cycle on and off every minute or so and the triac avoids the problem of burnt contacts which a relay would experience in these circumstances. Since the heat control is non-proportionating, the circuit is suitable for use with fan heaters.

Care should be used as the entire circuit is at mains potential, and the triac should be mounted on its heatsink using a mica insulator. A heatsink is essential as when controlling a 2.4 kW heater the triac dissipates about 15 W.

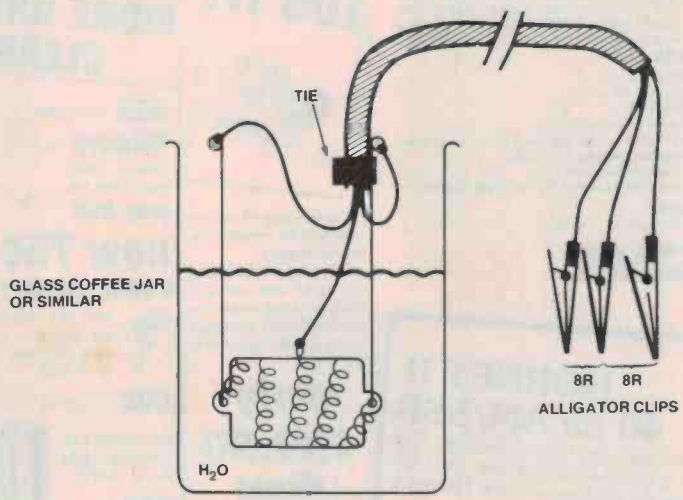
1 kW dummy load for testing audio power amplifiers

Philip Allison of Summer Hill NSW has worked out a cheap, simple method for testing audio power amplifiers.

You'll need a 1.6 kW electric jug replacement element, complete with its supporting arms, which you can buy from a hardware store.

The coil of Ni-Chrome wire on these elements has a resistance of about 36 ohms which needs to be reduced to 16 ohms for our purpose. To do this, first remove the coil and cut it at 16 ohms. Then stretch this length so that it equals the original length and carefully rewind it on the ceramic former.

Find the centre of this coil (8 ohms) and make a small twist. Using a length of three core mains flex attach the green wire to the twist and the blue and brown wires to the ends of the brass rods as shown in the diagram. Fit alligator clips or plugs to the other ends of this lead.



When immersed in water this unit will comfortably dissipate 500 watts per 8 ohm side or 1000 watts with a 4 ohm load (blue and brown linked) or with a 16 ohm load (using blue and brown only).

REAP THE BENEFIT

DICK'S

Cat D-2805

The DICK SMITH PRO 40 SCANNER

Compare with similar performance elsewhere at nearly twice the price! The new PRO 40 Scanner from Dick Smith represents the state-of-the-art in computerised scanning receivers!

★ Completely solid state computer-controlled circuitry — no expensive crystals to buy — complete with backup battery for stored frequencies.

★ Specially prepared Australian Instruction manual (written and produced by our own engineers). Other scanners often have hard-to-understand foreign instruction manuals.

★ Touch-type splashproof keypad for direct entry of all operational commands, frequencies etc.

★ Ideal as either a base or mobile scanner (operates from 12V — beware of others that don't operate from 12V!) with its own self-contained whip antenna or external plug-in antenna.

★ Complete with mobile mounting bracket and DC power cable.

LOOK AT THESE SPECIFICATIONS:

Frequencies covered	68 to 88MHz — 136 to 174MHz — 360 to 512MHz.
Scanning steps	5, 10, 12.5, & 25kHz (depending on band)
No. of channels	40
Power supply	12 to 16 volts DC (battery memory backup 9V)
Scan rate	Approx 18/sec

AND LOOK AT OUR LOW LOW PRICE **$399**

$9.27 weekly over 12 mths

Cat T-2000

The NEW Dick Smith Temperature Controlled Soldering Station

At last – A professional quality temperature controlled iron at a budget price! Yet it has even more features than those irons you'd pay $$$ more for! Features like . . . an exclusive temperature meter to show you exactly whats happening . . . fully controllable temperature from around 200 C to 500 C . . . self contained iron stand, tip cleaning sponge and a bit well. **And more . . . it's fully approved by the Electricity Authority!** Easy to use, lightweight – so that operators don't suffer from the fatigue problems of earlier irons. If your need is fast, efficient soldering, you need the new Dick Smith Temperature Controlled Soldering Station.

Specifications

Operating voltage: 240V AC
Iron Wattage: Nominal 50 watts
Iron Element Voltage: 24 V
Iron Barrel Potential: Nominally earth
Temperature Range: 200 to 500 (degrees C), fully variable
Temperature Indication: Moving Coil Meter
Tips Available: Fine, Medium and Thick
Electricity Authority Approval No. N 1188 T2000

Accessories supplied
Iron stand, cleaning sponge, tip well

around $20 less than equivalent units at only **$65**

Cat K-3400

CAR COMPUTER

Yes! The kit you've been waiting for is now a reality. Electronics Australia's new Car Computer is the ideal way to find out how your car is performing — and how much it is costing you to run it! The result of amazing technology is a kit which really can save you money! We've not only made our board with plated holes, we've also had a solder mask and component position overlay printed. You'll find it difficult to make an error!

FUEL FLOW SENSOR

Don't be fooled — the ONLY fuel flow sensor to give optimum results with the car computer is the fully imported 'Moray' unit. We are sole authorised Australian agents for this device. Buy the best and get the incredible accuracy you deserve!

Cat K-6100 **$69.50**

SPEED SENSOR

Knowing how incredibly difficult it can be to cut successfully a speedometer cable without risk of damage, we've decided to use the alternative driveline sensor. A lot easier to install, it is not subject to the problems of speedo cables.

Cat K-6102 **$8.25**

$93.50

★★★★★★★

SPECIAL OFFER

Buy both sensors and get the speed sensor for $3.00! YES: The exclusive Moray Fuel Flow Sensor plus the Driveline Sensor at the bargain price of just $72.50! This makes the complete Dick Smith Car Computer only $166.00 — with nothing else to buy! GREAT VALUE!!!

$166

LOG IT!

The amateur radio nut who also happens to like computers, has not been forgotten.

Now the tedious job of maintaining your log has been made easy. Simple to run and designed for System 80/TRS 80, this program includes a detailed users manual.

Cat X-3774

only $39.50 Great Value!!!

MORE GREAT STOCK CLEARANCES

50K Sliders Cat R-1980
Linear pot, 73mm length, 45mm travel.
was 95¢
now 75¢

KNOBS TO SUIT
8mm slider, 15mm deep 'chromed plastic, black face. Cat H-3780
60¢ 10 up 40¢

Black anodised knob 16mm deep, 10mm dia. Cat H-3782
50¢ 10 up 45¢

SAVE $10!!!
95H90 500MHz Divider IC
Cat Z-5360 ~~$19.95~~
now $9.95!

Clock Divider IC
AY-3-8112 Type Clock Frequency divider IC
Cat Z-6832 ~~$17.50~~
$12.50

WIRE WOUND POT
Throwaway Price!
7.5k
Cat R-6923
only $1.75

TANTALUM CAPACITORS

Cat R-4715	35V	.47uF	**60¢**	10 up 55¢
Cat R-4740	35V	4.7uF	**60¢**	10 up 55¢
Cat R-4750	25V	10uF	**70¢**	10 up 65¢
Cat R-4760	16V	22uF	**70¢**	10 up 65¢

HORNET II 40 ch AM/SSB

The latest in 40 channel CB technology. The quality of this unit is even better than the high standard set by its predecessor, the Hornet I, our most popular CB ever!

ONLY **$239.50**

Cat D-1710
DOC APP. NO. 249A006

"He started with Dick Smith's Fun Way — look at him now!"

Tomorrow's world will be a world of electronics and knowledge will be vital. Your child can gain that knowledge and have fun along the way with Dick Smith's Fun Way Into Electronics.

Volume 1 Cat. B-2600 **$4.95**

Volume 2 Cat. B-2605 **$6.95**

DIRECT IMPORT PRICES

STILL SOME LEFT!!!

FAMOUS **AMPEX** CASSETTES

Cat:	Type:	WAS	NOW	10 UP
C-3078	C-45 ELN	$2.16	$1.50	$1.35
C-3080	C-60 ELN	$2.40	$1.99	$1.79
C-3082	C-90 ELN	$3.15	$2.49	$2.24
C-3086	C-60 EDR	$3.49	$2.25	$2.00
C-3088	C-90 EDR	$4.15	$2.99	$2.69

★★★★★★ ★★★★★

THE PRO SIZED COMPUTER YOU BUILD YOURSELF AND SAVE!!!

The DICK SMITH SUPER 80

a professional sized computer you build yourself!

COMPLETE WITH INBUILT POWER SUPPLY

$245

Serious computer users and first time users alike can use this incredible computer. Works with any TV set and is extremely easy to build AND you get a huge 9K of BASIC — comparable with computers costing $1,000 or more! Cat K-3600

ACCESSORIES FOR THE SUPER 80

BASIC ON CASSETTE
The BASIC program for Super 80 on cassette. Cat. K-3602

$13.25

EPROM BASIC
If you don't have time to wait for a cassette to load, then the EPROM is the way to go! A set of 3 EPROM IC's with the BASIC and monitor programs already stored inside them. Cat. K-3604

$50.75

IC SOCKET SET
It is essential to use the IC socket set when building the SUPER 80 to facilitate any necessary repairs in the future. Cat. K-3603

$13.25

S-100 EXPANSION
Socket required for S-100 expansion. Cat. K-3606

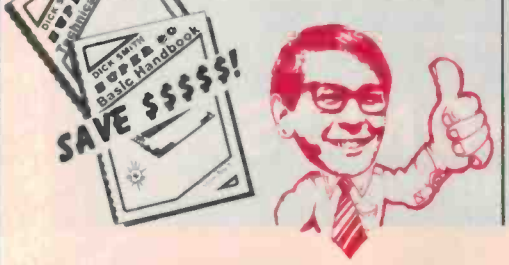
$21.00

SUPER 80 MANUALS

These two comprehensive manuals will assist you in the construction and programming of your SUPER 80.

SUPER 80 TECH. MANUAL Cat. B-3600 **$9.50**

SUPER 80 BASIC H/BOOK Cat. B-3602 **$9.50**



YOU'D BE CRAZY TO BUY A TV GAME

before you see the amazing . . .

HFC $6.85 weekly over 12 mths to approved customers

DICK SMITH WIZZARD

Yes — an absolutely up-to-date design. Most of the TV game consoles around were designed at least 2 years ago. And in electronics, that's an eternity!

Compare the quality

Amazing picture quality with over 49,000 dots — over twice as good as the largest selling TV game. You'll be amazed at the clarity — just like the screens NASA use in the space shuttle!

Space age Controllers

Not just simple sticks: full space-age guiding devices with 48 keys as well. You get incredible control capability — far more than possible with other games. And slide-in overlays for controllers: you can see exactly what to do! When the controllers are placed in the console, they form a standard typewriter-style 'QWERTY' keyboard — that's versatility!

Fantastic game Cartridges

21st century games — like you've never played before. And every cartridge has many games — up to 32 in each! You'll never be satisfied with anything less after playing the WIZZARD. Every cartridge has a built-in demonstration program to show you how to play the game.

The one with the inbuilt PERSONAL COMPUTER

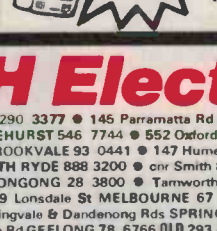
The Dick Smith WIZZARD has an inbuilt personal computer facility! Just plug in the optional 'BASIC' cartridge and the WIZZARD becomes a powerful personal computer, complete with 17K of memory (that's more than you get with many personal computers! Learn how to run your own programs. Finance, homework, anything!

'BASIC' CARTRIDGE Available soon — watch our ads for details!

Compare the price

The best part of all: the Dick Smith WIZZARD is around $200 cheaper than the closest comparable computer! Yes, you not only save a fortune by buying the Dick Smith WIZZARD, you get much greater flexibility and enjoyment!

Cat. Y-1600



with your Wizzard **$295**

DICK SMITH Electronics

NSW 6 Bridge St SYDNEY 27 5051 ● 125 York St SYDNEY 290 3377 ● 145 Parramatta Rd AUBURN 648 0558 ● T55 Terrace Level BANKSTOWN SQ 707 4888 ● 613 Princes Hwy BLAKEHURST 546 7744 ● 552 Oxford St BONDI JUNCTION 387 1444 ● B18 George St BROADWAY 211 3777 ● 531 Pittwater Rd BROOKVALE 93 0441 ● 147 Hume Hwy CHULLORA 642 8922 ● 162 Pacific Hwy GORE HILL 439 5311 ● 396 Lane Cove Rd NORTH RYDE 888 3200 ● cnr Smith & George Sts PARRAMATTA ● 173 Maitland Rd NEWCASTLE 61 1896 ● 263 Keira St WOLLONGONG 28 3800 ● Tamworth Arcade & Kable Ave TAMWORTH 66 1961 ACT 96 Gladstone St FYSHWICK 80 4944 VIC 399 Lonsdale St MELBOURNE 67 9834 ● 260 Sydney Rd COBURG 383 4455 ● 656 Brige Rd RICHMOND 428 1614 ● cnr Springvale & Dandenong Rds SPRINGVALE 547 0522 ● cnr Ross Smith Ave & Nepean Hwy FRANKSTON 783 9144 ● 205 Melbourne Rd GEELONG 78 6766 QLD 293 Adelaide St BRISBANE 229 9377 ● 166 Logan Rd BURANDA 391 6233 ● 842 Gympie Rd CHERMSIDE 59 6255 SA 60 Wright St ADELAIDE 212 1962 ● 435 Main North Rd ENFIELD 260 6088 ● cnr Main South & Flagstaff Rds DARLINGTON 298 8977 WA 414 William St PERTH 328 6944 ● cnr Wharf St & Albany Hwy CANNINGTON 451 8666 TAS 25 Barrack St HOBART 31 0800

MAIL ORDER CENTRE: PO Box 321, North Ryde NSW, 2113. Phone: (02) 888 3200

DSE/A365/LM

CLAMP METER

MODEL YF-700

Top of the range model AC Voltage 150V 300V 600V AC Current 6A 15A 60A 150A 300A. Resistance 5kΩ (Midscole 200Ω)

was $49.99

NOW ONLY

$43.55

DISCOUNT DISC DRIVES COMPUTERS

PRINTERS	
ITOH 8300 PARALLEL	$668 + TAX
ITOH 8300 SERIAL	$730 + TAX
ITOH 1500 PARALLEL (DAISYWHEEL)	$1515 + TAX
ITOH 1500 SERIAL (DAISYWHEEL)	$1555 + TAX
ITOH 8510 PARALLEL	$910 + TAX
ITOH 8510 SERIAL (GRAPHIC ETC)	$1015 + TAX

RITRON COMPUTER GRADE P/S
+5V reg 10a 16V unreg @ 1A.
KIT $79.95 inc
Built and tested $99.50

ETI636 MOTHERBOARD
7 Slot Motherboard $90.00
Built and Tested $120.00
ACTIVELY TERMINATED

INTERSIL LCD $34.50
3½ DIGIT PANEL METER KITS

Build a working DPM in ½-hour with these complete evaluation kits.
Test these new parts for yourself with intersil's low cost prototyping kits complete with A/D converter and LCD display (for the 7106) or LED display (for the 7107). Kits provide all matrials including PC board, for a functioning panel meter ICL7106EV (LCD).

P.C. EDGE CONNECTORS

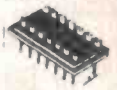
S100 gold plated wire wrap	$8.50
S100 solder tail	$6.90
D2 Motorola bus 43/86 solder tail	$8.50
43/86 gold plated wire wrap	$11.50

10 TURN POTENTIOMETERS

Stock resistance values
50R, 100R, 200R, 500R, 1K, 2K, 5K, 10K, 20K, 50K, 100k

Spectrol model 534 ¼" shaft.
Price 1–9 $9.50
10 + values may be mixed $8.90

DIP PLUGS



Ideal for use with flat ribbon cable or to mount components on
14 pin $1.20
16 pin $1.40
24 pin $1.20
40 pins $5

POWER TRANSFORMERS

SPECIALLY DESIGNED FOR MICROCOMPUTERS

- Good regulation electrostatic shield
- RI 810 8V @ 10A x 15V @ 1A $26.50
- RI 820 8V @ 20A 15V @ 1A 15V @ 3A $36.50

20 TURN CERMET TRIM POT

SPECTROL 43P ACTUAL SIZE

STOCK RESISTANCE VALUES
10R, 20R, 50R, 100R, 200R, 500R, 1K, 2K, 5K, 10K, 20K, 50K, 100K, 200K, 500K, 1M, 2M

1—9	$1.40
10—99	$1.30
100	$1.20

Values may be mixed.

Hexadecimal Keypad

$28.50 each

19-key pad includes 1-10 keys ABCDEF and 2 optional keys and a shift key

Ideal for dream project

MULTIDIALS

Dials to suit 10 T Pots

Model 21 1.8" dia	$16.50
Model 16 .9" dia	$12.50
Model 18 1" x 1.75" dia	$21.50

cermet single TURN TRIM POT

Spectrol model 63P ACTUAL SIZE

STOCK VALUES
10R, 20R, 50R, 100R, 200R, 500R, 1K, 2K, 5K, 10K, 20K, 50K, 200K, 500K, 1M, 2M

1—9	$1.00
10—99	0.90
100	0.80

Values may be mixed.

DIP SWITCHES SPST

P N	No of Switches	Price
SD3	3	$1.60
SD4	4	1.70
SD5	5	1.90
SD6	6	2.30
SD7	7	2.40
SD8	8	2.50
SD9	9	2.70
SD10	10	3.00

DIP SWITCHES SPST

TEXTOOL ZIP* DIP 11 SOCKETS

16 Pin Zip* Dip 11	$11.50
24 Pin Zip* Dip 11	12.50
40 Pin Zip* Dip 11	17.50

*Zero Insertion Pressure

INCREDIBLE MEMORY AND DISC DRIVE PRICES

	1-9	10-25	25+
2708	4.90	4.00	3.90
2716	4.90	4.20	3.90
2732	8.00	7.50	7.00
4116 (200nS)	1.95	1.80	1.75
4164 64K Dynamic	11.00	10.00	9.50
M58725P (2K x 8) Static	10.00	9.00	8.50

(As used in new 64K Static S100 PCB)
ALL PRICES INCLUDE SALES TAX

DISK DRIVES

MPI 51 $275.00 + 17.5% ST.
MPI 52 $385.00 + 17.5% ST.
MPI 91 $415.00 + 17.5% ST.
MPI 92 $515.00 + 17.5% ST.

TANDON

TM100-1 $295.00 + 17.5% ST.
TM100-2 $385.00 + 17.5% ST.
TM100-3 $415.00 + 17.5% ST.
TM100-4 $515.00 + 17.5% ST.

RS232 & "D" TYPE CONNECTORS

PART NO	DESCRIPTION	1-9	10-25	25+
DE-9P	9 PIN MALE	$3.50	$3.50	$3.10
DE-9S	9 PIN F/MALE	4.50	4.20	3.90
DE-9C	9 PIN COVER	2.20	2.10	1.90
DA-15P	15 PIN MALE	4.50	4.20	3.90
DA-15S	15 PIN F/MALE	5.10	4.90	4.70
DA-15C	15 PIN COVER	2.30	2.10	2.00
DB-25P	25 PIN MALE	5.90	5.60	5.10
DB-25S	25 PIN F/MALE	6.90	6.60	6.10
DB-25C	1 pc Grey Hood	2.40	2.20	2.00
DB-25C2B	2 pc Black Hood	2.80	2.70	2.50
DB-25C2G	2 pc Grey Hood	2.70	2.50	2.40
DC-37P	37 PIN MALE	7.90	7.50	7.10
DC-37S	37 PIN F/MALE	10.90	9.90	9.10
DC-37C	37 PIN COVER	4.90	4.50	4.10
DH-S	Hardware set (2 Pairs)	2.10	1.90	1.80

BUILD YOUR OWN SPEAKERS WITH PHILLIPS

PART No	PRICE
AD0140TB	$11.86
AD016101TB	$16.95
AD01605-TB	$16.54
AD0162-T15	$18.78
AD0162-T15	$13.03
AD0162-TB	$13.77
AD0210-SQ8	$32.70
AD02160-SQ8	$36.91
AD02161-SQ8	$33.46
AD10100-W8	$52.72
AD12100-HP8	$85.10
AD12100-M15	$79.11
AD12100-M8	$79.11
AD12100-W8	$53.99
AD12200-W8	$73.12
AD12250-W8	$90.52
AD12650-W8	$73.12
AD2273-T8	$5.03
AD4060-W8	$19.06
AD5060-SQ4	$22.05
AD5060-SQ8	$22.05
AD5060-W8	$17.59
AD5061-MB	$17.08
AD70601-W8	$20.40
AD70620-M8	$21.54
AD7063-M8	$20.78
AD70630-M8	$20.78
AD70650-W8	$26.96
AD7066-W8	$26.96
AD80601-W8	$20.24
AD8061-W8	$20.24
AD80652-W8	$26.20
AD8066-W4	$27.66
AD8081-M8	$9.81
AD9710-M8	$41.11
ADF1600-8	$19.44
ADF500-4500-8	$19.44

DIODES

	10-99	100+
IN4001	6c	5c
IN4002	6c	5c
IN4004	7c	6c
IN4148	5c	4c
IN5404	30c	25c
IN5408	35c	30c
IN4007	12c	11c

HEATSINKS

High Thermal Capacity Black Anodised

	1-4 $	5-9 $	10-49 $	50-99 $	100-499 $	500 plus $
HS1 — 38mm	1.85	1.75	1.50	1.35	1.00	0.90
HS2 — 75mm	3.00	2.90	2.50	2.00	2.00	1.50
HS3 — 150mm	5.80	5.40	4.90	3.80	2.90	2.70
HS4 — 225mm	8.10	7.60	7.10	5.90	4.50	4.30
HS5 — 300mm	8.90	8.40	7.90	6.50	4.90	4.60

Unanodised

HS11 — 38mm	1.40	1.20	1.00	0.90	0.80	0.70
HS12 — 75mm	2.50	2.20	1.90	1.60	1.25	1.20
HS13 — 150mm	4.90	4.50	4.00	3.20	2.45	2.40

BLANK CASSETTES T.D.K.

TDK ADC60	1 for $3.60	10 for $26.00
TDK DC60	1 for $2.10	10 for $18.00
TDK ODC60	1 for $3.50	10 for $31.00
TDK SAC60	1 for $3.30	10 for $29.00
TDK SAXC60	1 for $5.70	10 for $46.00
TDK DC90	1 for $3.05	10 for $21.00
TDK ADC 90	1 for $3.50	10 for $28.00
TDK SAC 90	1 for $4.20	10 for $37.00
TDK ODC90	1 for $4.70	10 for $45.00
TDK SAXC90	1 for $5.50	10 for $49.00
TDK DC120	1 for $4.50	10 for $37.00
TDK ADC120	1 for $5.40	10 for $46.50

Bankcard Mail Orders Welcome

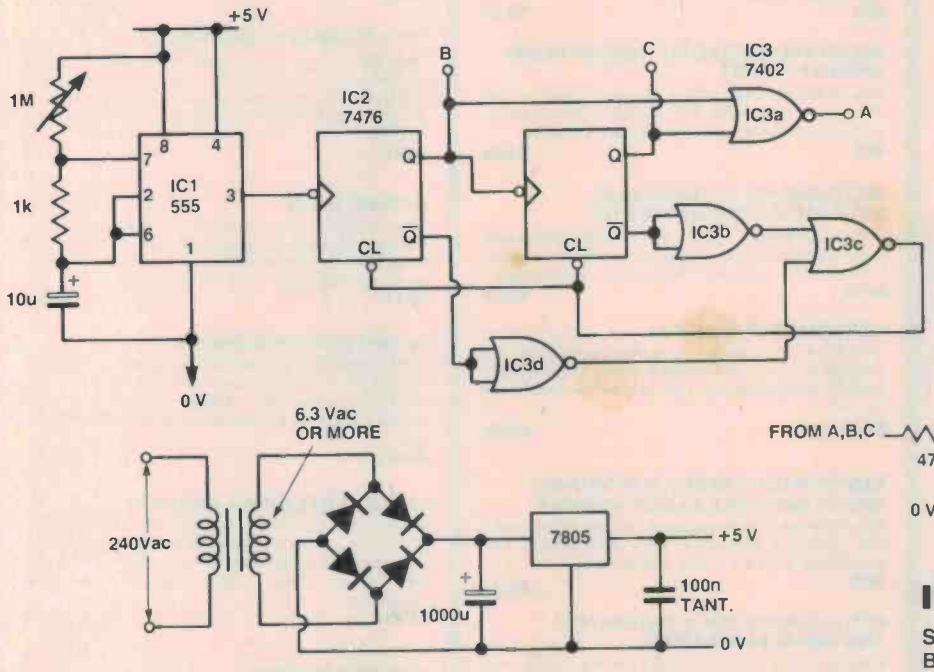
Please debit my Bankcard.
Bankcard No. . . . . ETI 10/82/5
Expiry Date . . . . . .
Name . . . . . .
Signature . . . . . .

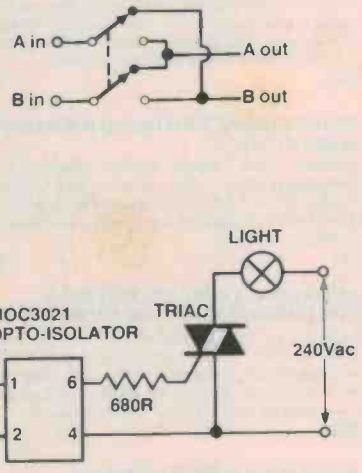
Post & Pack $2.50 small kits, heavier kits add extra postage.
Prices subject to change without notice. Send 60c and SAE for free price list and inclusion on all future mailing lists.
MAIL ORDERS: PO Box 235, Northcote, Vic 3070. Min P & P $1.00.
Ph: (03) 489 8131.

ROD IRVING ELECTRONICS

425 HIGH STREET, NORTHCOTE 3070, MELBOURNE, VICTORIA. Ph (03) 489 8131. Telex No. 38897

Ideas for Experimenters





IDEA OF THE MONTH

Stephen Pierrehumbert
Blackburn, Vic.

Three-channel light chaser

This simple idea comprises a three-channel light chaser incorporating a 'reversing' switch so that you can change the direction of the 'chase'.

A 555 is arranged as a variable astable multivibrator (IC1). Its output drives one flip-flop from a dual JK flip-flop (IC2). The Q output of this flip-flop drives the second flip-flop and a group of NOR gates (IC3) such that three outputs are produced, going high successively. The three outputs then drive opto-isolators which trigger triacs which drive the lamps.

A simple power supply circuit provides supply to IC1, IC2 and IC3. The DPDT switch reverses the A and B drives to reverse the chase sequence. The 1M variable pot varies the speed of the chase.

'IDEA OF THE MONTH' CONTEST

Scope Laboratories, who manufacture and distribute soldering irons and accessory tools, have offered to sponsor a contest with a prize to be given away every month for the best item submitted for publication in the 'Ideas for Experimenters' column — one of the most consistently popular features in ETI. Each month we will be giving away a Scope Panavise pc board holder, model 333 — as described in News Digest, p.8, October '81 issue. Selections will be made at the sole discretion of the editorial staff of ETI Magazine. Apart from the prize, worth about $70, each winner will be paid $10 for the item published. You must submit original ideas of circuits which have not previously been published. You may send as many entries as you wish.

RULES

This contest is open to all persons normally resident in Australia with the exception of members of the staff of Scope Laboratories, Murray Publishing, Offset Alpine, Australian Consolidated Press and/or associated companies.

Closing date for each issue is the last day of the month. Entries received within seven days of that date will be accepted if postmarked prior to and including the date of the last day of the month.

The winning entry will be judged by the Editor of ETI, whose decision will be final. No correspondence can be entered into regarding the decision.

Winner will be advised by telegram the same day the result is declared. The name of the winner, together with the winning idea, will be published in the next possible issue of ETI.

Contestants must enter their names and address where indicated on each entry form. Photostats or clearly written copies will be accepted but if sending copies you must cut out and include with each entry the month and page number from the bottom of the page of the contest. In other words you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

This contest is invalid in states where local laws prohibit entries.

Entrants must sign the declaration on the coupon that they have read the above rules and agree to abide by their conditions.

COUPON

"I agree to the above terms and grant Electronics Today International all rights to publish my idea in ETI Magazine or other publications produced by them. I declare that the attached idea is my own original material, that it has not previously been published and that its publication does not violate any other copyright*".

* Breach of copyright is now a criminal offence.

Title of idea .....

Signature .....

Name .....

Date .....

Address .....

..... **Postcode** .....

Cut out and send to: **Scope/ETI 'Idea of the Month' Contest, ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011.**

Seen these Babani Books?

REACTANCE/FREQUENCY CHART FOR AUDIO AND RF.
Enables the reactance of any capacitor or resistor to be read off immediately — from 10 Hz to 100 MHz. Reasonant frequencies of LC networks ditto.
196 — 75¢

HI-FI LOUDSPEAKER ENCLOSURES
Data for building corner reflex, bass reflex, exponential horn, folded horn, tuned port, Klipschorn labyrinth, tuned column, loaded port and multi speaker panoram-ics. Clear dimensioned diagrams included.
205 — $3.36

DIODE CHARACTERISTICS, EQUIVALENTS & SUBSTITUTES
Includes signal, zener, rectifier diodes etc. Full interchangeability data and characteristics of thousands of diodes of all types with every possible alternative. Includes UK, USA, European, Russian, and Far Eastern devices.
211 — $4.32

SHORT WAVE CIRCUITS AND GEAR FOR EXPERIMENTERS AND RADIO HAMS
Included are a crystal locked HF receiver, a shortwave converter for 2-6 MHz and another approach to the homodyne tuner. There are also two solid state RF preamps, an FM detector for amateurs and a solid state crystal frequency calibrator. And that's not all
215 — $2.86

BUILD YOUR OWN ELECTRONIC EXPERIMENTERS' LAB USING ICs.
Includes many circuits and designs for constructing test and measuring instruments mostly using modern ICs. Includes AF osc, TTL pulse detector, hi-impedence Vm, square-wave osc/pulse gen, logic probe, lo-range ohmmeter, bridge, signal tracer etc.
218 — $3.04

SOLID STATE SHORT WAVE RECEIVERS FOR BEGINNERS
Design and construction of several solid-state short-wave receivers giving high level of performance yet utilising relatively few inexpensive components. See also 226.
222 — $4.32

50 PROJECTS USING CA 3130 ICs.
The CA3130 is an advanced operational amplifier capable of higher performance than many others: circuits often need fewer ancillary components. Interesting and useful projects in five groups. Audio projects. RF projects. Test equipment. Household projects. Misc. projects.
223 — $4.32

PRACTICAL INTRO TO DIGITAL ICs
Introduction to digital ICs (mainly TTL 7400). Besides simple projects, includes logic test set to identify and test digital ICs. Also includes digital counter-timer.
225 — $4.32

HOW TO BUILD ADVANCED SHORT WAVE RECEIVERS
Full practical constructional details of receivers with performance equal to commercial units. Also 'add-on' circuits of Q meter, S meter, noise limiter etc.
226 — $4.16

BEGINNERS' GUIDE TO BUILDING ELECTRONIC PROJECTS
Enables total beginners to tackle electronic projects. Includes component identification, tools, soldering, building methods, cases, legends etc. etc. Practical basic projects are included.
227 — $5.12

ESSENTIAL THEORY FOR THE ELECTRONICS HOBBYIST
Knowledge of a subject considerably increases the enjoyment and satisfaction derived from its practice, and the object of this book is to supply the electronics hobbyist with a background knowledge tailor-made for his or her specific requirements. Minimum maths!
228 — $4.32

HANDBOOK OF RADIO, TV, INDUSTRIAL & TRANSMITTING TUBE & VALVE EQUIVALENTS
Equivalents book for amateurs and servicemen. More than 18 000 old and new valves from UK, USA, Europe, Japan et al. CV (military) listings with commercial equivalents included.
BP2 — $2.25

RADIO AND ELECTRONIC COLOUR CODES AND DATA CHART
This large wall chart covers all colour codes in use throughout the world. For all radio and electronic components made in UK, USA, Europe and Japan.
BP7 — $1.60

SECOND BOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES
Interchangeability data covers semiconductors manufactured all over the world. Immediate equiva-lents are shown and possible substitutes are included.
BP14 — $5.92

52 PROJECTS USING IC741
This book of projects using the inexpensive 741 integrated circuit is translated from the original highly popular German version, with copious notes, data and circuitry.
BP24 — $4.32

GIANT CHART — RADIO, ELECTRONICS, SEMI-CONDUCTOR & LOGIC SYMBOLS
Identify those symbols at a glance. A must for beginners and advanced enthusiasts alike. Professionals can always hide it in their desks! A steal at only . . .
BP27 — $1.92

HOW TO BUILD YOUR OWN METAL AND TREASURE LOCATORS
Electronic and practical details on the simple and inexpensive construction of heterodyne metal locators.
BP32 — $5.92

ELECTRONIC CALCULATOR USERS' HANDBOOK
Presents formulae, data, methods of calculation, con-version factors, etc, for use with the simplest or most sophisticated calculators. Includes the way to calculate using only a simple four-function calculator: trigono-metric functions (sin, cos, tan); hyperbolic functions (sinh, cosh, tanh); logarithms, square roots and powers.
BP33 — $5.12

50 CIRCUITS USING GERMANIUM SILICON AND ZENER DIODES
50 interesting and useful circuits and applications using the germanium and silicon signal diodes, silicon rectifier diodes and zener diodes etc.
BP36 — $3.36

50 PROJECTS USING RELAYS, SCRS AND TRIACS
Practical working circuits using silicon controlled rectifiers, relays and bi-directional triodes. With a minimum of difficulty you can use them in motor con-trol, dimming and heating control, timing and light sensitive circuits, warning devices and many others.
BP37 — $5.92

FUN AND GAMES WITH YOUR ELECTRONIC CALCULATOR
101 jokes and riddles, several mind-boggling games for two or more players and a dictionary of words with their corresponding numbers.
BP38 — $2.72

LINEAR IC EQUIVALENTS AND PIN CONNECTIONS
Shows equivalents and pin connections of a selection of popular linear ICs, with details of families, functions, country of origin and manufacture. Includes devices from Analog Devices, Advance Micro Devices, Fairchild, Harris, ITT, Motorola, Philips, RCA, Raytheon, Signetics, Sescocem, SGS-ATES, Siemens, AEG-Telefunken, Teledyne, Texas Instruments.
BP41 — $9.12

50 SIMPLE LED CIRCUITS
50 interesting and useful circuits and applications using the LED. Also includes circuits for the 707 Common Anode Display for the beginner and advanced enthusiast.
BP42 — $3.36

HOW TO MAKE WALKIE-TALKIES
This treatise on low power transmitter-receivers (walkie-talkies) covers many aspects from licensing requirements and bands, through practical circuitry and construction to the various types of aerials that may be used.
BP43 — $5.12

IC555 PROJECTS
One wonders how life went on before the 555! Included are basic and general circuits, motor car and model railway circuits, alarms and noise makers plus section on subsequent 556, 558 and 559s.
BP44 — $6.56

MOBILE DISCO HANDBOOK
Most people who start mobile discos know little about equipment or what to buy. This book assumes no preliminary knowledge and gives enough info to enable you to have a reasonable understanding of disco gear.
BP47 — $4.64

POPULAR ELECTRONIC PROJECTS
A collection of the most popular types of circuits and projects to interest most electronics constructors. The projects cover a wide range and are divided into four basic types: radio, audio, household and test equipment.
BP49 — $4.96

LM 3900 IC PROJECTS
Unlike conventional op-amps, the LM 3900 can be used for all the usual applications as well as many new ones. It's one of the most versatile, freely obtainable and inexpensive devices around. This book provides the groundwork for simple and advanced uses — it's much more than a collection of projects. Very thoroughly recommended.
BP50 — $4.64

LONG DISTANCE TV RECEPTION (TV-DX)
Written by UK authority, the book includes many units and devices made by active enthusiasts. A practical and authoritative intro to this unusual aspect of electronics.
BP52 — $6.56

YOUR ELECTRONIC CALCULATOR AND YOUR MONEY
Starts with a basic revision of percentages and decimals, then deals with mortgages, cars, insurance, fuel, shopping, tax etc. There's a section on investment and the last section deals with the calculator in a small business.
BP54 — $4.64

RADIO STATIONS GUIDE
This is an aid for all those who have a radio receiver. Shows the station site, country, frequency and/or wavelength, as well as the Effective Radiation Power (ERP) of the transmitter and in some cases, the station's call sign as well.
BP55 — $5.92

ELECTRONIC SECURITY DEVICES
Besides including both simple and more sophisticated burglar alarm circuits using light, infrared and ultra-sonics, this book also gives circuits for gas and smoke detectors, flood alarms, fire alarms, doorphones, baby alarms, etc.
BP56 — $5.92

HOW TO BUILD YOUR OWN SOLID-STATE OSCILLOSCOPE
Project divided into sections for builder individually to construct and test — then assemble into complete instrument. Includes short section on scope usage.
BP57 — $5.12

50 CIRCUITS USING 7400 SERIES ICS
50 interesting and useful circuits and applications using these inexpensive and versatile devices.
BP58 **$5.12**

SECOND BOOK OF CMOS IC PROJECTS
Leading on from book number 224 '50 CMOS IC PROJECTS', this second book provides a further selection of useful circuits mainly of a fairly simple nature. Contents have been selected to ensure minimum overlap between the two books.
BP59 **$5.12**

PRACTICAL CONSTRUCTION OF PREAMPS, TONE CONTROLS, FILTERS, ATTENUATORS
This book shows the enthusiast how to construct a variety of magnetic tape recording, microphone and disc preamplifiers, and also a number of tone control circuits, rumble and scratch filters, attenuators and pads.
BP60 **$4.96**

BEGINNER'S GUIDE TO DIGITAL ELECTRONICS
Covers all essential areas including number systems, codes, constructional and sequential logic, analog/digital/anlalog conversion.
BP61 **$3.36**

ELEMENTS OF ELECTRONICS
This series provides an inexpensive intro to modern electronics. Although written for readers with no more than basic arithmetic skills, maths is not avoided — all the maths is taught as the reader progresses.
The course concentrates on the understanding of concepts central to electronics, rather than continually digressing over the whole field. Once the fundamentals are learned the workings of most other things are soon revealed. The author anticipates where difficulties lie and guides the reader through them.
BOOK 1 (BP62): All fundamental theory necessary to full understanding of simple electronic circuits and components.
BOOK 2 (BP63): Alternating current theory.
BOOK 3 (BP64): Semiconductor technology leading to transistors and ICs.
BOOK 4 (BP77): Microprocessing systems and circuits.
BOOK 5 (BP89): Communications.
This series constitutes a complete inexpensive electronics course of inestimable value in hobby or career.
Books 1/2/3 ..... **$7.52 (each)**
Book 4 ..... **$9.76**
Book 5 ..... **$9.76**

COUNTER DRIVER AND NUMERAL DISPLAY PROJECTS
Well-known author F.G. Rayer features applications and projects using various types of numerical displays, popular counter and driver ICs, etc.
BP67 **$5.92**

ELECTRONIC GAMES
How to build many interesting electronic games using modern ICs. Covers both simple and complex circuits for beginner and advanced builder alike. Good one!
BP69 **$5.92**

TRANSISTOR RADIO FAULT-FINDING CHART
Used properly, this chart should enable the reader to trace most common faults quickly. Across the top of the chart are four rectangles containing brief descriptions of these faults: sound weak but undistorted; set dead; sound low and distorted; background noises. Selecting the appropriate fault, the reader simply follows the arrows and carries out the suggested checks in sequence until the fault is cleared.
BP70 **$1.92**

REMOTE CONTROL PROJECTS
Covers radio, infra-red, visible light, ultrasonic controls. Full explanations are provided so that the reader can adapt the projects for domestic and industrial as well as model use.
BP73 **$6.56**

ELECTRONIC MUSIC PROJECTS
Provides constructors with practical circuits for the less complex music equipment including fuzz box, waa-waa pedal, sustain unit, reverb and phaser, tremolo generator etc. Text covers guitar effects, general effects, sound generators, accessories.
BP74 **$5.92**

ELECTRONIC TEST EQUIPMENT CONSTRUCTION
Describes construction of wide range of test gear including FET amplified voltmeter, resistance bridge, field strength indicator, heterodyne frequency meter etc.
BP75 **$5.92**

POWER SUPPLY PROJECTS
This book gives a number of power supply designs, including simple unstabilised types, fixed voltage regulated types and variable voltage stabilised designs. The designs are all low voltage types for semiconductor circuits.
BP76 **$5.92**

PRACTICAL COMPUTER EXPERIMENTS
How to build typical compufer circuits using discrete logic. This book is useful intro to devices such as adders and storers as well as a general source book of logic circuits.
BP78 **$5.92**

RADIO CONTROL FOR BEGINNERS
How complete systems work with constructional details of solid state transmitters and receivers. Also included — antennas, field strength meter, crystal controlled superhet, electro-mechanical controls. Ideal for beginners. Section dealing with licensing etc. not applicable to Australia.
BP79 **$5.92**

ELECTRONIC SYNTHESISER PROJECTS
For the electronic music enthusiast, an invaluable reference. This book is full of circuits and information on how to build analogue delay lines, sequencers, VCOs, envelope shapers, etc. etc. The author takes a clear and logical approach to the subject that should enable the average enthusiast to understand and build up what appears to be a quite complex instrument.
BP81 **$5.92**

DIGITAL IC PROJECTS
Companion to No. 225 Practical Introduction to Digital ICs and BP61 Beginner's Guide to Digital Electronics. The projects included in this book range from simple to more advanced projects — some board layouts and wiring diagrams are included. The more ambitious projects have been designed to be built and tested section by section to help the constructor avoid or correct any faults that may occur.
BP84 **$6.56**

INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE
Companion to BP1 and BP14 equivalents books, but contains a huge amount of information on modern transistors produced by over 100 manufacturers. Wherever possible, equivalents are subdivided into European, American and Japanese types. Also shown are the material type, polarity, manufacturer and indication of use or application.
BP85 **$9.76**

SIMPLE LED CIRCUITS — BOOK 2
Sequel to BP42. Further light-emitting diode circuits. If you liked BP42 you'll love this one. If you don't know either it's well worth buying both!
BP87 **$4.64**

HOW TO USE OP-AMPS
Design notes and applications on many topics including basic theory, amplifiers, power supplies, audio circuits, oscillators, filters, computers and control engineering. It's written around the 741 IC but includes design notes for most of the common op-amps.
BP88 **$7.52**

EASY ELECTRONICS-CRYSTAL SET CONSTRUCTION
For those who wish to participate in the intricacies of electronics more through practical construction than by theoretical study. The circuits are based on those from earlier publications but have been modified to use modern inexpensive components and home wound coils.
BP92 **$6.56**

ELECTRONIC CIRCUITS FOR MODEL RAILWAYS
Constructional details of a simple model train controller, a controller with simulated inertia, a high-power controller, an electronic steam whistle and a 'chuff generator'. Signal systems and train lighting and RF suppression also covered.
BP95 (was 213) **$6.56**

MINI-MATRIX BOARD PROJECTS
This book provides a selection of 20 useful circuits which can all be built on a mini-matrix board which is just 24 holes by 10 copper strips in size. Simple and easy for those with not much experience in electronics.
BP99 **$6.56**

AN INTRODUCTION TO VIDEO
This book is written in layman's language and is for anyone who is thinking about buying or renting or who has just bought or rented a video recorder and wants to get the best out of the machine.
BP100 **$6.56**

THE 6809 COMPANION
It is not a beginners introduction to microprocessors in general but a discussion of the features of the 6809 and a reference work for the 6809 programmer in particular.
BP102 **$6.56**

AERIAL PROJECTS
Practical aerial designs including active, loop and ferrite which are relatively simple and inexpensive to build. The complex theory and mathematics of aerial design have been avoided.
BP105 **$6.56**

THE ART OF PROGRAMMING THE 1K ZX81
This book explains how to use the features of the ZX81 including its random number generator, graphics and timer. PEEK and POKE are explained and you should learn enough to develop programs of your own.
BP109 **$6.56**

ORDER FORM

Send to ETI Book Sales, 4th Floor, 15 Boundary St, Rushcutters Bay NSW 2011.
Please allow 4-5 weeks for delivery. Post & Handling 50c per book. Effective until December 31, 1982.

Please supply

Book	Qty.	Book	Qty.	Book	Qty.	Book	Qty.	Book	Qty.	Book	Qty.
196	.....	BP2	.....	BP42	.....	BP58	.....	BP74	.....	BP89	.....
205	.....	BP7	.....	BP43	.....	BP59	.....	BP75	.....	BP92	.....
211	.....	BP14	.....	BP44	.....	BP60	.....	BP76	.....	BP95	.....
215	.....	BP24	.....	BP47	.....	BP61	.....	BP77	.....	BP99	.....
218	.....	BP27	.....	BP49	.....	BP62	.....	BP78	.....	BP100	.....
222	.....	BP32	.....	BP50	.....	BP63	.....	BP79	.....	BP102	.....
223	.....	BP33	.....	BP52	.....	BP64	.....	BP81	.....	BP105	.....
225	.....	BP36	.....	BP54	.....	BP67	.....	BP84	.....	BP109	.....
226	.....	BP37	.....	BP55	.....	BP69	.....	BP85	.....		
227	.....	BP38	.....	BP56	.....	BP70	.....	BP87	.....		
228	.....	BP41	.....	BP57	.....	BP73	.....	BP88	.....		

Name .....

Address .....

..... Postcode .....

I enclose $ ..... inc.p&h Please debit my ☐ Bankcard ☐ American Express Card

Number: ..... Expiry Date ..... Signature .....

BUCK SAVERS

FROM SHERIDANS THE COMPONENT KINGS

PUSH-BUTTON PHONE $59

Complete pushbutton phone with 10 memories. Includes plug and manual. Limited stocks.

Don't pay $59 for just a memory dialler when you can get the complete phone.

Not Telecom approved

WOT ABOUT THIS!! LITRONIX DISPLAYS

1st time offer - Litronix Red Single Digit Light Pipe Dip "Displays"
Type: DL-750 common cathode display
Character height: .630"
7 segment D.P. left light output (MCD)
Typ. 5.0. Min. 2.0 = 20ma
Fwd. volt. Typ. 3.4. Max 4.00

ONLY $1

HERE WE GO AGAIN

Fairchild Displays

Fairchild 7 segment common cathode numeric displays. .5" character height - colour red.

Only 95¢ each

7 BANK DPDT ISOSTAT SWITCH

We're robbing ourselves!! Just take a note of this - you'll be amazed
7 Bank DPDT "ISOSTAT" switches (less knobs) with on/off power. 10 for the price of one. All new - all unused.

$2.50 FOR 10!

2716 EPROMS

A fantastic scoop purchase of prime spec 2716 EPROMS by National. This is a once in a lifetime offer. Be quick and grap them now!!

$3.99

10 for $37

WOW

MONSTER IC PACK

What a bargain!! Approx. 100 assorted ICs (not full spec) but many many common useable devices. And look at the price!!

$6.00

LOOK

IM6403P INTERSIL LOW POWER UARTS

From Intersil. Compatable with standard IM6402 but with these extra features:-

- Tiny power consumption less than 10mW @ 2MHz
- Programmable word length, stop bits, parity

Data available, 7 page data sheet at 20¢ per page.

WOW $4.00 each

12V Counter

Terrific **Resetable** four digit counter. 12 volt 50mA operation. Ideal for event counters etc. Counts up to 10CPS. Limited quantities.

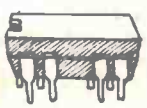
$10.00 each

12V DIL RELAY

Specs:-
SPST, 12V DC,
Coil resistance 1.100 ohms. Nominal current 11mA. Pull in voltage 8V
Contact rating 500mA

only $1.00

90¢ 10up,
80¢ 100up



40 TURN POT

Combined 100Kohm 40 turn pot with S.P. 3 pos. rotary switch. (Multiturn pot has windowed indicator). 10 for the price of one.
All new, all unused.

$2 FOR 10!

VERY IMPORTANT SPECIALS ON DISPLAYS AT VERY SPECIAL PRICES–

BUT IN LIMITED QUANTITIES

TYPE	PRICE	DESCRIPTION
DL-57	$2.10	Red alphanumeric no drivers no memories multiplexed 5 x 7 dot matrix. Single digit .35". Fwd. V. 2. Current 10ma. Litronix.
DL-750	$1.00	Red single digit light pipe DIP. common cathode. 7 segment D.P. left. .630" height. Fwd. V. 4. Litronix.
DL-722	$1.95	Red two digit light pipe dip. commom cathode ± polarity overflow. .510" height. Fwd. volt 2. 30ma Max. C.F.C. Litronix.
DL-728	$1.95	As DL722 but 7 segment D.P. right
DL-701	$1.00	Red single digit light pipe DIP. Common anode ± polarity overflow. .3" height. Fwd. volt. 2 Max. Litronix.
DL-721	$1.95	Red two digit light pipe DIP. Common anode. ± polarity overflow. .510" height. Max. Fwd. Volt. 2. C.F.C. per segment 30ma. Litronix.
DL-522	$1.95	Red two digit reflector dip. Common cathode. ± polarity overflow. .50" height. Max. Fwd. Volt. 2. C.F.C. per segment 30ma. Litronix.

Type	Price	Description
DL-527	$1.95	As DL-522 but common anode and 7 segment D.P. right. Litronix.
FND-530	$0.95	7 segment single display. Common cathode. Green. .5" height. Max. Fwd. volts 1.7 C.F.C. 25ma. Fairchild.
FND-560	$0.95	Red 7 segment single display. Common cathode .5" height. Max. Fwd. volts 1.7 C.F.C. 25ma. Fairchild.
FND-531	$0.95	Green single digit display. Common cathode. .5" height. ± polarity overflow. Max. Fwd. volts. 1.7 per segment. C.F.C. 25ma. Fairchild.

If purchasing 10 or over of each of the above displays take 10% off of total price.

We regret Bankcard not available on this 10% discount.

ELECTROS - SAVE 50%!

Huge scoop purchase of brand new computer grade electros from Philips, Sprague and Sangamo means you save if you get in now!!

Mounting clips only $1.00 each!!

CAP MFD.	WKG. VOLTS	MAKE	DIA MM	HEIGHT MM	PRICE
500	250	SPRAGUE	35	80	$5.00
590	200	SPRAGUE	35	80	$5.00
1800	50	SNGAMO	35	60	$3.50
2300	60	SPRAGUE	35	80	$4.00
2400	50	SPRAGUE	35	55	$4.00
2400	50	SNGAMO	35	60	$4.00
3000	75	SNGAMO	35	125	$5.00
3100	450	SPRAGUE	75	220	$21.00
3300	75	SNGAMO	35	110	$5.50
3600	25	SNGAMO	35	60	$3.25
3700	30	SNGAMO	35	60	$3.50
4300	25	SNGAMO	35	60	$3.75
4700	63	PHILIPS	50	90	$5.75
5400	35	SNGAMO	35	90	$4.25
7000	35	SNGAMO	35	90	$5.00
7500	15	SPRAGUE	35	60	$5.00
8000	35	SNGAMO	35	110	$6.00
8200	25	SNGAMO	35	90	$5.75
8700	40	SPRAGUE	35	110	$7.50
9100	60	SNGAMO	50	110	$10.00
10000	25	SNGAMO	35	90	$6.00
10000	40	SPRAGUE	50	90	$6.50
12000	10	SPRAGUE	35	85	$5.50
13000	60	SPRAGUE	65	110	$10.00
14000	25	SPRAGUE	50	85	$5.50
14000	40	SPRAGUE	50	110	$9.00
15000	3	SNGAMO	35	60	$3.50
15000	10	PHILIPS	35	85	$4.50
15000	16	PHILIPS	35	115	$5.00
15000	63	PHILIPS	65	120	$11.00
20000	25	SNGAMO	45	110	$8.75
22000	6.3	PHILIPS	35	85	$5.00
22000	10	PHILIPS	35	117	$6.00
22000	75	SPRAGUE	75	145	$19.00
26000	10	SNGAMO	35	110	$6.50
30000	25	SNGAMO	65	85	$13.00
30000	25	SPRAGUE	50	110	$12.00
33000	16	SPRAGUE	50	120	$12.00
36000	20	SNGAMO	50	110	$7.75
39000	25	SNGAMO	50	150	$10.00
39000	30	SPRAGUE	50	145	$13.00
44000	35	SNGAMO	75	110	$15.75
47000	10	PHILIPS	50	120	$13.00
47000	25	PHILIPS	65	120	$17.00
55000	3	SNGAMO	35	135	$6.00
65000	35	SNGAMO	75	150	$20.00
67000	10	SNGAMO	50	125	$12.50
70000	50	SNGAMO	75	225	$26.00
76000	25	SNGAMO	75	125	$22.00
88000	10	SPRAGUE	50	145	$14.50
100000	3	SNGAMO	65	85	$7.00
100000	10	PHILIPS	65	115	$13.00
110000	10	SNGAMO	65	120	$15.00
110000	20	SNGAMO	75	150	$20.50
120000	15	SPRAGUE	65	145	$18.00
150000	6.3	PHILIPS	65	113	$10.00
200000	3	SNGAMO	65	135	$12.00

SHERIDAN ELECTRONICS

164-166 Redfern St., Redfern NSW 2016. Phone (02)699 6912, (02)699 5922
Mail Orders to Dept EA, PO Box 229 Redfern NSW 2016

Trading Hours:-
Mon-Fri..... 9am-5.30pm
Thursday..... 9am-7pm
Saturday..... 9am-12noon

Mail Charges:-
$5.00-$9.99..... $2.50
$10.00-$24.99..... $3.00
$25.00-$49.99..... $5.00
$50.00-$99.99..... $6.00
$100.00 or more..... $7.00

Heavy or bulky items sent freight forward by 'Overnighters'

bankcard welcome here

Shoparound

ETI-647 SPEECH SYNTHESISER (Sept. issue)

Sydney readers unable to find a supplier for this project will be happy to know that kits can be obtained direct from ETI's offices. Cost is $250. You'll find us at 4th Floor, 15 Boundary St, Rushcutters Bay. Southern state readers are directed to Rod Irving Electronics.

THIS PAGE is to assist readers in the continual search for components, kits and printed circuit boards for ETI projects. If you are looking for a particular component or project — check with our advertisers if it is not mentioned here.

ETI-644 direct-connect modem

This project can be obtained in complete kit form from Jaycar in Sydney, Altronics in Perth and Microtrix and Rod Irving Electronics in Melbourne. As advised in the article, pc boards are obtainable direct from ETI, for those with a shelf full of parts able to supply most themselves. Boards cost $50 each, post free, from:

ETI-644 pc board
ETI Magazine
154 Clarence St
Sydney NSW 2000

Most of the parts are fairly stock-standard items, even the 2% (or 1%) resistors, as are many of the ICs employed. A number of items you will notice, however, are not common stock items, but we've hunted around for sources. Firstly, there seem to be only two sources currently for the Arlec 45035 600:600 ohm isolating transformer — Jaycar in Sydney (who have them in stock) and Kalextronics (who will order them for you) of 101 Burgundy St, Heidelberg Vic. 3084, (03)458-2976 (they're also in Melton). The Fujitsu micro reed relays and DPDT relay used in the line interface are distributed by IRH and plenty of stocks are held so you can order them through your favourite supplier. Same goes for the 5.07 MHz Ceralock resonator and CSC300K loading capacitor pack. If you'd rather use a quartz crystal, 5.0688 MHz crystals are available from Ellistronics in Melbourne and Applied Technology in Sydney.

As for the semiconductors, most are readily available over the counter, with the exceptions of the TL064 and ICL7612 or 7611. For TL064s try Rod Irving Electronics in Melbourne or Jaycar in Sydney. The Intersil 7612 or 7611 is available from R&D Electronics; in Melbourne they're located at 257 Burwood Hwy, Burwood 3125; in Sydney at 133 Alexander St, Crows Nest 2065. Note that these ICs are not cheap.

Here is an extraordinarily useful tool for the electronics hobbyist and/or home handyman. It's a thermoplastic glue gun. For those who've never used or heard of thermoplastic glue before, it's almost a 'universal' glue, bonding readily to most natural and man-made materials. Thermoplastic adhesives are used by model-makers and display artists, glazeries, mirror-makers, electrical equipment manufacturers, bookbinders, furniture-makers etc, etc. This glue gun has only recently been released in Australia and, having used one for the past month, it's a wonder how we got along without it! (We left those niggardly jobs for a rainy day!). The gun is German-made, distributed here under the Homelec name. Two varieties of glue are available to cope with a wide variety of material. It comes in 'sticks' that insert at the rear of the barrel. Hot glue comes out of the tip. Available from hardware stores. Further details from Homelec Products, 1073 Victoria Rd, West Ryde NSW 2114.

ETI-686 EPROM programmer

Designed to team with the ETI-685 2650 S100 Single Board Computer (December '81 ETI), but suitable for any computer with three programmable 8-bit I/O ports, this programmer is simple to build and operate and low in cost. The designer, Ron Koenig, has retained copyright on the pc board design and will be supplying pc boards, wholesale and retail. If you want to arrange your own parts and buy a pc board from him, write to R&S Koenig Computer Products, P.O. Box 363, Hornsby NSW 2077. He also has software for the programmer available on either disk or tape.

Most of the components for the project are widely available, but not all electronics suppliers carry things like ZIF sockets or SIP resistors. Most of the components should be obtainable from Applied Technology in Sydney or Data Parts in Sheparton, Victoria. Rod Irving Electronics has indicated they'll be carrying a kit. If you strike trouble obtaining the BY257 bridge rectifier, there are a number of equivalents in similar packages with in-line pins. Tandy stores stock a range, catalogue numbers 276-1146, 276-1171 and 276-1173. They cost around $2 or so.

ETI-494 loudspeaker protector

Save yourself the anguish of replacing expensive burnt-out speaker drive units — build yourself this signal-powered loudspeaker protector. Better still, build several and mount one inside each speaker!

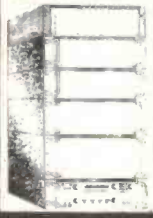
Components for this project are all off-the-shelf items and you should have no trouble assembling the parts. Printed circuit boards will be available from suppliers listed in this column previously.

Kit and component suppliers have generally indicated they'll be stocking this project as a kit, or at least have the pc boards available, plus the components in stock.

ROD IRVING ELECTRONICS

425 HIGH STREET, NORTHCOTE 3070, MELB, VIC PH (03)4898131 TELEX-38897

RACK MOUNTING BOXES



19 X 5¼ X 12" - $45.00
19 X 6 X 10" - $39.95
19 X 5¼ X 12" - $55.00
19 X 7¼ X 12" - $79.00
19 X 10 X 12" - $89.00
SERIES 5000 - $55.00

CABINET OF 16 DRAWERS

PUT ALL YOUR BITS & PIECES AWAY IN THESE INCREDIBLY CHEAP CABINET OF DRAWERS.

12.00

JIFFY BOXES

UB1 - 150 X 90 X 50 - $1.80
UB2 - 196 X 113 X 60 - $2.75
UB3 - 130 X 68 X 41 - $1.50
UB5 - 83 X 54 X 28 - $ .90

ROD CUTS PRICES ON CANNON CONNECTORS

3 PIN AUDIO PLUGS

	1-9	10 UP
LINE SOCKET -	$2.70	$2.60
PANEL PLUG -	$1.70	$1.60
LINE PLUG -	$1.60	$1.50
PANEL SOCKET -	$2.90	$2.80
XLR - LNE - 11C -	$4.20	$3.90
XLR - LNE - 32 -	$2.90	$2.50

ALSO AC POWER CONNECTORS AVAILABLE

HORNSPEAKERS

NOW ONLY 6.75

PANELMETERS

		1-9	10 +
RU45	0-30v	$10.00	$9.00
RU45	0-20v	$10.00	$9.00
RU45	0-100uA	$10.00	$9.00
RU45	0-10A	$10.00	$9.00
RU45	0-1A	$10.00	$9.00
RU45	0-50uA	$ 6.50	$5.90
RU45	0-100uA	$ 6.50	$5.90
RU45	0-50uA	$ 6.50	$5.90
RU45	Vu	$ 6.50	$5.90
RU45	0-20V	$ 6.50	$5.90
RU45	0-1A	$ 6.50	$5.90
RU45	0-1mA	$ 6.50	$5.90
RU45	0-10A	$ 6.50	$5.90

CONNECTORS DB 25

DB25P - PLUG -
DB25S - SOCKET -
DB25C - COVER -

1-9	10 +
$3.90	$3.50
$4.90	$4.50
$2.20	$1.80

SAVE

ALIGNMENT TOOL SET

2.95 This month only 1.95

SOLDERING IRON STAND

NEW!

5.50

TRANSFORMERS

	1-9	10-19	20+
2851	$2.90	$2.50	$1.90
2155	$4.50	$3.90	$3.30
6672	$5.50	$5.40	$5.10

HOOK UP WIRE

3.75 a roll

UNIVERSAL TEST LEAD KITS

4.95 This month only 3.95

WELLER SOLDERING STATION

62.50

MULTITESTERS

YF 370 26.50 17.50

YF 303 34.50 21.50

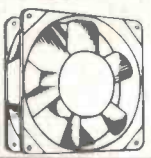
DIGITAL MULTIMETERS

GREAT NEW AUTO RANGING MULTIMETERS AS ADVERTISED RECENTLY

$49.95 ME-533 ME-532 $59.95

COMPUTER COOLING FANS

This month only 16.90 115V 240V 4%



COMPONENT SPECIALS

BF469 -	$ .90
BF470 -	$ .90
2114 -	$1.95
4116 -	$1.95
2708 -	$4.50
2716 -	$5.50
2732 -	$9.50
TMP50 -	$1.10

BD 139 - .45c 10 FOR $4.00
BD 140 - .45c 10 FOR $4.00
4MHz XTAL $2.00

BATTERY SNAPS A STEAL AT 10c EACH

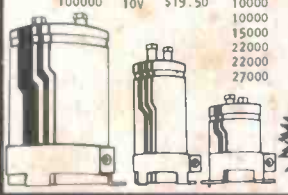
3AG FUSE HOLDER 50c
2AG FUSE HOLDER 50c

	1-9	10-99	100-999	1000
1N4148	.06c	.05c	.04c	.03c
1N4001	.06c	.05c	.05c	.05c
1N4002	.06c	.05c	.05c	.05c
1N4003	.06c	.05c	.05c	.05c
1N4004	.07c	.06c	.05c	.04c
1N4005	.09c	.08c	.07c	.06c
1N4006	.10c	.09c	.08c	.06c
1N4007	.12c	.09c	.08c	.07c

2.2 MF POLY 400V CAPS - .90c
555 - .25c
10 For $ 2.20
74C926 $ 5.00
BC547 100 For $ 9.00
BC558 100 For $10.00
BC559 100 For $10.00
BC548 100 For $ 9.00

CAPACITORS

CAPACITY (uF)	VOLTAGE (DCW)		CAPACITY (uF)	VOLTAGE (DCW)	
33000	16V	$21.70	2900	40V	$ 5.90
68000	16V	$19.50	6800	16V	$ 5.75
100000	10V	$19.50	10000	25V	$ 9.00
			10000	40V	$11.50
			15000	25V	$10.30
			22000	25V	$12.00
			22000	40V	$20.50
			27000	35V	$21.70



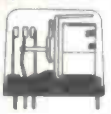
HIGH QUALITY

YF 10

This month only 9.50 VALUE

2KU/V

RELAYS



6 AMP CONTACTS PCB MOUNTING

12V	SP	$4.50
12V	DP	$5.50
24V	SP	$4.90
24V	DP	$5.90

COMPUTERS OF THE DECADE

Sorcerer Mk II - Dick Smith System 80

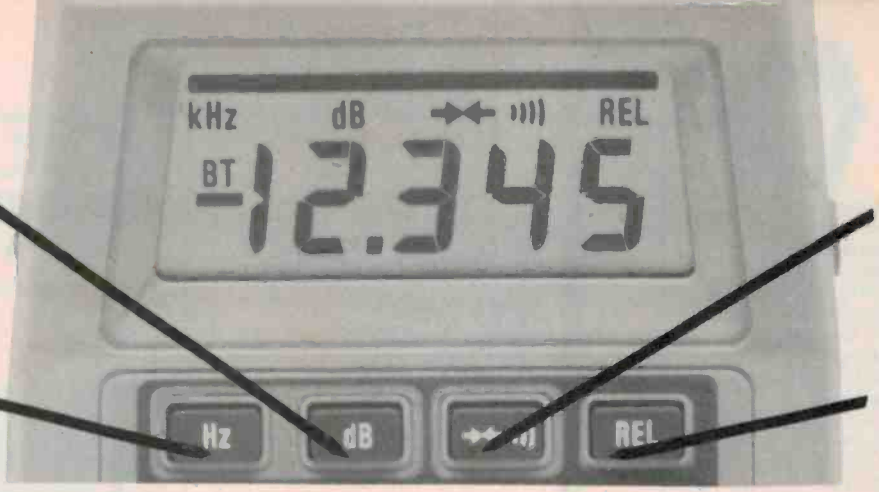
?'Ask Rod for a price'?

We have the cheapest price on Philips speakers

Bankcard Mail Orders Welcome

Please debit my Bankcard ETI 10/82/3
Bankcard No.....
Expiry Date.....
Name.....
Signature.....

MAIL ORDERS: P.O. BOX 235 NORTHCOTE, VIC. 3070
Min. P&P $2.00. Mail Order Enquiries (03) 481 1436.



AC or dc voltage displayed in dBm referenced to 600 ohms, or relative dB.

Measures frequencies from 12Hz to 200kHz, fully auto-ranging, with 1-second response time and 0.01 Hz resolution to 200Hz.

Selectable visual (⊣⊢) and audible ())))) indicators for high-speed continuity checking. 50μS response time.

Relative reference (offset) feature works with all functions — including frequency and dB—to indicate ± deviations from stored inputs.

NEW FLUKE HANDHELD DMM COMBINES 0.04% ACCURACY, 10μV RESOLUTION, TRUE RMS AC, DIRECT dB and FREQUENCY

8060A

This remarkable state of the art DMM combines the accuracy and resolution of larger, more expensive instruments with the convenience of a hand-held instrument. Flukes own LSI/microcomputer design provides:

- Wideband true RMS AC measurements to 100kHz
- Frequency measurement to 200kHz
- dBm and relative dB
- 10μV sensitivity
- Direct resistance measurement to 300Meg
- Relative reference on any range or function
- Microcomputer-based self diagnostics

8062A

Provides continuity and relative reference functions as 8060A also true rms to 30kHz.

	4½ Digit Resolution	Wideband True RMS AC	Continuity (Audible & Visual)	dBm, Relative dB	Frequency	Relative Reference (Offset)	Autoranging Megohms	Conductance	Constant Current Diode Test	Self Diagnostics	Basic DC Accuracy		
8060A	•	100 kHz	•	•	200 kHz	•	•	•	•	•	0.04%	$398
8062A	•	30 kHz	•			•	•		•	•	0.05%	$318

8050A

A bench portable providing 4½ digits with a basic accuracy of 0.03%. True rms measurements to 50kHz. 108dB range and 16 selectable reference impedances from 8 to 1200ohm.

$425

CHECK THE COMPLETE FLUKE 8020B SERIES OF DMMS

8020B

- 0.1% basic accuracy. 3½ digit
- Improved version of the most popular DMM ever made!
- Eight functions including conductance and diode test
- Now with high speed beeper

8021B & 8022B

- 0.25% Accuracy. 3½ digits
- Extensive overload protection
- AC and DC Voltage and Current, Resistance and Diode Test
- High Speed audible continuity beeper (8021B Only)
- 8022B is Fluke's lowest price DMM

8024B

- 11 functions including temperature with K-type thermocouples
- Peak hold on voltage and current ranges
- Logic detection and continuity
- Audible and visible indicators
- 0.1% basic accuracy. 3½ digit

Selection Guide

	DC Voltage	AC Voltage	DC Current	AC Current	Resistance	Diode Test	Conductance	Continuity	Logic Level	Temperature	Peak Hold	DC Accuracy	
8022B	•	•	•	•	•	•						0.25%	$162
8021B	•	•	•	•	•	•		•				0.25%	$172
8020B	•	•	•	•	•	•	•	•				0.1%	$219
8024B	•	•	•	•	•	•	•	•	•	•	•	0.1%	$275

FLUKE®

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

ELMEASCO

Instruments Pty. Ltd.

P.O. Box 30, Concord
N.S.W. 2137
13-15 McDonald Street,
Mortlake, N.S.W.
Telephone (02) 736 2888
Telex 25887

P.O. Box 107, Mt. Waverley
Victoria 3149
21-23 Anthony Drive,
Mt. Waverley, Victoria
Telephone (03) 233 4044
Telex 36206

Adelaide: (08) 271 1839
Brisbane: (07) 369 8688
Perth: (09) 398 3362

bankcard

N.S.W. George Brown 519 5855 • DGE Systems (049) 69 1625 • Radio Despatch 211 0191 • Vimcom (042) 28 4400 **VICTORIA** Radio Parts 329 7888 • Browntronics 419 3986 • G.B. Telespares 328 4301 • Elanco 428 4345 • Ellistronics 602 3282 **QUEENSLAND** L.E. Boughen 36 1277 • Colourview Wholesale 275 3188 • Audiotronics 44 7566 • Electronic Shop (075) 32 3632 • Nortek (077) 79 8600 • W.G. Watson (079) 27 1099 **S.A.** Protronics 212 3111 • Trio Electrix 516718 **W.A.** Atkins Carlyle 321 0101 • Hinco Eng 381 4477 • Brookeades 276 8888 • Protronics 362 1044 **A.C.T.** Actec (062) 80 6576 **N.T.** Thew & McCann (089) 84 4999 **TAS.** G.H.E. Electronics 31 6533 & 34 2233

MAIL COUPON FOR FREE GUIDE

Please send me details of Fluke DMMs
☐ 8060/62 & 8050 ☐ 8020B Series

NAME .....

ADDRESS .....

P'CODE .....

TELEPHONE .....

COMMUNICATIONS

1296 MHz Hawaii-California, one way

The KH6HME beacon in Hawaii was heard on the US mainland on 6 August by Chip Angle, N6CA, and several other California amateurs. The path is nearly 4000 km long (2475 miles).

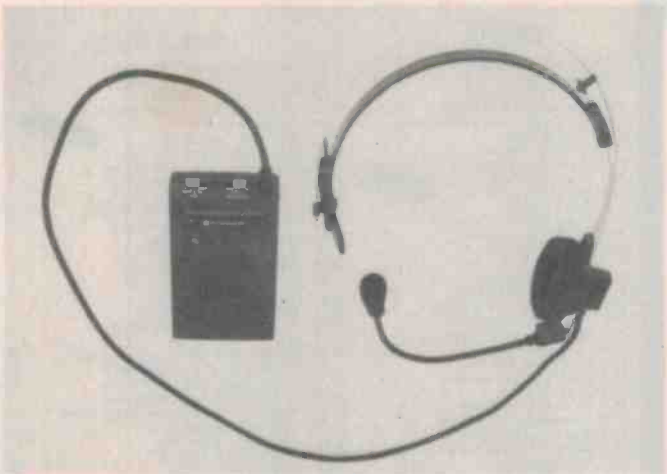
The beacon runs 50 watts into a quad set of 25 element loop yagi antennas. It was received in the Los Angeles area by N6CA using a single 44 element loop yagi.

It was not possible to try for a two-way contact since Paul Lieb, KH6HME (who operates the beacon) was visiting the mainland at the time.

An attempt at the two-way record was planned during August but no results are to hand at time of going to press. Equipment used at both ends of the path was developed by N6CA.

Current claimants to the world 1296 MHz two-way distance record are Dick Norman VK2BDN and Brian Ryall ZL1AVZ who had a contact over a distance of 2134 km on 9 February last (reported in **ETI**, April issue, p.8). I say claimant because the Federal body of the Wireless Institute of Australia hasn't decided yet who really has the record, nor have any counter claims been published.

Dick Norman is pressing ahead with efforts to span the Tasman sea to New Zealand on 2300 MHz. (US details from Westlink Report.)



'Hands free' personal communications

GFS Electronic Imports recently announced the release of a new personal mobile VHF FM transceiver, the C-900 'Talkman'.

Designed to provide its user with two way communications over distances up to one kilometer, the Talkman is said to be extremely simple to operate particularly because it makes use of a light weight headset.

This, coupled with its compact size, light weight and voice-operated transmitter make it suitable for hundreds of different communications applications, especially where 'hands free' operation is required, according to the importers.

The Talkman is approved by D.O.C. and operates on the 55 MHz band. The only two controls include a volume-level switch and a VOX sensitivity switch.

Weighing only 250 grams the Talkman will conveniently clip onto a belt or into a pocket.

For further details, contact GFS Electronic Imports, 15 McKeon Road, Mitcham Vic. 3132. (03) 873-3939.

UHF Yagi antennas from Scalar

Scalar has released a new range of Y400 series UHF yagi antennas designed for use in the 400 — 520 MHz band with quoted gains ranging from 3 dB to 14 dB.

They are manufactured from high grade seamless aluminium tubing and feature a 4% bandwidth at a VSWR of less than 1.5:1, 1.3:1 at centre frequency, according to the specifications. Special heavy duty models featuring stainless steel construction are also available.

A cable tail-to-N-type female termination is provided allowing easy weatherproofing.

The Y415PT is a special 'RF control' model designed for applications where a tightly controlled beam pattern is required and meets Department of Communications Draft Specification RB234C.

The Y415PT is a 15 element design having a multi-element reflector. Sidelobe levels at any angle greater than 55° from the centre of the main lobe are quoted to be at least 17 dB below forward gain. The Y415PT can be supplied either as an end-mount or with a centre-mount elbow.

Enquiries to Scalar office in Melbourne, Sydney, Brisbane or Perth.

Tx/Rx multicouplers

Vicom International now distributes the range of multicouplers and duplexers manufactured by Tx/Rx Systems Inc of USA.

Specific filters include bandpass cavity, series notch, varinotch and T-Pass, all of which can be cascaded to achieve an arithmetic sum of individual attenuation.

Included in the range is a series of expandable receiver multicouplers of modular design capable of handling 4 — 64 channels. Gain is adjustable for optimum receiver performance with no degradation in IM specification it is claimed. A typical figure is 20 dB isolation between channels and a 3rd-order intercept point of +46 dBm is said to be achieved.

Models of multicouplers are available to cover both receiver and transmitter functions up to 1000 MHz.

Further details and pricing on the extensive range is available from Vicom International, Melbourne and Sydney. (03)62-6931; (02)437-2766.

New rig and antenna from Yaesu

The world-famous Japanese amateur gear manufacturer Yaesu has released a new transceiver, the FT-102, and an active antenna, the FRA-7700.

The FT-102 transceiver covers 160 - 10 m, including the three new ('WARC') bands, with a quoted 240 W input and reportedly 'impressive' receiver specs.

The rig is an all-mode unit, CW/SSB in the basic rig, AM/FM being available as an option. (Seems to foreshadow a VHF/UHF transverter?).

Accessories include an exterhal synthesised VFO (FV-102DM) and an external speaker with audio filter (— that's new).

Interestingly, Yaesu claim the rig's noise blanker is highly effective against the Russian Woodpecker and other impulse noise.

The FRA-7700 active antenna is designed for use with Yaesu's popular deluxe general coverage receiver, the FRG-7700. The unit uses a 1.2 metre tall whip antenna coupled to a low distortion MOSFET preamp.

If you can't — or don't want to, erect an outdoor antenna, then this allows you to pull in the signals — even with the whip mounted indoors. It comes with gain and peaking controls and you can turn the preamp on or off.

NEW STORE opening October in Carlingford

AT "NEVILLE'S CORNER" CNR CARLINGFORD & PENNANT HILLS RD. NEXT TO KENTUCKY FRIED CHICKEN

★ JAYCAR FOR

NOT ONLY DO WE STOCK HARD–TO–GET SEMICONDUCTORS – WE STOCK HARD–TO–GET PASSIVES TOO!!

CMOS

4000	Dual 3 Input NOR Gate	40
4001	Quad 2 Input NOR Gate	35
4002	Dual 4 Input NOR Gate	48
4006	18 Stage Static Shift Registar	40
4007	Dual Complimentary Pair Plus Inverter	38
4008	4-Bit Full Adder	95
4009	Hex Buffer (Inverting)	$1.10
4010	Hex Buffer (Non-Inverting)	90
4011	Quad 2 Input NAND Gate	35
4012	Dual 4 Input NAND Gate	20
4013	Dual D Flip Flop	90
4014	8-Stage Static Shift Register	$1.00
4015	Dual 4-Bit Static Register	95
4016	Quad Analog Switch	50
4017	Decade Counter/Divider	$1.20
4018	Resettable Divide-by-N	50
4019	Quad AND OR Select Gate	75
4020	14-Stage Binary Counter/Divider	$1.45
4022	Divide-by-8 Counter Divider	$1.25
4023	Triple 3-Input NAND Gate	28
4024	7 Stage Binary Counter/Divider	$1.18
4025	Triple 3-Input NOR Gate	35
4026	Decade Counter-7-Seg Output	$2.20
4027	Dual JK Flip Flop	90
4028	BCD-to-Decimal Decoder	$1.18
4029	Presettable Up-Down Counter	$1.25
4030	Quad 2 Input EXCLUSIVE OR Gate	80
4031	64 Stage Static Shift Register	$2.20
4032	Triple Serial Adder	$1.95
4034	8 Stage TRI STATE Universal BUS Register	$2.95
4035	4 Bit Shift Register	50
4038	Triple Serial Adder (Negative Logic)	$1.95
4040	12 Stage Binary Counter	$1.65
4042	Quad Clocked D Latch	70
4046	Micropower Phase-Lock Loop	$1.55
4047	Low Power Mono/Astable Multi	$1.75
4049	Hex Inverting Buffer	75
4050	Hex Buffer (Non-Inverting)	60
4051	8 Channel Analog Multiplexer	95
4053	Triple 2 Channel Analog Multiplexer	$1.75
4055		50
4066	Quad Analog Switch	80
4067	1-of-16 Analog Switch	$2.95
4068	8 Input NAND Gate	48
4069	Hex Inverter	70
4070	Quad 2 Input EXCLUSIVE OR Gate	48
4071	Quad 2 Input OR Gate	48
4073	Triple 3 Input AND Gate	65
4075	Triple 3 Input OR Gate	60
4076	Quad D-Flip Flop	$1.25
4077	Quad EXCLUSIVE NOR Gate	50
4078	8-Input NOR Gate	85
4081	2-Input AND Gate	60
4093	Quad 2-Input NAND Schmitt Trigger	80
4411		$17.75
4426	Decade Counter 7 Seg Output	$2.20
4500		$2.50
4501	Triple Gate	$1.95
4502	Strobed Hex Inverter	$1.95
4503	Hex 3 Stage Buffer (Non Inverting)	95
4508	Dual 4-Bit Latch	$5.00
4511	BCD to 7 Seg Decoder/Driver	$1.50
4512	8 Channel Data Selector	$1.25
4514	4 to 16 Line Decoder/4 Bit Latched	$2.50
4517	Dual 64 Bit Static Shift Register	$1.95
4518	BCD Up Counter	$1.50
4520	Dual Binary Up Counter	$1.50
4526	Programmable 4-Bit Binary Counter	$1.50
4528	Dual Mono Multi	$1.25
4538	Dual Mono/Precision Multi	$2.65
4543	BCD to 7 Seg Latch/Decoder/Driver/LCD	$1.95
4553	3 Digit BCD Counter	$6.50
4557	1 to 64 Bit Variable-Length Shift Register	$3.50
4581	4 Bit	$3.50
4582	Look Ahead Carry Block	$2.50
4584	Hex Schmitt Trigger	$1.65
74C02	Quad 2 Input NOR Gate	50
74C04	Hex Inverter	55
74C14/40106	Hex Schmitt Trigger	$1.50
74C922	16 Keyboard Encoder	$9.50

SUPPORT

8255	PPI	$9.95
5303	UART	$12.95
1771	Floppy Disk Controller	$19.95
1488	RS232 Quad Line Driver	$1.50
1489	RS232 Quad Receiver	$1.50
8131	6-Bit Comparator (Negative Out)	$4.95
81LS97	Octal Buffer	$2.35
81LS98	Octal Buffer (Inverting)	$2.35

74LS TTL

74LS00	Quad 2 Input NAND Gate	35
74LS01	Quad 2 Input NOR Gate	40
74LS02	Quad 2 Input NOR Gate	40
74LS03	Quad 2 Input NAND Gate (oc)	60
74LS04	Hex Inverter	40
74LS05	Hex Inverter (oc)	60
74LS08	Quad 2 Input AND Gate	40
74LS09	Quad 2 Input AND Gate (oc)	50
74LS10	Triple 3 Input NAND Gate	40
74LS11	Triple 3 Input AND Gate	40
74LS12	Triple 3 Input NAND Gate (oc)	60
74LS13	Dual NAND Schmitt Trigger	60
74LS14	Hex Schmitt Trigger	85
74LS20	Dual 4 Input NAND Gate	40
74LS21	Dual 4 Input AND Gate	35
74LS27	Triple 3 Input NOR Gate	60
74LS30	8 Input NAND Gate	50
74LS32	Quad 2 Input OR Gate	45
74LS33	Quad 2 Input NOR Gate (oc)	50
74LS42	1 of 10 Decoder	95
74LS47	BCD to 7 Seg Decoder/Driver (oc)	$1.45
74LS48	BCD to 7 Seg Decoder/Driver	$2.95
74LS49	BCD to 7 Seg Decoder/Driver	$1.95
74LS73	Dual JK Flip Flop with Clear	95
74LS74	Dual D Flip Flop with Preset & Clear	75
74LS75	4 Bit Bistable Latch	65
74LS76	Dual JK Flip Flop	60
74LS78	Dual JK Flip Flop	60
74LS83	4 Bit Full Adder	$1.00
74LS85	4 Bit Magnitude Comparator	$1.25
74LS86	Quad 2 Input EXCLUSIVE OR Gate	50
74LS90	Decade Counter	75
74LS92	Divide by 12 Counter	$1.25
74LS93	4 Bit Binary Counter	85
74LS95	4 Bit Shift Register	75
74LS107	Dual JK Flip Flop	55
74LS109	Dual JK Edge-Triggered Flip Flop	75
74LS112	Dual JK Edge-Triggered Flip Flop	60
74LS122	Retrig Monostable with Clear	75
74LS123	Dual Retrig Mono with Clear	$1.10
74LS125	Quad BUS Buffer Tri-State (lo enable)	55
74LS126	Quad BUS Buffer Tri-State (hi enable)	75
74LS138	1-of-8 Bit Decoder/Multiplexer	92
74LS139	Dual 2 to 4 Line Decoder/Multiplexer	$1.45
74LS147	10 Line dec to 4 Line Priority Encoder	$2.95
74LS148	8 Line to 3 Line Priority Encoder	$3.95
74LS151	1 of 8 Selector/Multiplexer	75
74LS153	Dual 4 Line to 1 Line Selector/Mplexer	75
74LS155	Dual 1 of 4 Decoder	$1.00
74LS156	Dual 1 of 4 Decoder (oc)	$1.00
74LS157	Quad 2 Input Multiplexer (Non-Inverting)	$1.50
74LS158	Quad 2 Input Multiplexer (Inverting)	79
74LS160	BCD Decade Counter Asynch. Reset	95
74LS161	4-Bit Binary Counter Asynch. Reset	95
74LS162	BCD Decade Counter Synchron. Reset	$1.00
74LS163	4-Bit Binary Counter Synchron. Reset	$1.20
74LS164	8-Bit Shift Register	$1.20
74LS165	Parallel Load 8-Bit Shift Register	60
74LS166	8-Bit PISO Shift Register	$2.95
74LS173	4-Bit D Type Register	95
74LS175	Quad D Type Flip Flop	$1.65
74LS190	Up/Down Decade Counter	$1.25
74LS191	Up/Down Binary Counter	$1.15
74LS192	Up/Down Decade Counter Dual Clock	95
74LS193	Up/Down Binary Counter Dual Clock	$1.65
74LS194	4-Bit Left-Right Shift Register	95
74LS221	Dual Monostable Multivibrator	$2.25
74LS240	Octal Tri-State Driver	$3.50
74LS241	Octal Tri-State Driver	$3.50
74LS244	Octal Buffer/Driver	$3.95
74LS245	Octal Bus Transceiver	$2.95
74LS257	Quad 2 Input Multiplexer Tri-State	85
74LS258	Quad 2 Input Multiplexer Tri-State	75
74LS259	8 Bit Addressable Latch	$2.50
74LS266	Quad EXCLUSIVE NOR Gate (oc)	$1.25
74LS273	Octal D Type Flip Flop	$2.95
74LS365	Hex Buffer with Common Enable	60
74LS366	Hex Inverter with Common Enable	60
74LS367	Hex Buffer 4 Bit and 2 Bit	$1.25
74LS368	Hex Inverter 4 Bit and 2 Bit	70
74LS373	Octal Transparent Latch	$2.95
74LS374	Octal D Type Flip Flop	$2.50
74LS393	Dual LS93	$3.50

SPEECH SYNTHESISER

DT1050	National Digitalker Processor & ROM Set	$95.00
DT1057	National Digitalker Second ROM Set	$69.00

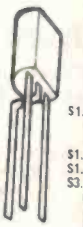
Send SAE for more details. NOTE new low price. Data sheets included in chip sets.

LINEAR DEVICES

ZN414	$2.50	LM381N	$3.95
TL061	$2.45	LM381AN	$5.95
TL062	$2.45	LM382	$2.60
TL064	$4.75	LM394CH	$5.95
TL071	98	NE555	35
TL072	$1.45	LM7555	$1.95
TL074	$3.50	LM556	$1.10
TL075	$3.50	LM567	$1.95
TL081	65	LM570	$7.50
TL082	95	NE571	$6.50
TL084	$2.95	LM723	$1.45
TL085	$3.50	LM741	40
LM234	$3.50	LM747	$1.95
LM301	60	LM1496	$1.98
LM307	90	LM3046	$1.45
LM308	$1.25	LM3080	$1.30
LM311	95	LM3130	$1.80
LM319	$3.50	LM3140	$1.45
LM324	$1.20	LM3900	95
LM334	$2.50	LM3914	$6.50
LM339	95	LM3195	$4.50
LF347N	$3.50	LM39152	$12.50
LM348	$2.25	LM4136	$1.85
DM350	$8.50	LM4558	$1.50
LM361	$3.75	LM5534N	$1.55
LM380	$1.48	LM5534AN	$2.00

DISCRETE DEVICES

VN88AF	$3.00	BC547	15
BCY71	95	BC548	15
JDT9203	$1.95	BC549	15
40411	$5.00	BC550	65
MJ15003	$4.75	BC556	65
MJ15004	$4.75	BC557	18
2SJ49(P)	$6.50	BC558	18
2SJ50	$8.50	BC559	18
BDV64B	$5.95	BC639	34
BUX80	$9.50	BC640	34
2SK134(N)	$6.50	BD286AD	$1.50
BU105	$12.50	BD139	53
MPSA05	95	BD140	53
TIP31A&B	90	MJ2955	$1.50
TIP32A	90	2N3055	$1.50
TIP2955	$1.20	2N3442	$3.00
TIP3055	$1.20	2N3569	68
MPF102	95	2N3638	53
MPF105/2N5459	85	2N3643	45
MPF106/2N5485	78	2N3645	45
MPSA55	95	2N3773	$5.00
MFE131	$1.98	2N4258	35
BF115	75	2N5484	85
BF200	95	2N5087	65
BF469	$1.65	2N5589	$12.75
BF470	$1.65	2N5590	$14.25
MJE340	$1.98	2N5591	$18.75
MJE350	$1.98	2N5245	$1.35
ZTX501	45	2N6027/D13T1	58
BC337	25	TT800	85
BC546	65	2N3566	45
BF469	$1.65	2SK135	$8.50
BF470	$1.65		



SPECIAL FUNCTION

SAB0600 Door Chime	$9.95
AY-1-5050	$9.50
TEA-1002 PAL Colour Encoder	$17.50
TDA-1022 Bucket Brigade	$29.50
EXAR 2206 Function Generator	$5.95
MOC-3020 TRIAC Opto Coupler	$2.50
MM 5837 Noise Generator	$3.90
TA 7205P Audio Amp	$4.50
7216A Frequency Display Driver	$47.50
SN 76488NF Sound Effects Generator	$5.95
AY-1-0212 Top Octave Synthesiser	$19.50

Z-80A/6800

Z-80A	CPU 4MHz	$8.50	Z-80A	DART 4MHz	$32.95
Z-80A	PIO 4MHz	$8.50	Z-80A	DMA 4MHz	$20.95
Z-80A	CTC 4MHz	$8.50	6802	CPU	$11.00
Z-80A	S10/0 4MHz	$20.95	6810	RAM	$4.95
Z-80A	S10/1 4MHz	$20.95	6821	PIA	$4.95
Z-80A	S10/2 4MHz	$20.95			

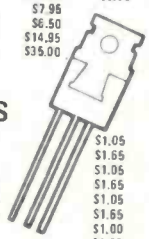
ZENER DIODES 1 WATT

From 3.3V to 33V 35¢

MEMORIES

		1-7	8 up
2102	1K x 1 RAM	$1.95	$1.65
2114-3	1K x 4 RAM 350nS	$2.45	$2.00
4116	16K x 1 Dynamic RAM 250nS	$2.50	$2.00
6116	2K x 8 CMOS RAM	$12.50	$9.90
2708	1K x 8 EPROM	$7.95	
2716	2K x 8 EPROM (Single +5V)	$6.50	
2532	4K x 8 EPROM (Single +5V)	$14.95	
2564	8K x 8 EPROM (Single +5V)	$35.00	

VOLTAGE REGULATORS



7805	5V+ Regulator TO-220/amp	$1.05
7905	5V– Regulator TO-220/amp	$1.65
7812	12V+ Regulator TO-220/amp	$1.05
7912	12V– Regulator TO-220/amp	$1.65
7815	15V+ Regulator TO-220/amp	$1.05
7915	15V– Regulator TO-220/amp	$1.65
78L12	12V+ Regulator 100mA	$1.00
78L15	15V+ Regulator 100mA	$1.00
79L15	15V– Regulator 100mA	$1.00
LM323	3amp 5V TO-3	$1.50
LM309	1.5 amp 5V TO-3	$7.50
LM317T	2-30V adjustable 1 amp TO-220	$2.80
LM317KC	2-30V adjustable 3 amp TO-3	$6.50
LM337K	3 amp variable 2-30V TO3	$9.50
LM396K	10 amp variable 1.25-15V TO3	$19.50

LED's

5mm Red	15	3mm Yellow	28
5mm Green	26	Rectangular Red	40
5mm Yellow	30	Rectangular Green	40
5mm Orange	28	Rectangular Yellow	40
3mm Red	18	Flashing Red	49
3mm Green	28	Flashing Red 10+ each	45

BRIDGE RECTIFIERS

WD4	68
P04	$2.95
MDA3504	$4.50

OPTO

COY89	Infra Red LED	$1.25	FND500	"	$1.35
BPW50	Infra Red Diode	$2.95	FND507	"	$1.75
LT302	7 seg Display	$1.45	LT547	"	$2.95
LT303	7 seg Display	$1.45			

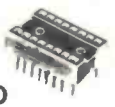
DIODES

IN4002	80	BA102	25	BYX21L/200R	$1.90
IN4006	20	BA114	25	OA91	12
IN5404	35	BA215/219	25	OA202	50
IN914	5	BR100	95	OA697	20
BAW62	29	BYX21L/200	$1.90	5082-2800	$2.75

IC SOCKETS – SOLDER

8 Pin	25	18 Pin	35	24 Pin	50
14 Pin	30	20 Pin	38	28 Pin	60
16 Pin	35	22 Pin	40	40 Pin	70

QUALITY WIRE WRAP IC SOCKETS



14 Pin	85	22 Pin	$1.40		
16 Pin	$1.05	24 Pin	$1.75		
18 Pin	$1.35	28 Pin	$2.25		
20 Pin	$1.45	40 Pin	$2.65		

DIL PLUGS AND COVERS SOLDER TYPE

14 Pin Plug	85	16 Pin Cover	25
14 Pin Cover	25	24 Pin Plug Only	$2.50
16 Pin Plug	95		

CRYSTALS

Case Style: HC-33/U		4.9152MHz	$6.50
1.000MHz	$12.50	5.000MHz	$5.50
1.8432MHz	$9.50	8.867238MHz	$5.50
2.000MHz	$7.50	10.000MHz Parallel Resonant	
3.000MHz	$7.50		$8.50
Case Style: HC-18/U		12.000MHz	$5.50
4.000MHz	$6.50	16.000MHz	$6.50
4.43MHz	$6.50	20.000MHz	$7.50

MINIMUM MAIL ORDE R $5.00

CARLINGFORD PHONE 872 4422

NUMBER 1 COMPONENTS

NEW STORE opening October in Carlingford

AT "NEVILLE'S CORNER" CNR CARLINGFORD & PENNANT HILLS RD. NEXT TO KENTUCKY FRIED CKICKEN

JAYCAR PASSIVE COMPONENTS

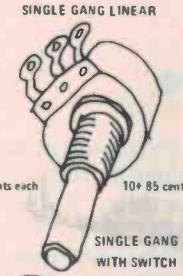
We regret to advise that we have had to pass on drastically increased costs due to the devaluation of the Australian dollar and the savage sales tax increase.
Most of the prices on this page had not changed in 18 months. In some cases our cost has increased 50% whereas our increases average about 10%. We haven't got the heart to pass on to you the costs that were passed on to us!
We are very proud of our range of components at Jaycar. Our quality is first class – so remember that if someone offers you a component that may APPEAR cheaper.
Jaycar components are 100% prime spec and guaranteed. They are the same parts that were used in TV stations, telephone exchanges and other industrial equipment.
NOTE! We have saved space in some places by saying that components conform to "E12". This means that we have 12 values in each "decade" i.e. 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and back to 10 in other words, 22pF, 220pF, 2200pF and so on.

POTENTIOMETERS

POTENTIOMETERS CARBON ROTARY
Jaycar rotary pots did not go metric. We keep ¼" plain shaft types with 3/8th bush mount. Most have a flat machined on the shaft.

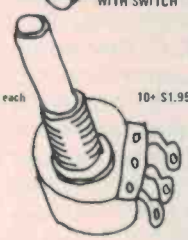
LINEAR (linear)	SINGLE GANG LINEAR LOG
500 ohms	
1k	1k
5k	5k
10k	10k
25k	25k
50k	50k
100k	100k
	250k
500k	500k
1M	1M
2M	2M

Price: 1 – 9 95 cents each 10+ 85 cents each



LINEAR	SINGLE GANG WITH SWITCH LOG
	1k
	5k
	10k
25k	25k
	50k
	100k
	500k
1M	1M
	2M

Price: 1 – 9 $2.25 each 10+ $1.95 each



DUAL GANG LINEAR	LOG
5k	5k
10k	10k
25k	25k
50k	50k
100k	100k
500k	500k
1M	1M

Price: 1 – 9 $2.25 each 10+ $1.95 each
Dual gang with switch 100k log (only) $3.95 each

CARBON SLIDER CONTROLS
45mm type – some with tap.

LINEAR	LOG
2k	1k
10k	5k
50k	50k
100k	250k

Price: 1 – 9 $2.95 each 10+ $2.50 each
30mm type 5k linear only $1.95 each
60mm type 10k log only $3.95 each

WIREWOUND POTS
3 watt rating (linear). ¼" shaft, 3/8th bush.
10 ohms, 25 ohms, 50 ohms, 100 ohms, 500 ohms, 1k, 5k
Price: 1 – 9 $3.45 each 10+ $2.95 each

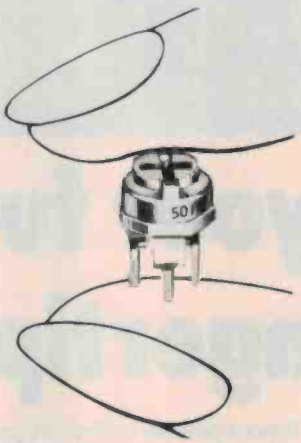
Jaycar stocks two types of trimmers. The low cost 'skeleton type and the high quality 'PIHER' European made dust proof type.

MINIATURE VERTICAL (SKELETON)
100 ohms, 250 ohms, 500 ohms, 1k, 2k, 5k, 10k, 25k, 50k, 100k, 250k, 500k
Price: 1 – 9 42 cents each 10+ 40 cents each

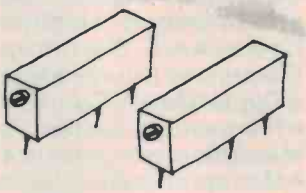
LARGE VERTICAL (PIHER TYPE)
100 ohms, 200 ohms, 500 ohms, 1k, 2k, 5k, 10k, 20k, 50k, 100k, 200k, 500k, 1M, 2M.
Price: 1 – 9 48 cents each 10+ 45 cents each

SMALL HORIZONTAL (PIHER)
100 ohms, 500 ohms, 1k, 2k, 5k, 10k, 20k, 50k, 100k
Price: 1 – 9 45 cents each 10+ 42 cents each

CERMET (Ceramic/Metal Film/Oxide)
High stability trimmers in a small package. 1/3rdW dissipation, dustproof, 100ppm T.C., 5mm lead spacing (.1" grid).
100 ohms, 500 ohms, 1k, 2k, 5k, 10k, 20k, 50k, 100k
Price: 1 – 9 65 cents each 10+ 60 cents each



MULTITURN TRIMMER POTS
(Sometimes called 10 turn). Jaycar multiturn trimmers feature Cermet element, leadscrew drive with over-ride clutch, sealed design and industry standard pin spacing.
100 ohms, 500 ohms, 1k, 2k, 5k, 10k, 20k, 50k, 100k, 1M.
Price: 1 – 9 $1.95 each 10+ $1.75 each

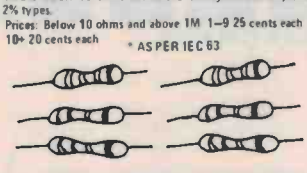


RESISTORS

RESISTORS We stock ¼, ½ and 1 watt 5% carbon film in the E12* series. I.e. 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82. From 1 ohm to 10 Megohm.

¼W 5%	1 – 9 5 cents each	10+ 4 cents each
½W 5%	1 – 9 5 cents each	10+ 4 cents each
1W 5%	1 – 9 9 cents each	10+ 6 cents each

These are **QUALITY** OEM grade carbon film resistors – **NOT** junk.
METAL FILM We only stock ¼W but in the extended resistance range E24*. I.e. 24 resistance values per decade: 1, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91.
Resistors between 10 ohms and 1 Megohm have a temperature co-efficient of 50ppm 1% tolerance and conform to Mil–R 10509F RN600 style.
Values below 10 ohms and above 1 Megohm are Beyschlag 2% types.
Prices: Below 10 ohms and above 1M 1–9 25 cents each 10+ 20 cents each * AS PER IEC 63



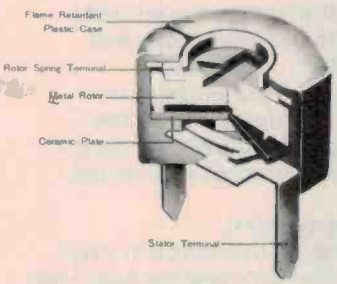
CAPACITORS

TANTALUM BEADS also called 'TAG' tantalums.
This is a brand name that has become a description.

VALUE	VOLTS	1 – 9	10+
0.1uF	35	55	50
0.22uF	35	60	55
0.33uF	35	60	55
0.47uF	35	60	55
1uF	35	60	55
1.5uF	35	60	55
2.2uF	35	60	55
3.3uF	35	60	55
4.7uF	35	60	55
6.8uF	35	60	55
10uF	25/35	65	60
22uF	25	65	60
33uF	16	70	65
47uF	10	70	65
100uF	3	70	65

RBLL CAPACITORS
Logical and economical replacements for Tantalums
0.1uF, 0.15uF, 0.22uF, 0.33uF, 0.47uF, 0.68uF
Price: 1 – 9 32 cents each 10+ 30 cents each
1uF, 1.5uF, 2.2uF, 3.3uF
Price: 1 – 9 35 cents each 10+ 32 cents each
4.7uF – 38 cents each 1 – 9 10+ 35 cents each
6.8uF – 40 cents each 1 – 9 10+ 36 cents each
10uF, 22uF, 33uF
Price: 1 – 9 45 cents each 10+ 42 cents each
47uF – 50 cents each 1 – 9 10+ 45 cents each
100uF – 60 cents each 1 – 9 10+ 52 cents each

TRIMMER CAPACITORS
Features: *Fully sealed * Top adjustable * Solid dielectric * 5mm lead spacing * Colour denotes capacitance range * Temperature co-efficient N750 ppm/degree C (average) * Q (1MHz C. max) 500.
2.0 – 7pF BLUE
5.2 – 30pF GREEN
6.8 – 45pF YELLOW
9.8 – 60pF BROWN
Price: 1 – 9 65 cents each 10+ 60 cents each



POLSTYRENE: Jaycar Polystyrene dielectric capacitors are used where stability is important. They exhibit low dielectric leakage as well.
Range: 33pF thru 1000pF (IEC E12 Series)
most are 100V rated.
Price: 1 – 9 30 cents each 10+ 28 cents

CERAMIC: Jaycar capacitors are generally NPO, 50V plate 10% types.
– Range 1pF – 1000pF (IEC E12 Series)
and: – 2200pF, 3300pF, 0.0047uF, 0.0056uF, 0.0068uF 0.0082uF, 0.01uF, 0.022uF, 0.033uF, 0.047uF, 0.1uF, 0.22uF, 0.33uF, 0.47uF.
Price: 1 – 9 15 cents each 10+ 12 cents each
100pF 3kV 50 cents each
CERAMIC TRIMMER
1 – 12pF 25 cents each
4 – 20pF 25 cents each

BIPOLAR ELECTROLYTICS: Quality made by ELNA RB type.

		1 – 9	10+
2.2uF	25V	55	50
4.7uF	50V	60	55
6.8uF	50V	60	55
10uF	50V	60	55
22uF	50V	65	60
47uF	50V	80	72

ALUMINIUM ELECTROLYTICS
Both axial (RT) and single ended radial (RB) types kept. We keep a large range of the now popular RB types. Each capacitor is fitted with a durable vinyl jacket which has the value and polarity clearly marked.

AXIAL TYPES

Capacitance	Voltage	1 – 9	10+
1uF	50	28	26
3.3uF	25	28	26
4.7uF	25	28	26
4.7uF	63	32	30
10uF	16	28	26
10uF	63	34	32
25uF	25	28	26
25uF	63	36	34
47uF	10	28	26
47uF	63	36	34
100uF	10	36	34
100uF	25	38	36
100uF	63	40	38
100uF	350	$3.50	$3.00
470uF	10	80	75
470uF	50	$1.20	$1.10
1000uF	10	$1.10	$1.00
1000uF	63	$1.80	$1.70
2500uF	16	$1.25	$1.15
2500uF	35	$1.95	$1.85
2500uF	60	$2.45	$2.35
3300uF	16	$1.95	$1.80
4700uF	35	$2.95	$2.60

RADIAL (RB) TYPE

0.47uF	63	28	26
1uF	50	28	26
2.2uF	50	28	26
4.7uF	25	28	26
4.7uF	50	36	34
10uF	25	28	26
22uF	50	36	34
25uF	25	28	26
33uF	25	30	28
47uF	16	28	26
47uF	25	30	28
47uF	50	36	34
100uF	16	30	28
100uF	25	32	30
100uF	63	50	46
220uF	25	55	50
220uF	35	75	70
220uF	50	85	80
330uF	25	78	72
470uF	35	78	72
470uF	63	$1.30	$1.25
1000uF	16	55	52
1000uF	25	82	78
2500uF	35	$1.45	$1.40
2500uF	80	$5.45	$5.20
4000uF	75	$7.50	$6.95
5600uF	40	$4.95	$4.45
8000uF	75	$9.95	$9.25
10000uF	40	$7.25	$6.85

GREENCAPS – or more precisely Metallised Polyester. Our Greencaps (many of which are BLUE!!) are prime spec OEM quality – not necessarily the cheapest we can buy!
Jaycar Metallised Polyester (sometimes also called 'Mylar') caps exhibit high 'Q' and low inductance and generally have 100 – 125V working.
Values: 1nF thru 47nF (0.001uF – 0.47uF) in IEC E12 Series as well as the following values: 1.0uF, 2.2uF and 3.3uF.
Price: 1nF (0.001uF) thru 22 nF (0.022uF)
1 – 9 22 cents each 10+ 20 cents each
27nF (0.027uF) thru 56nF (0.056uF)
1 – 9 24 cents each 10+ 22 cents each
68nF (0.068uF) thru 220nF (0.22uF)
1 – 9 32 cents each 10+ 30 cents each
270nF (0.27uF) 40 cents each 1 – 9 10+ 35 cents each
330nF (0.33uF) 40 cents each 1 – 9 10+ 35 cents each
390nF (0.39uF) 45 cents each 1 – 9 10+ 40 cents each
470nF (0.47uF) 60 cents each 1 – 9 10+ 55 cents each
1000nF (1.0uF) $1.45 each 1 – 9 10+ $1.35 each
2200nF (2.2uF) $1.45 each 1 – 9 10+ $1.35 each
3300nF (3.3uF) $2.45 each 1 – 9 10+ $2.25 each

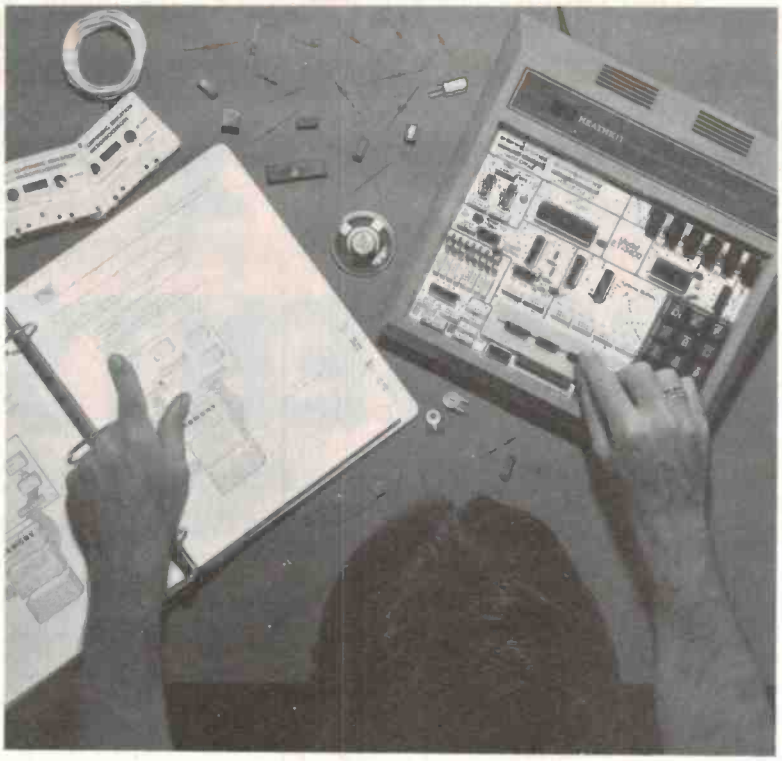
630V GREENCAPS - High Quality.
Relatively small in size

	1 – 9	10+
10nF (0.01uF)	32	30
22nF (0.022uF)	38	35
33nF (0.033uF)	42	40
47nF (0.047uF)	49	46
100nF (0.1uF)	60	56
220nF (0.22uF)	88	84
330nF (0.33uF)	$1.10	$1.05
470nF (0.47uF)	$1.30	$1.20

JAYCAR
125 YORK ST SYDNEY 2000
Ph. 2646688 Telex: 72293
Mail Orders To:
Box K-39 Haymarket 2000

POST AND PACKING CHARGES
$5-$9.99 ($1.20) $10-$24.99 ($2.40)
$25-$49.99 ($3.50) $50-$99.99 ($4.60)
$100 up ($6.20)

NEW SHOP HOURS
Mon-Fri 8.30 to 5.30pm
Sat 8.30 to 12.00pm
Thurs night to 8.30pm



We can put your future at your fingertips.

The Heathkit Continuing Education Courses are the low-cost, time-saving way to learn . . . in your own time . . . at your own speed.

Programmed Learning

Comprehensive programs that lead you naturally, logically, from one subject to the next. You read about one aspect of a subject . . . listen to a recording that expands on it . . . measure your understanding with the self-evaluation quizzes . . . then reinforce that learning with actual "hands on" experiments which demonstrate what you've just mastered.

A "state of the art" learning system!

Heathkit Learning Programs are furnished in vinyl-covered looseleaf binders that lay open for easy use, and allow you to add additional material for your own reference.

Along with your program, you'll receive related audio recordings that provide a personal touch as you're introduced to the program . . . given an overview of the theories involved and their applications . . . and then a preview of what you'll be learning in the next. These handy records can be played on any standard record player, serving as a refreshing "change of pace" as you learn this pleasant, modern way.

Courses available in the Heathkit Continuing Education Program include: ● Weather Course ● Electronics for Hobbyists ● D.C. Electronics Course ● A.C. Electronics Course ● Semi-conductor Electronics Course ● Electronics Course ● Analogue & Digital Meters Course ● Oscilloscopes Course ● Frequency & General Measurement ● Special Measuring Instruments ● Digital Techniques ● Microprocessors Course ● Introduction to Microprocessors ● Operational Amplifiers Course ● Active Filters Course ● I.C. Timers Course ● Phase-locked Loops Course ● Optoelectronics Course ● Basic Electricity Course ● Basic Course ● Pascal Course ● Cobol Course.

Send for your free Heathkit Catalog today and find out how you can acquire valuable new knowledge in a logical, enjoyable way.

Heathkit Continuing Education Courses

Please send the free Heathkit Continuing Education Catalog

Name .....

Address .....

..... P/Code .....

Send to W.F. Heathkit Centre, 220 Park Street, South Melbourne, 3205.
Phone: (03) 699 4999.

WF873/01

COMPUTING TODAY

'DAOS' program handles input from instruments or transducers

Computers in the laboratory are almost as common as microscopes. But all that hardware is not much good without the right program. 'DAOS' (Data Acquisition Operating System) from Laboratory Associates is part language, part level program and claimed to be an ideal tool for the researcher who lacks a specialist computing background.

Computer operations are simplified by the use of an extended form of BASIC and the incorporation of well over 1000 keyboard commands.

In the laboratory, 'DAOS' handles data arrays quickly and by single commands, segments of data can be multiplied, divided, rotated, integrated, differentiated, filtered, Fourier transformed and using the 'DAOS' Chebyshev transform, be fitted accurately with polynomials.

'DAOS' will allow the user to run programs and store data at the same time.

Every laboratory has its own needs and these can be catered for using the fully interactive capabilities of 'DAOS' it's claimed. Programs can be created and run without assembly, compiling or linking. They can then be stored on library files to be retrieved when needed. In this way the user can construct a powerful set of programs for any type of experiment and develop different libraries for different experiments. The system can also be linked to assembly language programs or FORTRAN subroutines.

The flexibility and expandibility of 'DAOS' is claimed to be a real advantage, particularly in areas where research needs are liable to change eliminating the need for time consuming in-house programming which can cause costly delays in the extraction and analysis of data.

The system is available with an optional graphics facility, which provides an X-versus-t, X-versus-y and pseudo three dimensional facilities, full labelling, rotation, page allocation and interactive drawing.

At present, the program is only available on DEC processors (PDP-11 and LSI-11) but the company is in the process of adapting the system for use with Apple machines and hardware incorporating the 68 000 range of microprocessors.

In Australia, 'DAOS' is distributed by Digital Electronics at a cost of approximately $2500 including the cost of optional extras.

NEC 16-bit personal computer

NEC Information Systems Australia Pty Ltd recently announced a new 16-bit personal computer and software aimed at the business marketplace which will become available in November.

The Advanced Personal Computer is built around an NEC-manufactured, 16-bit 8086-compatible microprocessor. It is packaged in a compact, integrated enclosure with separate keyboard. The APC comes in two basic models and they both incorporate 12" (diagonal) monitors and display 25 lines of 80 characters plus a system status line.

The monochrome model, priced at around $4000 combines a green/black high-resolution monitor, 128K of user memory, a single NEC-manufactured 1M, dual-sized 8" floppy disk drive upgradeable to a second diskette, keyboard and many other standard features.

The colour model, which includes two diskette drives, is priced at around $6000. It is functionally identical in every way except that its high resolution monitor displays eight colours.

Standard I/O equipment includes a parallel printer controller and a serial communications controller that supports both asynchronous and synchronous communications at up to 19 200 bps.

Backed up by a 2-year life lithium battery are a 4K write-protectable CMOS RAM and hardware clock/calendar. Auto-Power-Off allows the system to turn itself off (or be instructed to do so by a remote host) at the completion of some predefined set of tasks.

Hardware options include a second 1M disk drive for the monochrome model, an additional 128K of memory, hardware graphics subsystem and a second communication controller.

Software announced for the NEC APC includes the CP/M-86 operating system from Digital Research. The company indicated that MSDOS from Microsoft would soon be offered as well as the Ryan-McFarland RM/COBOL compiler.

A large variety of application packages will be made available with first deliveries of the new product including the Benchmark word processor, Telecommunicator and Mailing List Manager from Metasoft and MicroPlan from Chang Laboratories.

For further information contact Jolyon Bone, NEC Information Systems Pty Ltd, (02)438-3544.

S100 DMA controller

AED Microcomputer Products have announced the release of a new S100 floppy disk controller which they claim has superior performance and features than the alternative designs.

The controller transfers operating instructions as well as data from and into the system memory by direct memory access. It therefore offers very fast speed and minimal use of processor time. The DMA channel that this controller operates on can be anywhere within the 24 address line space, so it is suitable for use in extended address systems, 16-bit systems, or multi-user systems.

The controller electronics is based on a Z80 instead of the more usual 1793 series of the Intel/Nec controller chips. This gives it compatibility with both double density sector header standards.

Because the controller electronics is intelligent it is possible to change the controller parameters to suit any possible need by either reprogramming the EPROM or by down loading a controller routine directly into the on-board RAM and passing the on-board Z80 control to it. This card can control both 8" and 5¼" drives concurrently.

An advantage of this card is that it does not consume any memory space in the host computer even during the boot up procedure.

For further information about this product contact AED Microcomputer Products at 130 Military Rd, Guildford NSW. (02)681-4966.

Computer

Has the computer you want

Complete builtup computer

MicroBee is now ready built in a superb new case. And the best news of all – it costs no more.
Response to the MicroBee has been so great that we are able to offer the builtup MicroBee at the same price as the kit. With over 2,000 MicroBees sold, and a government schools contract, we want to thank all those who have supported the MicroBee and made it a success.

Powerful BASIC

MicroBee has been developed as the finest low cost instructional computer you can buy. Vital to this is MicroBee's incredibly powerful ROM BASIC. It's advanced error reporting and editing features make running and debugging your programs quicker and more effective. The exclusive MicroBee BASIC manual means you've got a complete learning package.
You can quickly master elementary programming and move on to enter and run sample programs.

And it doesn't stop there. As a MicroBee user, you are part of the MicroWorld Users Group. You will receive the Newsletter and be in contact with other MicroBee users, both in Australia and overseas.

MicroBee's BASIC makes it both easier to use yet more powerful than other Micros.

Expansion Power

Like most computer buyers, you're probably not sure just how you might be using your computer in the future. You want to keep your options open. This is where MicroBee is ahead of other machines.

If you need more memory to run longer, more advanced programs, your MicroBee's memory or 'core' board can be upgraded from 16K to 32K or 64K of RAM when you want to run longer more advanced programs. To run Z80 machine code, the Editor/Assembler ROMs just plug straight in. Extra ROM (up to 32K can be plugged straight in to the memory board.
If you want to expand to disk drives or use the international standard S100 bus so you can use S100 products like our Digitalker (speech synthesis) or ROMBLASTER (EPROM programmer) or a host of other S100 products from other manufacturers you can. All necessary pins of the Z80 CPU chip are brought out at the back of the MicroBee. Just connect up the low cost MicroBee S100 interface and you can fit disk drives, (the disk controller board fits into the S100 expansion box, and up to three other S100 boards. To do this your MicroBee needs to be upgraded to 64K RAM. Then you can add disk drives. With your first drive you get CP/M 2.2. This opens up the huge library of world class software. Further drives can be added on later at low cost.

Continuous Memory

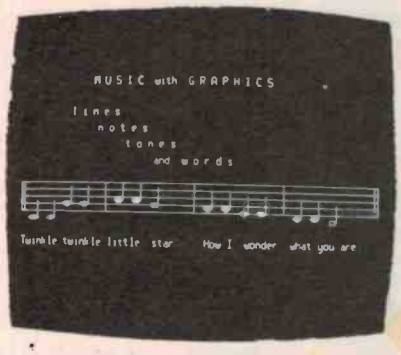
MicroBee's power and price come as a result of the new generation of super powerful LSI chips. The latest CMOS memory chips make battery backup of memory possible. Like your continuous memory calculator MicroBee can remember data and programs when you switch off or the power fails. Move to a new location and your program and data is still there.

Graphics and Sound

Facilities such as the high and low resolution graphics, and built in sound are under BASIC control. So you can use them more easily. The inbuilt I/O ports are also under BASIC control so it's very easy to use a modem or printer with your MicroBee.

shopping?

got all these features?



When you want to go further, MicroWorld's Editor/Assembler helps you write in Z80 machine code. You'll be able to write USR subroutines. And the editor/assembler is in ROM for instant access.

Software Growth

Because MicroBee uses the Z80 it has a huge software base. Our expanding range of cassette software shows our commitment to the MicroBee as an inexpensive cassette based Micro. We believe cassette storage is the most effective for the enthusiast and educational environment.
The cassette storage interface on the MicroBee works quickly and reliably. It is not a 'token effort' as it is on many Micros. MicroBee's interface works reliably with the sort of ordinary cassette recorder you have at home. It works at both 300 and 1200 baud, so you can store and recall your programs up to four times more quickly than on many other Micros.
The 6545 VDU controller chip gives you a fully programmable screen display with upper/lower case. The standard of 16 lines of 64 characters can be quickly and inexpensively changed to the professional 80x24 format if you want to move up to disk drives and CP/M. When you're ready, use MicroBee's optional parallel port and connect up joysticks or other peripherals to the optional parallel port.

Order Details

MicroBee 16K including manuals and 16K ROM BASIC	**$399.00**
MicroBee 32K	**$499.00**
MicroBee 64K	**$649.00**
New Moulded case	**$25.00**
Black and White monitor	**$139.50**
Green Screen Monitor	**$299.00**
Cassette Recorder	**$35.00**
MicroBee Editor/Assembler	**$49.50**
Cassette Software	**each $7.95**
Space Invaders program	**$14.75**
Conversion 16K to 32K	**$100.00**
Conversion 32K to 64K	**$155.00**
S100 Expansion Interface	**$299.00**
Disk Drive with CP/M and disk controller	**$799.00**
Add on disk drive	**$549.00**

Cassette Programs
MicroBee is supported by a wide range of stimulation, games and educational cassette software. Contact us for full details. Listed below is some of our games and practice software.

Space Invaders	Concentration
Chess	Typing/Solitare
Target	Lunar Lander/Hurkle
Star Shoot/Hangman	Biorythmn/Calender
Eliza	Kids Game
MasterMind/Nim	Chase/Wumpus
Z Trek	

New Stores

To help MicroBee customers, we've opened a number of new stores. Buying and getting support for your MicroBee is getting easier all the time. New Branches are:
Canberra: Applied Technology (ACT) Pty Ltd. 27 Colbee Court, Philip ACT. Phone (062)82 4611
Gosford 1, Debenham Road, West Gosford (043)24 1022
Artarmon: 35, Dickson Ave. Artarmon 2064 Phone (02)439 2322

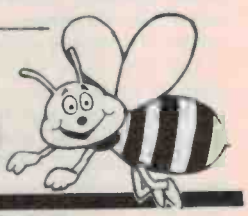
BeeLine

If you have technical questions on MicroBee, just phone on our new Beeline number:

(043) 24 1022

microbee apologizes

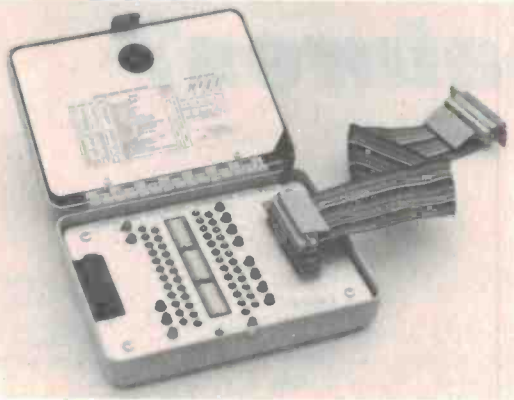
A sincere apology to all those people who have waited for their MicroBees over the past few months. It is your patience that has made MicroBee such a success. We are rapidly expanding our facilities to keep pace with the demand.



microbee
APPLIED TECHNOLOGY

Sydney Showrooms: 1A Pattison Ave. Waitara NSW 2077. Hour 9-5 Monday to Saturday. Phone (02)487 2711 (order queries), (02)487 3798 (mail orders). **Artarmon:** 35, Dickson Ave. Artarmon NSW 2064 Phone (02)439 2322
Gosford Showroom: 1, Debenham Road, West Gosford NSW 2250. Phone (043) 24 1022 Mail Orders to: PO Box 311 Hornsby NSW 2077.

Print-out



Interface analyser

The Electro Standard Laboratory Model 700 EIA RS-232 interface analyser is a diagnostic tool designed for use at the standard EIA RS-232 or CCITT V.24 data interface of modems, multiplexers, terminals and computers.

It is inserted in series between the data terminal equipment (DTE) and the data communications equipment (DCE) to provide access to and monitoring of all data, timing and control signals.

The unit features state of the art tri-state light emitting diodes to clearly display polarity, activity and validity of all interface signals.

Details from Scientific Devices Australia, 2 Jacks Rd, South Oakleigh Vic. 3167. (03)579-3622.

Colour video controller

The iSBX 270 video display controller provides low-cost, eight-colour display-terminal control for all 8 or 16-bit Multibus and iSBX-compatible systems.

The 76 x 177 mm iSBX multimodule board can interface with either colour or black and white display monitors at a 50 or 60 Hz frame rate. Up to 256 characters are contained in EPROM reprogrammable by the user for custom applications.

Three types of character font displays are supported by the iSBX 270 in matrixes of seven by nine, five by seven, or six by eight dots.

The iSBX 270 contains a software package in its on-board 8741A microcomputer that initialises and monitors the various on-board ICs.

For further information contact T.J. Casey, Total Electronics, 9 Harker St, Burwood Vic. 3125. (03)288-4044.

Another monitor for the ETI-685

Microbyte has developed a monitor/cassette operating system for the ETI-685 2650-based S100 computer (Dec. '81 ETI), called SBCOS.

SBCOS contains the popular and proven BINBUG monitor together with ACOS, Microbytes "... fast and reliable" cassette operating system.

Supplied in a 2532 EPROM, SBCOS contains two versions of BINBUG which support serial and parallel keyboards and serial or memory mapped VDU devices. Serial I/O may be performed at 300, 1200 and 2400 baud.

The cassette operating system utilises a simple interface to reliably record named files at 3000 baud using a conventional audio cassette recorder.

Port C of the on-board PPI is used by SBCOS to establish the Monitor I/O characteristics as well as for cassette recorder I/O and motor control, and details of the minor modifications required to install SBCOS on the SBC-2650 are supplied in the comprehensive user's guide.

The SBCOS EPROM including a manual with source listing and cassette tapes containing utility programs costs $75. The pc board for the ACOS interface costs $5 (45 x 105 mm board). An update 2532 EPROM is available to registered purchasers of ACOS and BINBUG for just $25.

Enquiries to Microbyte, P.O. Box 274, Belconnen ACT 2616.

Microprocessor applications course

Following on from his popular radio courses on Microprocessor Fundamentals, Dr. David Mee, of the University of New South Wales School of Electrical Engineering, will broadcast over the University's radio station, Radio University, a new course on microprocessor applications, starting early in October.

These lectures will enable the student to use a microprocessor in his own system for measurement, monitoring or control. It will be assumed that students will have a basic knowledge of microprocessors derived from earlier courses or elsewhere.

The course covers applications of microprocessors to a variety of common situations, each exemplifying different aspects of microprocessor system design. The applications will include:

- A complete single chip analogue data acquisition, display and control system for water heating.
- EPROM programming for a single chip microcomputer.
- A raster scan terminal.
- Subsystem for communications and magnetic storage.

There will be eight lectures broadcast over the University's radio station VL2UV at 7 pm Tuesdays, repeated 8 pm Thursdays. Transistor radios adjusted to pick up VL2UV can be purchased from Radio University for $10 post paid or $8 if collected. Students also receive instructions on how to modify their own radio.

One lecture will be transmitted over VITU, the University's television station. There will be two attended seminars held at the University.

The course fee of $27.50 includes a comprehensive set of notes in addition to the lectures and seminars.

Following broadcast the course will be available on tape, at $8 per radio lecture on audio cassette and $30 or $50, according to format, for the video cassette of the television programme. Three sets of notes are supplied with the tapes, making them ideal for training purposes.

For full particulars on this course, and others offered by the University of New South Wales by radio, television and tape, phone 622 2691 or write to P.O. Box 1, Kensington NSW 2033.

OKI 2350 printer

The OKI 2350 high-speed, high-quality, dot matrix printer has been released in Australia and New Zealand by Anderson Digital Equipment.

The durable nine-pin head boasts a head life of 500 million characters to handle the demands of office computer applications.

Capable of printing in two colours, the OKI 2350 offers standard, two condensed and three expanded fonts. It can also print subscripts and superscripts as well as underline. Any combination of these may be printed on the same line.

A 2K ROM allows users to store a full alternate character set in the unit.

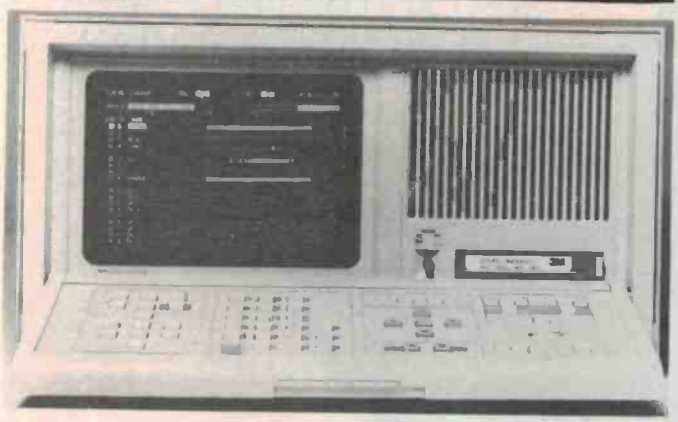
The OKI2350 is able to print at speeds up to 350 character per second and it employs a bi-directional printing mechanism, short-line seeking logic, and high horizontal and vertical slew speeds for maximum throughput.

A print buffer employing a 2K RAM permits downline loading of an alternate character set from the host computer, so users can change character fonts electronically without changing any print element.

In the graphics mode of the OKI 2350 72 x 72 dot addressable graphics are offered, giving users the capability to generate tables, graphs and charts.

Form handling is provided by horizontal and vertical tabs, top of form, extended paper feed, and a fourteen-channel vertical format unit.

For further information contact Hugh Logie, Anderson Digital Equipment, 14 Whiteside Road, Clayton Vic. (03)544-3444.



Colour logic analyser

Tektronix recently introduced the colour version of its DAS 9100 family of Digital Analysis Systems that features a colour CRT display.

The DAS 9120 Series of colour logic analysers is a modular digital analysis system housing both data acquisition and pattern generation card modules in the same mainframe.

Offered in a variety of data widths to 104 channels and speeds to 660 MHz these modules are combined in the mainframe to match the user's applications needs. The interactive pattern generator allows simultaneous stimulation and acquisition from a device under test.

For data acquisition, three modules are available to meet specific design requirements. The 32-channel module provides 25 MHz sampling and the 8-channel module provides 100 MHz sampling, both with 512 bits per channel memory. The 4-channel module provides 330 MHz sampling with 2048 bits per channel memory and a special high resolution mode provides 660 MHz (1.5 ns resolution) on two channels with 4096 bits per channel memory. These modules can be intermixed to support a variety of applications.

For pattern generation, there is a module with 16 data output channels at 25 MHz, expandable up to 80 channels.

For more information on the new DAS 9120 Series contact Tektronix Australia Pty Ltd, 80 Waterloo Rd, Nth Ryde NSW 2113. (02)888-7066.

Printer range

The first two products in a new range of intelligent matrix printers have been released to the Australian market by CASE Communication Systems.

Manufactured for CASE in the UK, the initial range constitutes the BD 136 with 240 cps capability and the WM 2000 with a speed of 120 cps. Both printers offer a bi-directional logic seeking mechanism for maximum throughput speed and to minimise printhead movement.

A 9 x 9 dot matrix provides high quality print and the ballistic printhead has a reliable, long life, according to CASE.

Both units include dot-addressable and character graphics as well as user programmable characters. The DB 136 has an alternative 96 character set, user-definable and capable of printing with a resolution of 60 dots per inch horizontally and 72 per inch vertically.

Large buffers are standard features of both machines, with 10 000 characters on the BD 136 and a possible 1800 on the WM 2000.

The BD 136's data formatting functions include centre justification, shift to right margin, decimal point and comma alignment, underlining, expanded characters, proportional spacing and right margin justification.

Other features include full forms control and horizontal and vertical tabbing, and the ability to define additional non-standard characters as well as down loading complete character sets.

Interfaces available with both models include Centronics parallel, RS 232, Current Loop and IEEE.

For further information contact Barry Foster, CASE Communication Systems. (02)438-2400.

OUR LOWEST PRICES EVER ON SEMI-CONDUCTORS AND IC's

	1-24	25-99	100plus
2708	4.90		3.10B
2716 5V	4.50	4.00	3.50B
2732 5V	5.50	5.00	4.50B
2114 300NS	2.10	1.90	1.80B
4116 200NS	1.40	1.30	1.20B
8164 64x1K DYN. RAM	38.00	32.00	29.00B
Z80 CPU 2MEG	6.00	5.00	4.00B
Z80ACPU 4MEG	7.00	6.00	4.20B
Z80P10	5.00	4.50	4.00B
Z80AP10	6.00	5.00	4.20B
Z80CTC	6.90	5.10	4.80B
Z80ACTC	8.40	6.00	5.70B
Z80S10/0	15.00	14.00	10.00B
Z80AS10/0	16.00	15.00	11.00B
8212	3.00	2.50	2.10B
8214	6.00	5.50	4.90B
8224	4.90	4.50	4.20B
8251	4.90	4.50	4.20B
8255	5.50	4.30	4.00B
6800	5.50	5.00	4.50B
6802	8.00	7.00	6.20B
6821	2.50	2.20	2.00B
6850	2.50	2.20	2.00B
FD1771	15.00		
FD1791	24.00	23.00	21.00B
FD1795	27.00	25.00	23.00B
8080A	5.00	4.50	4.20B
8085	6.00	5.00	5.00B
7400	.18	.17	.16B
7410	.18	.17	.16B
7421	.15	.12	.11B
74LS00	.18	.17	.13B
74LS10	.18	.17	.13B
74LS32	.18	.17	.13B
74LS74	.45	.41	.30B
74LS240	.80	.70	.60B
74LS241	.80	.70	.60B
74LS242	.80	.70	.60B
74LS244	.80	.70	.60B
74LS245	1.00	.90	.90BN
81LS95	1.70	1.50	1.40B
81LS96	1.70	1.50	1.40B
81LS98	1.70	1.50	1.40B
8131	2.10	1.90	1.70B
BC547-8-9	.10	.09	.07B
BC557-8-9	.10	.08	.07V
RED LEDS 5mm	.10	.08	.07B
IN4001	.04	.035	.032B

	1-24	25-99	100plus
IN4002	.05	.04	.035B
IN4003	.05	.04	.035B
IN4004	.06	.04	.039B
IN4007	.11	.09	.07B
IN4148	.04	.03	.025B
IN5404	.20	.018	.017B
IN5408	.25	.023	.021B
BU126	1.70	1.50	1.30A
BUX80	2.50	2.20	2.10A
TIP50	.99	.89	.81A
BD139	.40	.30	.22A
BD140	.40	.30	.22A
LINEARS			
LM308	.60	.45	.40A
LM555	.29	.26	.25B
LM741	.29	.26	.25A
LM317K	2.90	2.50	2.40B
LM350K	6.50	5.50	4.90B
LM380-14	1.10	1.00	.90A
LM324	.80	.65	.55A
CA3130T	1.50	1.40	1.30A
CA3140T	1.50	1.40	1.30A
RO-3-2513	11.00	10.90	9.50B
7805	.50	.40	.38B
7812	.50	.40	.38B
7815	.50	.40	.38B
7905	.60	.50	.45B
7912	.60	.50	.45B
7915	.60	.50	.45B
MDA3501	2.80	2.70	2.60B
MDA3502	2.90	2.80	2.70B
MDA3504	3.00	2.90	2.80B
FND357	1.00	.95	.72B
FND500	.95	.90	.72B
FND507	1.00	.95	.72B
78HO5	6.50	5.90	5.00B
78HGKC	6.90	6.50	5.90B
78PO5	9.90	9.50	8.90B
4001	.19	.18	.16B
4002	.19	.18	.16B
4007	.19	.18	.16B
4011	.19	.18	.16B
4077	.19	.18	.16B
4081	.19	.18	.16B
4093	.60	.55	.50B
4082	.19	.18	.16B
4017	.70	.60	.50B
2SK134	4.90	4.75	4.30A
2SK49	4.90	4.75	4.30A
MJ802	4.50	4.00	3.50A

LESS 5% THIS MONTH ONLY

DISC DRIVES

MPI 51.....$275.00 + 20% S.T.
MPI 52.....$385.00 + 20% S.T.
MPI 91.....$415.00 + 20% S.T.
MPI 92.....$515.00 + 20% S.T.

	100+	1000+		100+	1000+
DB25C	1.00	.90	4116	1.30	1.10
DB25P	1.90	1.70	2716	3.50	2.95
DB25S	2.90	2.75	2764	9.00	8.50

ALL SEMI-CONDUCTORS ARE PLUS TAX

TAX A = 32½% TAX B = 20%

RITRONICS WHOLESALE

425 HIGH STREET, NORTHCOTE 3070. MELBOURNE. (03) 489-8131.

TO ORDER: Heavy items sent Comet Freight on Mail Order Phone 481-1436. Wholesale Customers Phone: 489-7099. Mail Orders to RITRONICS WHOLESALE, P.O. Box 235, Northcote 3070. Telex No. AA38897. Minimum P&P $2. Add extra for heavy items, registration and certified mail. Prices and specifications subject to change without notice.

Bankcard mail orders welcome

ORDER FORM ETI 10/82/9

Please Debit my Bankcard

No.....

Expiry Date.....

Name.....

Signature.....

ETI 10/82/1

Printout

"Escape from Rungistan" and "Flywars"

A fair indication of the worth of a computer game is the latest time in the wee small hours that you find yourself playing the thing. I call this factor the 'Cohen Rating', and "Escape from Rungistan" (by Sirius Software) has a CR of 3.

"Escape" is one of a family of computer games known as 'adventure games'. The idea is that a series of what the Americans call 'scenarios' are put onto the screen, and you have to find the right words to feed into the computer to get you out of trouble.

For example, the computer might come up with "YOU COME TO A CAVE, OUT OF WHICH RUNS A HUNGRY BEAR". You have to type in an answer to this situation, such as "SING TO BEAR", at which the computer will respond "THE BEAR LIKES YOUR SINGING SO MUCH THAT IT DECIDES NOT TO EAT YOU". Or perhaps, "THE BEAR IS TONE DEAF, AND SO IT EATS YOU — END OF GAME".

(If this example seems rather arbitrary to you, then I have to warn you that adventure games are all written in much this vein — with much humour and practically no logic. It's in trying to guess the mind of the writer that the fun lies.)

"Escape" is a rather special adventure in that it not only describes the scenario to you, it draws a picture of it too, using the Apple's high-resolution graphics. In fact, some of the picutres actually **move** — a snowstorm, for example, with falling snow, or a snake that slides from one side of the screen to the other.

The theme behind "Escape" is that you start off in a prison cell in the country of Rungistan, and you have to escape from the cell, and then move from scenario to scenario across the face of the country, encountering all sorts of dangers, until you finally reach freedom.

If any of the dangers get the better of you — you die! Then it's back to the start of the adventure (in the cell) and go through it all again. One of the nice features of "Escape", though, is that you can 'save' the state of play at any stage, so that you can return to the spot in the next game, without going through all of the trials and tribulations you had to work your way through the first time.

The game doesn't only use pictures, it plays tunes too — each appropriate to the situation (the tunes can be turned off if you are playing at three in the morning, by the way). For example, in the prison cell, the first thing you hear is "Hang Down Your Head Tom Dooley"!

"Flywars" is quite a different type of game — it's more like the 'slot machine' variety. That's not to say it's not as addictive (CR of 2.30).

The idea behind "Flywars" is that you are a spider (not one of those nasty poisonous ones — just a plain old huntsman, catching flys). As you crawl across the screen, you leave a web behind.

Flies cannot pass through this

Superpilot extends Apple software

Superpilot, a versatile extension of the Apple Pilot software language, has been introduced by Apple Computer Inc. The Pilot series helps educators and industrial trainers create lessons and illustrations for computer-aided instruction.

The features of Superpilot are graphic enhancement, easy debugging, and external video control.

"Lessons or training sessions created on Superpilot will make difficult concepts and processes easier to understand and retain," states Debra Janssen, product marketing manager. "Powerful computer simulations for industrial or academic learning situations can now be designed without a mainframe computer or its complicated software."

The Superpilot program controls external videodisc and videotape through user and computer command and response and presents 'Turtle graphics for easy graphics programming and discovery learning.

Two support products in Apple's Pilot family which have just been released, are Co-Pilot and Superpilot Log. Co-Pilot is a completely self-contained, self-paced interactive tutorial on two diskettes which teaches how to program in Apple Pilot.

Superpilot Log works with Superpilot as an administrative record keeping program that automatically tracks test scores by item, student, or class and can also analyse non-computer test scores entered manually.

games for the Apple II — review

web, and you cross and recross the screen, trapping them in smaller and smaller areas of space, until finally you corner them and eat them (with a very satisfying 'squelch'!). As you eat more and more flies, your score goes up. And as the score goes up, your job becomes more and more difficult.

For example, a 'fly spray' appears that shoots clouds of chemicals at you — if you're hit by one, you die, and fall to the bottom of the screen.

If you still manage to improve your score while dodging the spray, other nasties appear, making it more and more difficult as you go on. This is a nice change from the usual game plan, where you choose a 'degree of difficulty' at the start of the game.

The "Flywars" programmer has provided an automatically adjusting degree of difficulty.

I never got past the flyspray, by the way — and there are about half a dozen degrees of difficulty past that!

"Flywars" (which comes with a dazzling plastic stick-on display, presumably for the side of your TV) is also by Sirius Software, and both games are distributed in this country by Imagineering, 22 Sir John Young Cr, Woolloomooloo NSW 2011 and available through Apple dealers.

Now if you'll excuse me, I think I'll get back to my computer and play another couple of rounds . . . after all, it's only two in the morning . . .

Phil Cohen

64K Dynamic RAM with pin one refresh

Motorola MOS Integrated Circuits Group has announced availability of the second generation 64K dynamic RAM with 'pin one refresh', the MCM6664A, offering improved performance.

The MCM6664A can do either RAS/CAS or RAS-only refresh cycles and has two additional refresh methods available to the user. These special functions are incorporated on pin 1 of the device and have been approved by JEDEC as an alternative function for that pin on the 64K dynamic memory. They are the auto-refresh and self-refresh modes.

The auto-refresh mode is accomplished by simply making pin 1 active during the time interval when a refresh cycle is desired. The refresh address is generated internally and is automatically incremented for the next refresh cycle. During pin 1 active low time, RAS and CAS are at V_{IL} and all other inputs are 'don't care'.

The second refresh method is intended primarily for battery backup applications where pin 1 will be active longer than 2 us. This self-refresh mode generates internal refresh pulses in addition to the internal refresh addresses.

Both the auto-refresh methods simplify memory system designs, save system refresh overhead circuitry and reduce skew times associated with board level refresh address multiplexing.

For more information contact Motorola Semi Conductor Products, 250 Pacific Hwy, Crows Nest NSW 2065. (02)438-1955.

Print-out

Amazing space for Sinclair's little wonder

In 1981 Clive Sinclair's ZX81 was hailed as an important breakthrough in the micro world. But this amazing machine's lack of memory power was a big handicap for the serious computer user or advanced programmer.

The RAM pack offered with the ZX81 was very handy but its capacity was limited to 16K. Since the BASIC interpreter can work with 32K of memory, Vendale Pty Ltd are selling a 32K RAM expansion board (RP32) which puts this potential to good use.

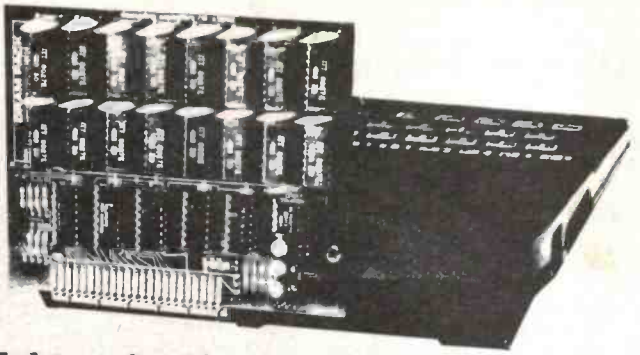
Because it is difficult to achieve both performance and low power consumption, the RP32 uses dynamic RAM chips. They offer several advantages over static chips, being considerably denser and cheaper.

We gave readers a brief introduction to this RAM add-on on page 81of the August issue, but as we didn't know much about it at the time, could not supply much detail. Shall we fill in the gaps now?

The RP32 is a self-contained, high performance 8-bit memory manufactured with high speed, low power MOS RAM. There are four sections.

The address decoder uses address lines A15 and A14 and divides the memory space into four blocks of 16K bytes: block 0 is ROM, block 1 is unused, block 2 is the second RAM bank and block 3 is unused; the timing logic section provides refresh and address multiplexing. The refresh is performed at the end of FETCH OPCODE (M1 cycle) and is totally transparent to the user; a −5 V generator uses the Intersil MAXICOSMOS ICL7660 to transform the +12 V into −5 V for biasing the DRAM; the DRAM array consists two banks of 4116s, each bank containing eight chips, giving 32K. No extra power supply is required.

This 32K RAM pack is available from Vendale Pty Ltd, P.O. Box 456, Glen Waverley, Victoria 3150, at a cost of $165, postage included (Australia).



Tektronix microprocessor selection

Tektronix Australia announces two one-day seminars on how to select the right 8 and 16-bit microprocessor for your application.

The topics discussed will cover fabrication technology, chip-architecture, development tools and other selection criteria.

David Ransier, a visiting Tek US expert on microprocessor development, will be conducting the seminars.

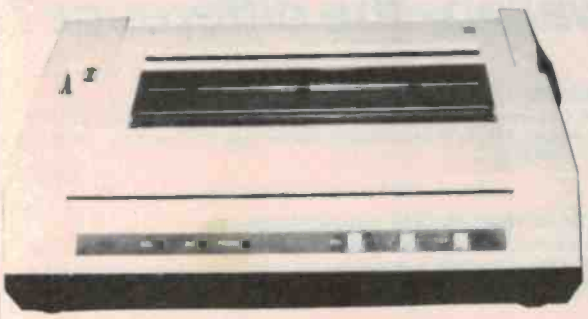
The seminars are intended for decision makers who need to know what the microprocessors can do and to better understand the chip selection process, experienced engineers who need to quickly learn the internals of a micro and how it affects the selection process and less experienced engineers who are suddenly thrust with the task of developing hardware or software and must make the best decision on which micro to use.

The seminars will be full day events, one held in Sydney on Thursday, October 7 and the other in Melbourne on Tuesday, October 12. A fee of $25 per person will cover a luncheon and the seminar materials.

For further information contact Sonya Stokell in Sydney by phoning (02)888-7066 or Jill Radford in Melbourne on (03)813-1455.

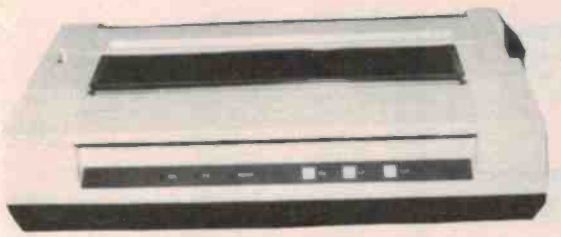
C. Itoh PRINTERS

FROM ROD IRVING ELECTRONICS



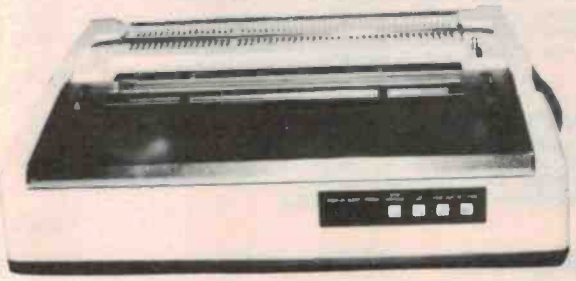
Pro/Writer Printer 8510

Print Features: Number of columns—136 col. max. Print Speed—120 CPS. Print Direction—Single-directional and Bidirectional, Switch Selectable. Throughput Speed—From 44 to 152 lpm. Character spacing (max. number of columns per line)—Pica 10 CPI (80), Double Width 5 CPI (40), Compressed Font 17 CPI (136), Double Width 8.5 CPI (68), Elite 12 CPI (96), Double Width 6 CPI (48), Proportional Double Width Proportional. Line Spacing—Variable to 1/144". Print Width—203 mm (8") max.
Forms Type: Fan Fold Roll or Cut Sheet: Width—113 mm to 254 mm (4.5" to 10.0"). Total Thickness—0.05 to 0.28 mm (0.002" to 0.011"). Number of Copies—Original + 3 copies nominal.
Form Feed: Method—Tractor or Friction. Form Loading—Either rear or top.
Interface—Serial: Method—EIA RS232-C and 20mA (40 & 60mA switchable option) Current Loop Serial Interface. Baud Rate (BPS)—110, 300, 600, 1200, 2400, 4800, 9600. Transmitting Method—Half Duplex. Synchronization—Asynchronous.
Interface—Parallel: Method—TTL compatible, 7-bit, parallel interface. Control Signals—ACK, BUSY, SELECT, DATA STB, INPUT PRIME FAULT, INPUT BUSY, PAPER EMPTY. Instruction Codes—(ASCII): CR, LF, VT, FF, CAN, SO, SI, DEL, DC1, DC2, DC3, DC4, GS, RS, US, FS, EM; GRAPHIC SYMBOLS: BIT GRAPHICS.
Error Detection: (1) Parity (VRC)—Odd, Even, No-parity. Switch selectable. (2) Framing Error—Stop bit check. (3) Overrun Error—Error is detected when data are received before the previous data have been processed.
Physical dimensions: 398 mm W x 120 mm H x 285 mm D (15.7" W x 4.7" H x 11.2" D).
Weight: 8.5 kg (18 lbs., 12 oz.)



Model 1550

The Model 1550 is a compact desk-top dot matrix serial impact printer used for data communication terminals, hardcopy of CRT displays, peripheral terminals for minicomputers and microcomputers, and small-sized business systems.
The character format is a dot matrix of 7(H) x 9)(V). or 8(H) x 8(V).
Print speed is 120 characters/second. Up to 136 characters can be printed per line at 10 CPI.
Its main features are: ● Compact desk-top dot matrix printer ● 136-column print ● Light-weight ● Low power-consumption ● High-quality print ● Bit image graphics ● Graphic Symbols ● Prints in six different languages ● High reliability ● Low cost.



F-10 Printmaster Daisy Wheel Printer

Print Speed: 40 CPS. **Print Method:** Static Print Impact. **Number of Printable Columns:** 136, 163, Variable. **Character Spacing:** 1/120 Inch (minimum). **Line Spacing:** 1/48. **Return Time:** 900 msec. **Line Feed Time** 40 msec. **Paper Width:** 406 mm (maximum). **Print Characters:** 96. **Printwheel:** Industry Standard 96 Character Wheel. **Interface:** Industry Standard 8-bit Parallel, RS232-C Compatible, X-ON, X-OFF, 12-bit Qume and Diablo Compatible. **Dimensions:** 574 mm W x 405 mm d x 153.5 mm H (22.5" W x 15.9" D x 6" H). **Weight:** 14 kg (30.8 lbs.) with cover and power supply. **Noise:** Less than 65 Db (1M from Platen, A Scale).

RITRONICS WHOLESALE

425 HIGH STREET, NORTHCOTE 3070. MELBOURNE. (03) 489-8131.

TO ORDER: Heavy items sent Comet Freight on Mail Order Phone 481-1436. Wholesale Customers Phone: 489-7099. Mail Orders to RITRONICS WHOLESALE, P.O. Box 235, Northcote 3070.
Minimum P&P $2. Add extra for heavy items, registration and certified mail.
Prices and specifications subject to change without notice.

Turn to Page 80 for our Big Board Specials

Bankcard mail orders welcome
ORDER FORM ETI 10/82/6
Please Debit my Bankcard
No.....
Expiry Date.....
Name.....
Signature.....

PACKAGED INFORMATION

—delivered to your own door!

No matter how, no matter where, We'll do our best to get it there, Australia Post or kangaroo...wallaby the difference?

HOW TO BUILD SPEAKER ENCLOSURES

A practical guide to the 'whys' and 'hows' of constructing high-quality top-performance loudspeaker enclosures.

20520 $8.75

MODERN RECORDING TECHNIQUES

Explains the equipment, controls and techniques found in a modern recording studio and how to use them creatively and correctly to produce a desired result. Numerous photographs, diagrams and charts.

21037 $19.25

SOUND SYSTEM ENGINEERING

Dealing with audio systems as a whole, it includes installing and equalising the sound system and interfacing the electrical and acoustic systems. Instrumentation, the acoustic environment and designing for acoustic gain are covered.

21156 $32.50

ACTIVE-FILTER COOKBOOK

Learn how to construct filters of all kinds — highpass, lowpass, bandpass. The book is easy to understand — no advanced maths or obscure theory is used.

21168 $21.95

REFERENCE DATA FOR RADIO ENGINEERS

The largest and most comprehensive collection of equations, graphs, tables, and other reference data needed in general radio engineering and design. Contains hundreds of charts, monographs, diagrams, curves, tables and illustrations.

21218 $51.00

INTRODUCTION TO RADIO ASTRONOMY

It gives background information on the structure of the universe, classification of galaxies and radio-wave propagation. It covers in detail reception of extraterrestrial radio signals and their sources and the types of antennas. It also explains how to construct several practical, low-cost radio telescopes.

21246 $8.75

CMOS COOKBOOK

This book explains CMOS technology and its application to 'real-world' circuitry. A mini-catalogue is included, which lists over 100 devices, giving their pinouts and application notes.

21398 $19.25

IC TIMER COOKBOOK

Gives you a look at the hundreds of ways IC timers are used in electronic instrumentation.

21416 $15.95

SECURITY ELECTRONICS

The principles of operation of the electronic devices used in the various types of security systems are described. Intrusion detection and alarms, object detectors, bugging and debugging devices, computer protection, as well as the planning of systems.

21419 $11.25

TRANSISTOR SUBSTITUTION HANDBOOK

17th edition—Accurate transistor substitution in a matter of seconds with this replacement listing of over 19 000 American and foreign bipolar transistors.

21515 $8.75

VIDEO TAPE RECORDERS

In this completely revised second edition, the author tells in simple language how helical VTRs work and how to operate and service them. Includes numerous examples of circuits and mechanical systems.

21521 $17.50

CHEAP VIDEO COOKBOOK

Complete discussion of a new, low-cost way to get words, pictures and opcode out of your computer and onto any ordinary TV screen, using a seven-IC easy-to-build circuit which you can build for less than $20.

21524 $11.75

IC CONVERTER COOKBOOK

Written for the practising engineer, technician, hobbyist or student, this book will be an invaluable working guide to the understanding and use of IC analogue/digital and digital/analogue converters.

21527 $20.75

DESIGN OF OP-AMP CIRCUITS, WITH EXPERIMENTS

The design of the fundamental circuits that are the basic building blocks of more sophisticated systems. A series of 35 experiments illustrates the design and operation of linear amps, differentiators and integrators, voltage [redacted] converters, active filters, and lots more.

21537 $16.50

555 TIMER APPLICATIONS SOURCE BOOK, WITH EXPERIMENTS

This book describes the construction of the 555 timer and gives numerous practical examples of its applications in all areas of electrical and computer engineering, including 17 simple experiments.

21538 $11.25

AUDIO IC OP-AMP APPLICATIONS

This book discusses IC op-amps and their application in audio systems, and describes the numerous advantages of using op-amps, including small spatial needs, low power consumption, reliable performance and low cost. Assumes a basic understanding of op-amp theory.

21558 $13.25

UNDERSTANDING CMOS INTEGRATED CIRCUITS

This book tells you what CMOS ICs are, how they work, and how they can be used in electronic circuit designs. Many practical circuits, complete with parts values, are included.

21598 $9.95

GUIDE TO CMOS BASICS, CIRCUITS, AND EXPERIMENTS

If you are already familiar with TTL devices and are ready to examine the benefits of CMOS, this book is your complete source. It tells you what CMOS devices are, their characteristics and design rules. 22 experiments demonstrate the concepts discussed.

21654 $14.95

PRACTICAL TRANSFORMER DESIGN HANDBOOK

An easy to understand, illustration-filled guide to designing and constructing transformers. Reviews the fundamentals of electricity, magnetism and algebra needed to understand transformer theory, and covers general design considerations, transformer types, power losses and transformer use in converters and inverters.

21657 $35.50

IC OP-AMP COOKBOOK

Basic op-amp theory in detail, with 200 practical, illustrated circuit applications: JFET and MOSFET units are featured, plus manufacturers' data sheets and company addresses.

21695 $23.75

TROUBLESHOOTING WITH THE OSCILLOSCOPE

Excellent for the professional service technician or the serious hobbyist, as it combines step-by-step procedures for using the scope with the specific nuts and bolts of TV receiver troubleshooting.

21738 $15.95

PRACTICAL SOLID-STATE CIRCUIT DESIGN

An introductory course in practical solid-state circuit design for the experimenter, designer or technician who is interested in constructing 'tailor-made' circuits.

21787 $14.95

EFFECTIVELY USING THE OSCILLOSCOPE

Excellent for the professional service technician or the serious do-it-yourselfer, as it combines the correct step-by-step procedures for using a scope with the specific nuts and bolts of TV receiver troubleshooting.

21794 $14.95

REGULATED POWER SUPPLIES
Comprehensive discussion of the internal architecture and operation of the latest solid-state regulators. Explains when regulated supplies are needed and how to incorporate them in your projects, and discusses modern circuitry including linear and switching circuits and late ICs.
21808 $29.75

INTRODUCTION TO AUTOMOTIVE SOLID-STATE ELECTRONICS
For the professional as well as the home mechanic — explains the functions of most on-board automotive black boxes and logic systems, including anti-skid braking, electronic spark control, diagnostic systems and trip computers.
21825 $14.95

ELECTRONIC MUSIC CIRCUITS
How to build a custom electronic music synthesiser, outlines numerous other circuit designs and then shows you how to modify them to achieve particular responses. Many of the circuits can be used as special-effects boxes for guitars and other musical instruments.
21833 $24.95

ANALOG INSTRUMENTATION FUNDAMENTALS
Numerous practical, hands-on lab experiments and solved problems are includes, plus discussions of movements, dc ammeters, voltmeters, ohmmeters, bridges, filters and attenuators. No calculus is required.
21835 $29.75

SOLAR CELLS
In-depth description of the basic operating principles and design of solar cells. It also covers the techniques currently used to produce solar cells and reviews system applications.
22270 $37.95

USE OF THE DUAL-TRACE OSCILLOSCOPE
This programmed text breaks down the process of operating a scope into a series of logical steps starting with the deflection of the electron beam and continuing through proper use of the triggering controls to measure the phase difference between two waveforms.
40023 $23.75

ELECTRONIC DESIGN WITH OFF-THE-SHELF ICS
It contains virtually all the information you need to design and build electronic circuits, systems and subsystems with readily available ICs. Shows how to interface them into highly complex systems.
50274 $14.70

ELECTRONIC TROUBLESHOOTING HANDBOOK
This workbench guide shows you how to pinpoint transistor troubles in minutes, how to test almost everything electronic and how to get the most out of low cost test equipment.
52585 $10.50

CONTEMPORARY MATHEMATICS FOR ELECTRONICS
This book is split into three sections. Direct current maths introduces the student to the calculator, fractions and dimensional analysis. Alternating current maths covers phasors, quadratics and RMS in both sine and digital waveforms. Active device maths introduces number systems and boolean.
70274 $29.75

BEGINNERS HANDBOOK OF IC PROJECTS
The novice is guided in mastering the fundamentals of building, troubleshooting and testing electronic projects. In addition to many elementary projects, more advanced ones are included concerning bipolar integrated circuits and medium and large-scale integrated circuits.
74286 $19.25

INTRODUCTION TO ELECTRO-ACOUSTIC MUSIC
This book assumes no previous technical knowledge. It discusses the relationship between the technology and the composition of electro-acoustic music.
81515 $15.95

MODERN FILTER DESIGN
This book details the advances in active RC filters, both from a practical standpoint and from a state-of-the-art point of view. It is the first book that gives detailed analysis and design procedures for switched capacitor filters.
94663 $49.95

EXPERIMENTER'S GUIDE TO SOLID STATE ELECTRONICS PROJECTS
This huge collection of easy-to-follow electronics projects and tests enables you to perform experiments with solid state devices such as solar cells, fibre optics, LEDs and both linear and digital ICs.
95469 $10.50

ORDER FORM

Send to ETI Book Sales, 4th Floor, 15 Boundary St, Rushcutters Bay NSW 2011.

Please allow 4-5 weeks for delivery. Post & Handling $2.00 per book.

Effective until December 31, 1982.

Please supply

No.	Qty.						
20520	....	21515	....	21657	....	22270	....
21037	....	21521	....	21695	....	40023	....
21156	....	21524	....	21738	....	50274	....
21168	....	21527	....	21787	....	52585	....
21218	....	21537	....	21794	....	70274	....
21246	....	21538	....	21808	....	74286	....
21398	....	21558	....	21825	....	81515	....
21416	....	21598	....	21833	....	94663	....
21419	....	21654	....	21835	....	95469	....

I enclose $..... inc. p&h

Name .....

Address .....

..... Postcode .....

Please debit my ☐ Bankcard ☐ American Express Card Expiry Date .....

Number: .....

Signature .....

PPI-based EPROM programmer

Here is a real application for the programmable ports provided on the ETI-685 processor board by the 8255 PPI. The hardware required for this EPROM programmer has been reduced to a bare minimum by transferring most of the programming control to the program software.

Ron Keonig

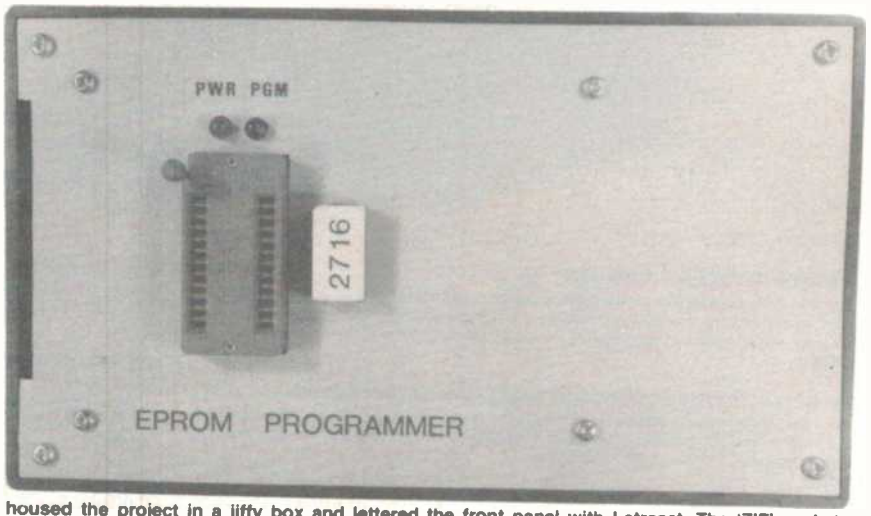
ERASABLE PROGRAMMABLE Read-Only Memories (EPROMs) are available today in a large range of types and capacities. This simple programmer has been designed primarily for the single-rail (+5 V) range of EPROMs but it can be modified to program the three-rail 2708 EPROM. The original design catered only for the 2716 2Kbyte EPROM which is by far the most popular type in use. The current design incorporates a 16-pin DIP 'personality module' to provide a means of rewiring the programmer to cater for all the 24-pin single-rail EPROMs.

The EPROM programmer is completely self-contained and can be used with any microcomputer which has three 8-bit ports available. A full source listing of a 2650 program to read, program and verify the programming of a 2716 EPROM has been supplied in this article. Of course, this program will have to be altered to cater for the other types of EPROMs.

Most computer systems use EPROMs to store the monitor program and to provide the VDU character generator ROM. With this programmer these EPROMs can be easily modified or replaced. EPROMs can also be used to store useful 'utility' programs and for the exchange of large programs from one system to another.

The ETI-685 2650 S100 Processor Board contains the unique feature of having RAM memory overlayed on the EPROM monitor. This feature allows new programs (either new monitors or OEM dedicated software) which are to reside at address '0000'H to be written on an assembler and assembled into the RAM. These programs can then be run and their operation verified before they are committed to EPROM. The following seven-byte program, when executed, will disable the monitor EPROM and transfer the CPU control to the program just assembled and stored in the on-board RAM at '0000'H. (Note: the two 2114 RAMs at IC14 and IC29 must be fitted to the ETI-685 board.)

```
04 01   LODI,R0 H'01'    Bit to set EPROM disable latch
D4 07   WRTE,R0 H'07'    I/O address of the latch
1F 0000 BCTA,UN H'0000'  Branch to Address '0000'H
```



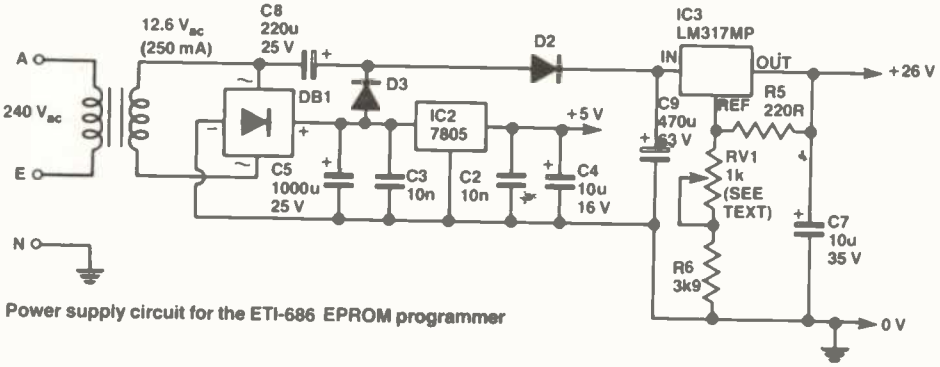
I housed the project in a jiffy box and lettered the front panel with Letraset. The 'ZIF' socket and 'personality' module DIP header are readily identified here.

The principal requirement for an EPROM programmer is to apply a 25 V programming voltage to EPROM pin Vpp, supply the appropriate address and eight bits of data to the EPROM socket and then generate the appropriate programming pulse. For the 2716 EPROM the addresses can be output in any order, and for each address a once-only 50 ms logic '1' pulse is applied to the CE input.

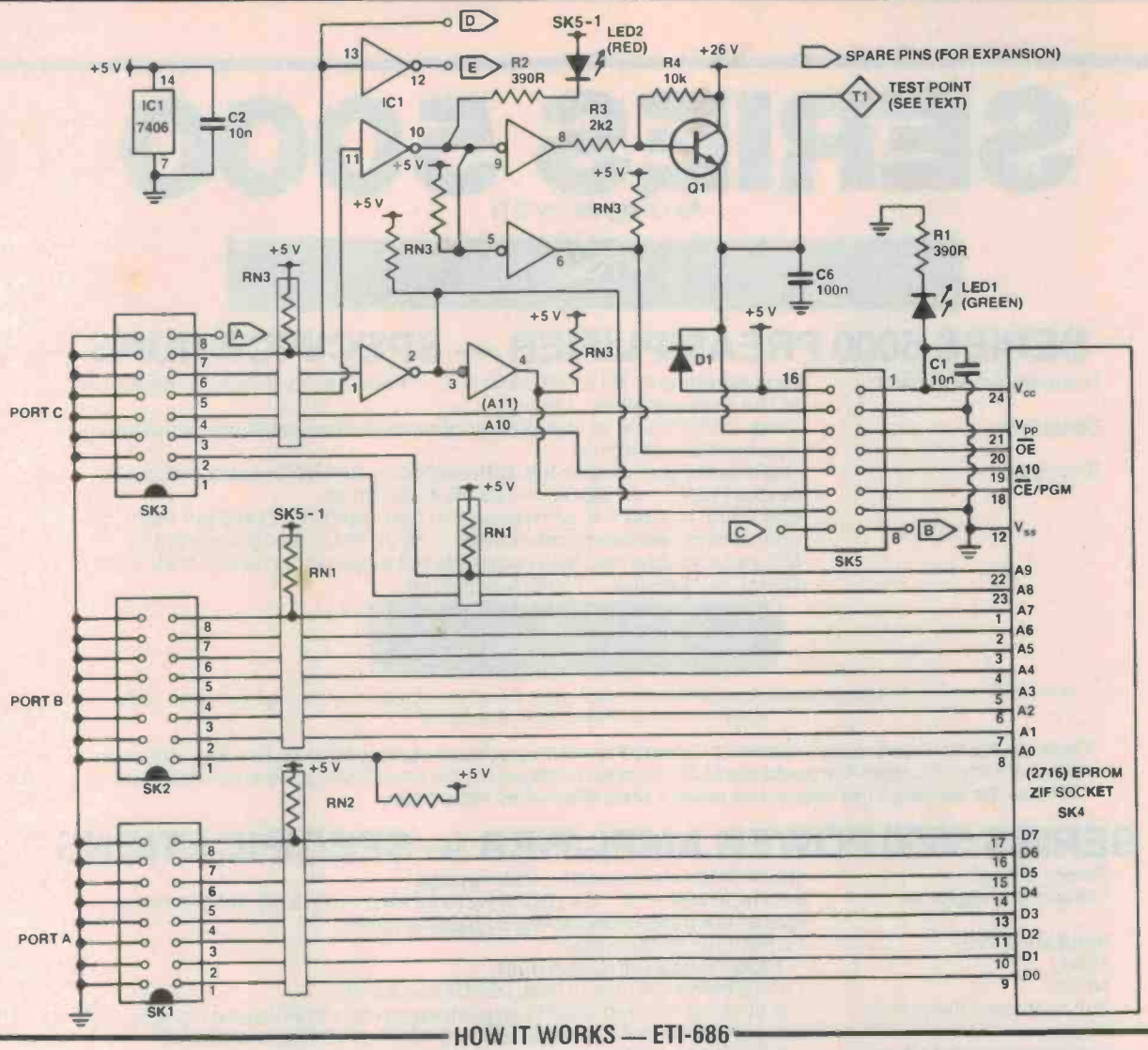
This programmer uses the B port and C port (lower) PPI lines to supply the required 11 address lines, and the A port is used to transport the data. The A port is set for output during programming, and for input during reading and verification. Two lines from the C port (upper) are used to switch on the Vpp programming voltage and to pulse the CE line during programming.

In most simple programmers the programming pulse duration is generated by the timing of a monostable multivibrator. As the pulse duration needs to be accurate for reliable programming these 'one-shots' must be set up using expensive test-equipment such as a frequency-period meter or a CRO. For this programmer the pulse duration is generated by the microprocessor executing a 'calibrated' delay subroutine. With all CPUs running from a crystal controlled 1 MHz clock the pulse length generated is extremely accurate, and no user timing calibration is required.

Interested software-buffs may like to know that the PPI's single bit set/reset feature has been used to generate the program pulse (see the PULSE subroutine in the program listing). ▶



Power supply circuit for the ETI-686 EPROM programmer



HOW IT WORKS — ETI-686

When the program is first run the PPI is initialised with the A port set for 'input' and the B and C ports set to 'output' and reset to all zeros. With a logic '0' on PC4 the programming LED is off, and a logic 0 will be present on pin 20 of the EPROM socket producing a valid output-enable signal. A logic 0 will also be present at IC1 pin 8 which, by the voltage divider action of R3 and R4, will place 4 V on the base of the transistor (Q1). As 5 V is present on the emitter of Q1 (via the diode D1), the transistor Q1 is reverse-biased (non-conducting) and the Vpp voltage at pin 21 remains at 5 V.

As a logic 0 is also present on PC5, a logic 0 will be applied to pin 18 of the EPROM socket producing a valid 'chip-enable' signal. The EPROM socket is now in the 'read' mode and it is safe to insert an EPROM into the socket. You might like to turn off the programmer's power supply before inserting or removing EPROMs from the socket.

I have been using a Textool zero insertion force 24-pin socket and I have not found it necessary to remove the power from the socket.

The program will now display the command MENU and wait for a valid input. There are five valid single letter commands: C, I, P, Q and V, explained in the main text.

The programmer remains in the 'read' mode except when programming is actually taking place. During the commands Copy and Verify the EPROM address is sequentially incremented and presented to the EPROM via port B and port C (lower). The data present at these addresses is read in via port A. The Copy command causes this data to be stored in the programmer's buffer memory at the appropriate locations. The Verify command compares the EPROM data with that already stored in the buffer.

During programming the sequence of events changes. The PPI is reconfigured for port A as an output and, using the bit-set PPI feature, the PC4 bit is set to a logic 1. With PC4 at logic '1', pin 10 of IC1 is a logic 0 and the programming LED is turned on. A logic 1 is also presented to pin 20 of the EPROM to tri-state (turn-off) its data drivers. The logic 0 at IC1 pin 9 produces an open-collector logic 1 at the inverter's output at pin 8. With pin 8 open-circuit, current flows from the 26 V supply via R7 to the base of Q1. Q1 is turned on and the 26 V supply is switched to the EPROM's Vpp input at pin 21. Some voltage is dropped across Q1 so the voltage applied to pin 21 will be less than 26 V. In fact, the 26 V supply is adjusted to provide a Vpp voltage during programming of 25 V, + or − 1 V.

During programming the address is sequentially incremented and the address and the relevant data from the buffer memory is presented to the EPROM via the PPI ports A, B and C. After the address and data have been latched into the PPI the PC5 line is pulsed to a logic 1 for 50 ms using the bit-set bit-reset feature. This produces the required 50 ms logic 1 programming pulse at the CE/PGM pin (18) of the EPROM.

The programmer requires the two dc voltages +5 V and +25 V to program single-supply EPROMs. A conventional full-wave bridge rectifier and a three-terminal regulator (IC2) is used to generate the +5 V supply. For the +25 V supply a half-wave voltage doubler is used to generate about 35 V across C9 from the incoming 12 Vac. For one half cycle D3 conducts and C8 charges to about 17 V. In the next half cycle D2 conducts and the charge on C3 is placed in series with the applied 17 V peak half-wave to generate about 35 Vdc on C9. An adjustable voltage regulator (set by RV1) is used to regulate this 35 V down to the required 25 V programming voltage. RV1 is set for 25 V at the Vpp pin with a simulated load of 1k, 1 W resistor placed in the EPROM socket between pin 21 (Vpp) and pin 12 (0 V).

The 12 Vac can be obtained from the computer's transformer, a suitable transformer mounted in the programmer's box, or from an external 12 Vac 'plug pack'. A suitable transformer for including in the box to make the programmer completely self-contained is the type 2155, available from many manufacturers and retailers, or the Ferguson PL12/20 VA. A suitable external 12 Vac plug pack is available from Dick Smith, catalogue no. M-9555.

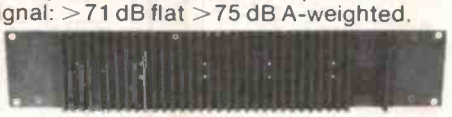
Three flat ribbon cables are used to connect the three 8-bit PPI ports on the CPU board to the programmer board. As the eight Data lines and 11 Address lines in these cables are connected directly to the 24-pin EPROM socket these cables should not exceed one metre in length. The termination resistor networks, RN1 and RN2, can be omitted if the cable length is not to exceed half a metre in length.

SERIES 5000

As designed by ETI

SERIES 5000 PREAMPLIFIER — SPECIFICATIONS

Frequency response:	High-level input: 15Hz-130 kHz, +0, −1 db Low-level input — conforms to RIAA equalisation, ±0.2 dB
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 300 mV input signal at full output (1.2V): >92 dB flat >100 dB A-weighted. MM input, master full, with respect to full output (1.2V) at 5 mV input, 50 ohm source resistance connected: >86 dB flat >92 dB A-weighted. MC input, master full, with respect to full output (1.2V) and 200 μV input signal: >71 dB flat >75 dB A-weighted.



N.B. Picture is only of original heatsink supplied with this project. Our one is tapped from the rear so that no screw heads are visible. New picture next month.

Please note that the "Superb quality" Heatsink for the power amp was designed and developed by Rod Irving Electronics and is being supplied to other kit suppliers. This product cost $1,200 to develop so that your amplifier kit would have a professional finish as well as sound. We also have a new range of rack mounting boxes which will be released soon.

SERIES 5000 POWER AMPLIFIER — SPECIFICATIONS

Power output:	100W RMS Into 8 ohms (±55 V supply).
Frequency response:	8 Hz to 20 kHz, +0−0.4 dB 2.8-Hz to 65 kHz, +0−3 dB. NOTE: These figures are determined solely by passive filters.
Input sensitivity:	1V RMS for 100W output.
Hum:	−100dB below full output (flat).
Noise:	−116 dB below full output (flat, 20 kHz bandwidth).
2nd harmonic distortion:	<0.001% at 1 kHz (0.0007% on prototypes) at 100 W output using a ±56 V supply rated at 4 A continuous. <0.003% at 10 kHz and 100 W.
3rd harmonic distortion:	<0.0003% for all frequencies less than 10 kHz and all powers below clipping.
Total harmonic distortion:	Determined by 2nd harmonic distortion (see above).
Intermodulation distortion:	<0.003% at 100 W. (50 Hz and 7 kHz mixed 4:1).
Stability:	Unconditional

EXTRA FEATURES OF OUR KITS
POWER AMPLIFIER
KIT PRICE $279.00 P & P $8.00

- 1% Metal Film Resistors are used where possible
- Prewound Coils are supplied
- Aluminium case as per the original article
- All components are top quality
- Over 200 Kits now sold
- We have built this unit and so know what needs to go into every kit
- SUPER FINISH Front panel supplied with every kit at no extra cost to you
- We are so confident of this kit that we can now offer it assembled and tested so that people who do not have the time can appreciate the sound that this applifier puts out. This is done on a per order basis delivery approx. two weeks after placement.
  The price is only $399.00

**All parts available separately for both kits*

PREAMPLIFER
KIT PRICE $239.00 P & P $8.00

- 1% Metal Film Resistors are supplied
- 14 metres of Low Capacitance Shielded are supplied (a bit extra in case of mistakes)
- English "Lorlin" Switches are supplied no substitutes as others supply
- We have built and tested this unit and so know what needs to go into every kit
- Specially imported black anodised aluminium knobs
- Again as with the power amp we are offering this kit A & T at a price which we do not believe there is a commercial unit available that sounds as good. Same delivery as the P.A.

All the above for only $399.00

SERIES 4000 SPEAKERS FROM ETI

SERIES 4000/14-WAY SPEAKERS

A no comprise, top-line system designed by David Tilbrook and described in the February 1980 ETI. Those who own them or have heard them universally praise them for clarity of sound, superb stereo Immaging and smoothness of response. Employing Philips' latest range of low distortion drivers and a specially-designed crossover network (another Tilbrook masterpiece) these speakers are the equal of other systems costing up to three times the price. The 4000/1 will handle 100 W continuous, up to 400 W peak.
PLEASE CHECK PRICES AND AVAILABILITY

ROD IRVING ELECTRONICS

425 HIGH STREET NORTHCOTE 3070 MELBOURNE (03) 489-8131

ETI 10/82/7

PARTS LIST — ETI-686

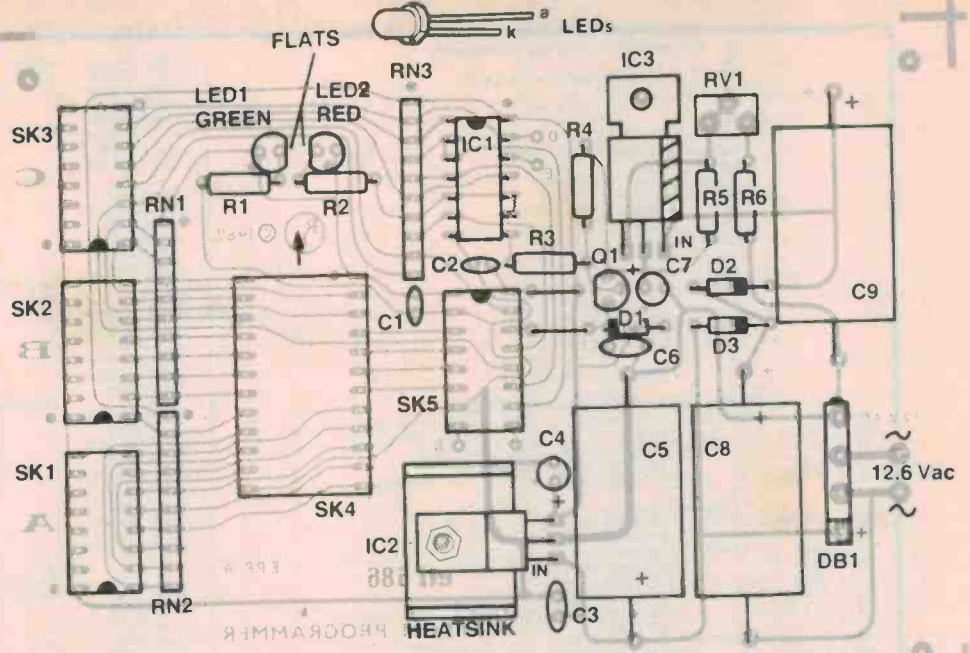
Resistors ..... all ½ W, 5%
- R1, R2 ..... 390R
- R3 ..... 2k2
- R4 ..... 10k
- R5 ..... 220R
- R6 ..... 3k9
- RN1, 2, 3 ..... 3k3 x 9 SIP resistor pack
- RV1 ..... 1k min. vert. trimpot

Capacitors
- C1, 2, 3 ..... 10n ceramic
- C4 ..... 10u/16 V tant.
- C5 ..... 1000u/25 V axial electro.
- C6 ..... 100n ceramic
- C7 ..... 10u/35 V tant.
- C8 ..... 220u/25 V axial electro.
- C9 ..... 470u/63 V axial electro.

Semiconductors
- D1 ..... 1N914, 1N4148
- D2, D3 ..... EM401, 1N4001 etc.
- DB1 ..... BY257 Philips bridge rect.
- IC1 7406
- IC2 7805
- IC3 ..... LM317MP
- LED1 ..... TIL220G green LED
- LED2 ..... TIL220R red LED

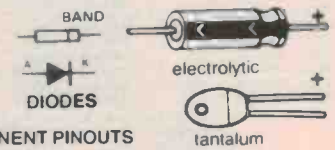
Miscellaneous
ETI-686 pc board; three 16-pin solder-in type IC sockets (SK1, 2, 3) — optional; one 24-pin wire-wrap socket (SK4); one 24-pin ZIF socket; 4 x 18 mm spacers; one TO220 heatsink; one 2155 or PL12/20 VA transformer or similar (12 V/1 A); jiffy box, 196 x 113 x 60 mm (UB2 or similar); wire etc.

Price estimate $42 — $48



Component overlay. Test point T1 is on the link adjacent to the cathode of D1. The ● at one end of RN1, 2 and 3 shows the common pin (+5 V).

View of the board showing mounting of the wire-wrap and ZIF sockets.



COMPONENT PINOUTS

As you can see from the circuit diagram this must be just about the simplest EPROM programmer ever published, requiring only one TTL interface IC and two voltage regulators. But the software supplied makes this programmer a very versatile 2716 EPROM programming package.

Construction

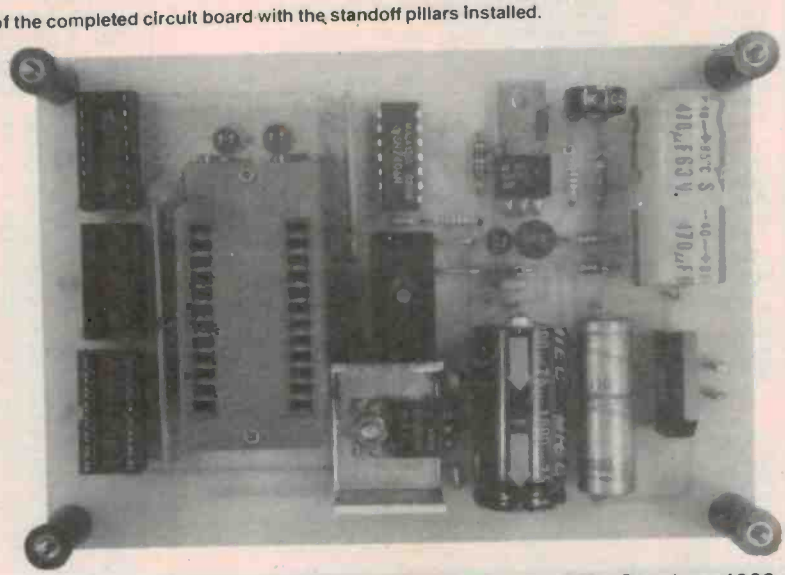
All components for the programmer are mounted on a single sided printed circuit board which measures approximately 140 mm by 90 mm. The maximum height of components on the board is 18 mm. The board may be mounted permanently in the computer or assembled into a suitable case (as illustrated in the accompanying photograph). If you intend to only program 2716 EPROMs then the 'programming module' socket can be replaced with five wire links. If you intend to mount the board behind a panel or box lid you can use a 24 and 16-pin wire-wrap socket to raise the height of the sockets above the other board.

It is important that you use a good quality 24-pin socket for the EPROM. Ideally, a 'zero insertion force' type (ZIF) should be used. If you purchase the Textool brand ZIF you may find that it will not fit into the holes on the board or plug into any type of IC socket. I solved this problem by soldering a 24-pin component header (similar to the 16-pin module header) to the pins of the Textool ZIF.

Mount all the components on the board paying close attention to the polarity of the electrolytic capacitors and the orientation of the resistor networks. Install the six resistors, three diodes and two wire links first. Next install Q1, then the diode bridge, the resistor networks and the capacitors. The two voltage regulators and the TTL IC are installed next and, after the board has been fitted to the panel, the LEDs can be installed. The three 16-pin IC sockets for the port A, B and C cables can be installed next.

The wire-wrap sockets should be fitted after the assembled board has been secured to the front panel so that you can accurately set their height. A suitable heatsink for the 5 V regulator can be fabricated by bending up two 12 mm sides from a 45 mm x 20 mm x 1.2 mm piece of aluminium. When the board is completed it can be secured to the front panel using four 18 mm to 20 mm long spacers. Plug the zero insertion force socket into the 24-pin wire-wrap socket and fit it to the assembly. Check that the release lever of the ZIF is not resting on the front panel and solder the wire-wrap pins to the board. Next locate the 16-pin module socket to be just proud of the front panel and solder it in place. ▶

View of the completed circuit board with the standoff pillars installed.



```
                        ;*  PPI BASED 2716 EPROM PROGRAMMER
                        ;*
                        ;*       Execute by kevins G4000
                        ;*
                        ;*              11-4-82
                        ;*
                        ;*
                        ;*Monitor Subroutines used:
                        ;MBUG    EQU     H'0022'
                        ;LINE    EQU     H'005B'
                        ;CRLF    EQU     H'008A'
                        ;BOUT    EQU     H'0269'
                        ;CHIN    EQU     H'0286'
                        ;COUT    EQU     H'02B4'
                        ;GNUM    EQU     H'02DB'
                        ;*Constants
                        ;SPAC    EQU     H'20'
                        ;CR      EQU     H'0D'
                        ;LF      EQU     H'0A'
                        ;BS      EQU     H'08'
                        ;BELL    EQU     H'07'
                        ;*
                        ;       ORG     H'4000'
                        ;*
                        ;*Initialise and Print the Command Menu
4000 0402               ;ENTRY   LODI,R0 02              Arith. compare,
4002 93                 ;        LPSL                    Clear Carry, RS1
4003 7640               ;        PPSU    FLAG            Set Flag
4005 0500               ;        LODI,R1 MSSG0-MSSG0
4007 3F412C             ;        BSTA,UN PMSSG           Print the Menu
                        ;*
                        ;*Command Input
400A 3F008A             ;START   BSTA,UN CRLF            to CRT
400D 3F4040             ;        BSTA,UN INIT
4010 042B               ;PMPT    LODI,R0 A'+'            Prompt
4012 3B89               ;        BSTR,UN *OUT+1          Cout
4014 040B               ;        LODI,R0 BS
4016 3B85               ;        BSTR,UN *OUT+1          Cout
4018 3F0286             ;        BSTA,UN CHIN            Wait for a command
401B C1                 ;        STRZ,R1
401C 3F02B4             ;OUT     BSTA,UN COUT            Echo command to CRT
401F E543               ;        COMI,R1 A'C'
4021 1C408B             ;        BCTA,EQ COPY            Copy EPROM into Buffer
4024 E550               ;        COMI,R1 A'P'
4026 1C40A2             ;        BCTA,EQ PROG            Programme EPROM from Buffer
4029 E549               ;        COMI,R1 A'I'
402B 1C407D             ;        BCTA,EQ INITB           Initialise Buffer with 'FF'
402E E556               ;        COMI,R1 A'V'
4030 1C410F             ;        BCTA,EQ VER             Verify EPROM with Buffer
4033 E551               ;        COMI,R1 A'Q'
4035 1C0022             ;        BCTA,EQ MBUG            EXIT to Monitor
4038 05BA               ;        LODI,R1 MSSG8-MSSG0 Print 'INVALID' command
403A 3F412C             ;MOUT    BSTA,UN PMSSG
403D 1F400A             ;        BCTA,UN START
                        ;*Define the PPI Ports (A,B and C) used
                        ;PORTA   EQU     H'00'           for Data (in and out)
                        ;PORTB   EQU     H'01'           for A0 to A7
                        ;PORTC   EQU     H'02'           PC0-PC3 for A8-A11
                        ;CNTRL   EQU     H'03'
                        ;*
                        ;SETPG   EQU     H'0B'           Set Programme Pulse (PC5)
                        ;RSTPG   EQU     H'0A'           Reset Pulse
                        ;SETDE   EQU     H'09'           Tristate PROM, apply Vpp (PC4)
                        ;PGEN    EQU     H'10'           Programme Enable flag
                        ;*
                        ;*Routine to Initialise the PPI
4040 0490               ;INIT    LODI,R0 H'90'           A Input, B and C Output
4042 D403               ;        WRTE,R0 CNTRL
4044 20                 ;        EORZ,R0
4045 CC0202             ;        STRA,R0 PGENF           Clear flag
                        ;*Initialise the Buffer Pointer TEMP
                        ;*       to the value stored at BUFST
4048 0C01FD             ;INITP   LODA,R0 BUFST
404B CC0200             ;        STRA,R0 TEMP            High byte
404E 20                 ;        EORZ,R0
404F CC0201             ;        STRA,R0 TEMP+1          Low byte
4052 17                 ;        RETC,UN
                        ;*
                        ;*Routine to Write Byte Address to PPI
4053 0C0201             ;WRITE   LODA,R0 TEMP+1          Low byte
4056 D401               ;        WRTE,R0 PORTB
4058 0C0200             ;        LODA,R0 TEMP            High byte
405B 440F               ;        ANDI,R0 H'0F'           Strip top nibble
405D 6C0202             ;        IORA,R0 PGENF           add Enable flag
4060 D402               ;        WRTE,R0 PORTC
4062 17                 ;        RETC,UN
                        ;*
                        ;*Routine to Increment TEMP until TOP address
4063 0C0200             ;INCR    LODA,R0 TEMP            High byte
4066 0D0201             ;        LODA,R1 TEMP+1          Low byte
4069 EC01FE             ;        COMA,R0 TOP             Compare high byte
406C 1A04               ;        BCTR,LT INCT
406E ED01FF             ;        COMA,R1 TOP+1           Compare low byte
4071 14                 ;        RETC,EQ                 Finished if equal
4072 D902               ;INCT    BIRR,R1 SAVE            Incr. low byte and
4074 D800               ;        BIRR,R0 SAVE            Incr. high byte if R1=0
4076 CC0200             ;SAVE    STRA,R0 TEMP            Store the new address
4079 CD0201             ;        STRA,R1 TEMP+1
407C 17                 ;        RETC,UN                 Not finished
                        ;*
                        ;*Routine to Initialise the Data Buffer with 'FF' Hex.
407D 04FF               ;INITB   LODI,R0 H'FF'
407F CC8200             ;        STRA,R0 *TEMP           Data byte to buffer
4082 3B5F               ;        BSTR,UN INCR            Next address
4084 9877               ;        BCFR,EQ INITB           Loop till end
4086 058F               ;        LODI,R1 MSSG3-MSSG0
4088 1F403A             ;        BCTA,UN MOUT            Print 'Completed'
                        ;*Routine to Copy EPROM into Buffer
408B 3F4053             ;COPY    BSTA,UN WRITE           Address to PPI
408E 5400               ;        REDE,R0 PORTA           Data from EPROM
4090 CC8200             ;        STRA,R0 *TEMP           to buffer
4093 3F4063             ;        BSTA,UN INCR            Next address
4096 9873               ;        BCFR,EQ COPY            Loop till end
4098 058A               ;        LODI,R1 MSSG2-MSSG0
409A 3F412C             ;        BSTA,UN PMSSG           Print 'Copy'
409D 058F               ;        LODI,R1 MSSG3-MSSG0
409F 1F403A             ;        BCTA,UN MOUT            'Completed'
                        ;*
                        ;*Routine to Programme EPROM from buffer
                        ;*Check if EPROM Erased first
40A2 3F4053             ;PROG    BSTA,UN WRITE           Address to PPI
40A5 5400               ;        REDE,R0 PORTA           EPROM Data
40A7 E4FF               ;        COMI,R0 H'FF'           Erased?
40A9 9C40B5             ;        BCFA,EQ PERR            Error if not 'FF'
40AC 3F4063             ;        BSTA,UN INCR            Next address
40AF 9871               ;        BCFR,EQ PROG            Loop till end
40B1 057E               ;        LODI,R1 MSSG1A-MSSG0 'PROM Erased'
40B3 1B02               ;        BCTR,UN CONT            and ready to programme
                        ;*
40B5 056E               ;PERR    LODI,R1 MSSG1-MSSG0 'PROM not Erased'
40B7 3F412C             ;CONT    BSTA,UN PMSSG
40BA 3F0286             ;        BSTA,UN CHIN            Command?
40BD E40D               ;        COMI,R0 CR              'CR' to continue
40BF 9C400A             ;        BCFA,EQ START           Abort if not 'CR'
40C2 3F4040             ;        BSTA,UN INIT            Reset pointers
40C5 0599               ;        LODI,R1 MSSG4-MSSG0
40C7 3F412C             ;        BSTA,UN PMSSG           Print 'Programming'
                        ;*Set up PPI for Programming
40CA 0410               ;        LODI,R0 PGEN
40CC CC0202             ;        STRA,R0 PGENF           Set PGEN flag bit
40CF 0480               ;        LODI,R0 H'80'
40D1 D403               ;        WRTE,R0 CNTRL           Port A output mode
40D3 0409               ;        LODI,R0 SETDE
40D5 D403               ;        WRTE,R0 CNTRL           Apply Vpp, Tristate EPROM
                        ;*Programme the Buffer contents into the EPROM
                        ;*Address range specified by BUFST (start) and TOP (end.
40D7 3F4053             ;NXTP    BSTA,UN WRITE           Address to PPI
40DA 0CB200             ;        LODA,R0 *TEMP
40DD D400               ;        WRTE,R0 PORTA           Byte to EPROM
40DF 3F40FE             ;        BSTA,UN PULSE           Pulse programme bit
40E2 3F4063             ;        BSTA,UN INCR            Next address
40E5 9870               ;        BCFR,EQ NXTP            Loop if not finished
                        ;*Completed programming
40E7 3F4040             ;        BSTA,UN INIT            Clear Enable, Port A input
40EA 058F               ;        LODI,R1 MSSG3-MSSG0
40EC 3F412C             ;        BSTA,UN PMSSG           Print 'Completed'
40EF 05A5               ;        LODI,R1 MSSG5-MSSG0
40F1 3F412C             ;        BSTA,UN PMSSG           'and'
40F4 0532               ;        LODI,R1 50
40F6 0600               ;        LODI,R2 0
40F8 FA7E               ;        BDRR,R2 $               delay before verify
40FA F97C               ;        BDRR,R1 $-2
40FC 1B11               ;        BCTR,UN VER             Go to Verify programme
                        ;*
                        ;*Routine to generate a 50ms Programme Pulse
40FE 040B               ;PULSE   LODI,R0 SETPG
4100 D403               ;        WRTE,R0 CNTRL           Set Programme Pulse
4102 0632               ;        LODI,R2 50
4104 046E               ;DLY     LODI,R0 110
4106 FB7E               ;        BDRR,R0 $               1mS delay
4108 FA7A               ;        BDRR,R2 DLY             * 50
410A 040A               ;        LODI,R0 RSTPG
410C D403               ;        WRTE,R0 CNTRL           Reset Pulse
410E 17                 ;        RETC,UN
                        ;*
                        ;*Routine to Verify EPROM with the buffer
410F 0600               ;VER     LODI,R2 0               Loop of 256
4111 3F4053             ;VFY     BSTA,UN WRITE           Address to PPI
4114 5400               ;VRFY    REDE,R0 PORTA           EPROM data byte
4116 EC8200             ;        COMA,R0 *TEMP           Check byte
4119 980C               ;        BCFR,EQ VFERR           Error if not equal
411B FA77               ;        BDRR,R2 VRFY            Read 256 times
411D 3F4063             ;        BSTA,UN INCR            Next address
4120 986F               ;        BCFR,EQ VFY             Loop till TOP
4122 05B0               ;        LODI,R1 MSSG7-MSSG0
4124 1F403A             ;        BCTA,UN MOUT            Print 'Verified'
4127 05A9               ;VFERR   LODI,R1 MSSG6-MSSG0 or
4129 1F403A             ;        BCTA,UN MOUT            Print 'ERROR'
                        ;*
                        ;*Routine to Print a Message from the table
412C 0420               ;PMSSG   LODI,R0 SPAC
412E 3F02B4             ;        BSTA,UN COUT            print a space
4131 0D613A             ;POUT    LODA,R0 MSSG0,R1        fetch character
4134 14                 ;        RETC,Z                  end if a Null (0)
4135 3F02B4             ;        BSTA,UN COUT            else print character
4138 D977               ;        BIRR,R1 POUT            inct. pointer & loop
                        ;*Menu Table
413A 0D0A4550           ;MSSG0   DATA    CR,LF,A'EPP COMMANDS',CR,LF,LF
414B 432D2043           ;        DATA    A'C- Copy PROM into Buffer',CR,LF
4165 502D2050           ;        DATA    A'P- Programme PROM',CR,LF
4178 562D2056           ;        DATA    A'V- Verify PROM',CR,LF
4188 492D2049           ;        DATA    A'I- Initialise Buffer',CR,LF
419E 512D2051           ;        DATA    A'Q- Quit',CR,LF
41A7 00                 ;        DATA    0
                        ;*Messages
41A8 50524F4D           ;MSSG1   DATA    A'PROM not Erased',0
41B8 50524F4D           ;MSSG1A  DATA    A'PROM Erased',0
41C4 436F7079           ;MSSG2   DATA    A'Copy',0
41C9 436F6D70           ;MSSG3   DATA    A'Completed',0
41D3 50726F67           ;MSSG4   DATA    A'Programming',0
41DF 616E6400           ;MSSG5   DATA    A'and',0
41E3 4552524F           ;MSSG6   DATA    A'ERROR',BELL,0
41EA 56657269           ;MSSG7   DATA    A'Verified',BELL,0
41F4 494E5641           ;MSSG8   DATA    A'INVALID',BELL,0
                        ;*Data Buffer Address Set to 5000-57FF, length 2K
                        ;*
41FD 50                 ;BUFST   DATA    H'50'           Sets Buffer Start Address
41FE 57                 ;TOP     DATA    H'57'           Sets Buffer High End Add.
41FF FF                 ;        DATA    H'FF'           Sets Buffer Low End Add.
                        ;*
4200                    ;TEMP    RES     2               Temporary address
4202                    ;PGENF   RES     1               OE flag register
                        ;*
00 ERRORS DETECTED
```

EPROM Programmer HEX Listing.

```
4000   04 02 93 76 40 05 00 3F 41 2C 3F 00 8A 3F 40 40
4010   04 2B 3B 89 04 08 3B 85 3F 02 86 C1 3F 02 B4 E5
4020   43 1C 40 BB E5 50 1C 40 A2 E5 49 1C 40 7D E5 56
4030   1C 41 0F E5 51 1C 00 22 05 BA 3F 41 2C 1F 40 0A
4040   04 90 D4 03 20 CC 02 02 0C 01 FD CC 02 00 20 CC
4050   02 01 17 0C 02 01 D4 01 0C 02 00 44 0F 6C 02 02
4060   D4 02 17 0C 02 00 0D 02 01 EC 01 FE 1A 04 ED 01
4070   FF 14 D9 02 D8 00 CC 02 00 CD 02 01 17 04 FF CC
4080   82 00 3B 5F 98 77 05 8F 1F 40 3A 3F 40 53 54 00
4090   CC 82 00 3F 40 63 98 73 05 8A 3F 41 2C 05 8F 1F
40A0   40 3A 3F 40 53 54 00 E4 FF 9C 40 B5 3F 40 63 98
40B0   71 05 7E 1B 02 05 6E 3F 41 2C 3F 02 86 E4 0D 9C
40C0   40 0A 3F 40 40 05 99 3F 41 2C 04 10 CC 02 02 04
40D0   80 D4 03 04 09 D4 03 3F 40 53 0C 82 00 D4 00 3F
40E0   40 FE 3F 40 63 98 70 3F 40 40 05 8F 3F 41 2C 05
40F0   A5 3F 41 2C 05 32 06 00 FA 7E F9 7C 1B 11 04 0B
4100   D4 03 06 32 04 6E F8 7E FA 7A 04 0A D4 03 17 06
4110   00 3F 40 53 54 00 EC 82 00 98 0C FA 77 3F 40 63
4120   98 6F 05 B0 1F 40 3A 05 A9 1F 40 3A 04 20 3F 02
4130   B4 0D 61 3A 14 3F 02 B4 D9 77 0D 0A 45 50 50 20
4140   43 4F 4D 4D 41 4E 44 53 0D 0A 0A 43 2D 20 43 6F
4150   70 79 20 50 52 4F 4D 20 69 6E 74 6F 20 42 75 66
4160   66 65 72 0D 0A 50 2D 20 50 72 6F 67 72 61 6D 6D
4170   65 20 50 52 4F 4D 0D 0A 56 2D 20 56 65 72 69 66
4180   79 20 50 52 4F 4D 0D 0A 49 2D 20 49 6E 69 74 69
4190   61 6C 69 73 65 20 42 75 66 66 65 72 0D 0A 51 2D
41A0   20 51 75 69 74 0D 0A 00 50 52 4F 4D 20 6E 6F 74
41B0   20 45 72 61 73 65 64 00 50 52 4F 4D 20 45 72 61
41C0   73 65 64 00 43 6F 70 79 00 43 6F 6D 70 6C 65 74
41D0   65 64 00 50 72 6F 67 72 61 6D 6D 69 6E 67 00 61
41E0   6E 64 00 45 52 52 4F 52 07 00 56 65 72 69 66 69
41F0   65 64 07 00 49 4E 56 41 4C 49 44 07 00 50 57 FF
```

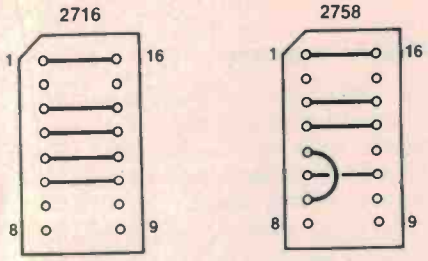


Figure 1 (left). Strapping of the personality module for 2716 programming.

Figure 2 (right). Strapping for 2758 programming.

Wiring the programming module plug

The program module required for the 2716 type EPROM is shown in Figure 1. The top and bottom link supply +5 V and the Vpp voltage to the EPROM socket. The other links supply the OE, CE/PG and A10 signals. Figure 2 shows the required module for a 2758 where the A10 input has been wired to 0 V.

The inclusion of the programming module has allowed this EPROM programmer to cater for a wide variety of EPROMs. It was not my intention that this project would be the design of a 'universal' EPROM programmer so I will not, at this time, go into the diverse software and module changes required to satisfy the programming requirements of the other types of EPROMs.

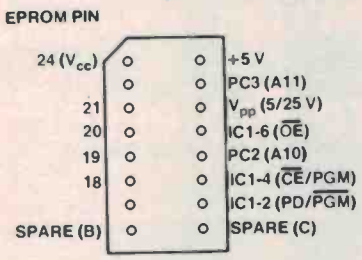


Figure 3. Module signals.

For those interested in experimenting I have included the following additional information. Figure 3 shows the signals available at the programming module and Figure 4 shows the timing of the signals generated by this software package. Most EPROMs require a similar 50 ms 'program pulse', but the timing and polarity of this and the other signals vary.

EPP Software

The program supplied occupies only 512 bytes of memory and uses a 2K block of RAM for a buffer. This buffer may be loaded from tape, disc or from another EPROM, or it may be loaded by the assembly of a source program under the control of an editor-assembler. Using the Microbyte 2650 Assembler, the command sequence to assemble a source program into the buffer memory at 5000 is to enter 'M.5000' to the prompt 'OPTION?'. The assembler will then assemble the source program using the 'ORG' statement for address calaculations, and insert the generated code into the EPROM buffer at H'5000'.

The location and length of the EPROM buffer is defined by three bytes at the end of the program. The start of the buffer is defined by the BUFST byte at 41FD, and the end is defined by the two bytes labelled TOP at 41FE and 41FF. These initially define a 2K buffer which commences at H'5000' and ends at H'57FF'. These locations can be altered if necessary and, to copy an EPROM already installed, they can be set to the address of the resident EPROM.

When the EPP program is run a menu is displayed illustrating the available software commands. The required EPROM programmer (EPP) command is selected by entering the appropriate single letter label. The following is a brief description of the operation of the five available commands in this simple EPP program.

The COPY routine

The Copy EPROM routine is used to load the contents of a pre-programmed EPROM into the buffer memory. As supplied, the routine reads the entire 2K into the buffer and the previous contents are lost. The copy routine can be used when copying EPROMs, disassembling programs or for listing the contents using a HEX lister. The routine is selected by keying in 'C' and, when the copy is complete, the routine will display the message 'Completed' and prompt with a '+' for another command.

The INITIALISE routine

This routine will erase the entire 2K buffer memory and fill it with the value H'FF'. When the routine is finished the message 'Completed' is displayed on the screen and the program will prompt for a new command. The Initialise routine is mainly used when part-programming is required (see following section) to prepare the buffer. This routine is selected by keying an 'I' and, when finished, the routine will display 'Completed' and return to the command level.

The PROGRAM routine

This routine is actually a dual purpose program and it includes a safeguard to prevent the inadvertant programming of an EPROM which you may have only wanted to copy. When selected with the command 'P' the routine first checks to see if the EPROM is erased. At the end of this test either the message 'PROM Erased' or 'PROM not Erased' will be displayed and the program will pause and await the entry of the 'Return' key. If any other key is entered the program routine is aborted and the prompt for a new command is displayed.

If the Return key is entered the program cycle commences. The message 'Programming' is appended to the previous message and, on the EPROM programmer board, the red LED is illuminated. The entire contents of the buffer memory (as defined by the start and end address) is now programmed into the EPROM.

At the end of the programming cycle the LED is extinguished and the message 'and' is appended to the previous message. The routine now enters the verify cycle where the contents of the EPROM at every address is read and compared 256 times with the appropriate contents of the buffer. This level of checking has been chosen for the detection of poorly programmed EPROMs. The loop count can be changed by altering the value of the byte at H'4110'. If an error is located the message 'ERROR' is displayed and the routine returns to the command level. A reprogram cycle can be introduced by reselecting the program cycle.

If the programming has been successful the message 'Verified' is displayed and the program returns to the command level. ▶

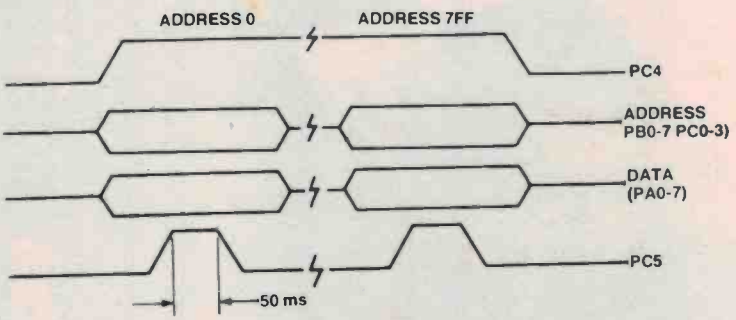


Figure 4. 2716 program cycle.

The VERIFY routine

The verify routine used at the end of the program routine can be selected separately with the command 'V'. This routine will either display the message 'Verified' or 'ERROR' and return to the command level. The verify program is particularly useful in comparing the contents of programmed EPROMs to determine if they are at the same revision level.

The QUIT routine

The input of the command 'Q' will cause the computer to exit from the EPROM programmer and return to the system monitor at H'0022'. The EPP program can be re-entered at any time with a G4000 command and, in both instances, the contents of the buffer memory will not be altered.

Programming example

The following is a typical display generated during the copying of a programmed EPROM. The first verify sequence has been selected to check that the correct data has been read into the buffer memory. As the COPY routine only reads each address once I have found that poor contact in the EPROM socket, due to bent or dirty pins, has caused occasional reading errors, but the verify has found them every time. Better safe than sorry. The second verify, after programming, is actually quite unnecessary.

EPP COMMANDS

C — Copy PROM into buffer
P — Program PROM
V — Verify PROM
I — Initialise buffer
Q — Quit

Part programming

Erased EPROMs contain the data byte 'FF' in every location and only logic 0s are actually programmed into an EPROM. Any attempt to program an 'FF' into an already programmed EPROM will not alter the contents. It is therefore possible to add to or alter the contents of a programmed EPROM, or to part-program an erased one by filling the buffer with 'FF' in the addresses where programming is not required.

The Initialise routine can be used to completely fill the buffer with 'FF' before the part-program is loaded into it. Of course, if the EPROM and the buffer contain different data, the Verify routine will report the message 'ERROR'.

EPROM erasure

Data written into an EPROM can only be erased by irradiating the memory element with ultraviolet light. The following manufacturers' warnings on erasure should be noted.

1. If an EPROM which has not been properly erased is programmed and used, writing problems and operating problems are likely to arise.
2. Excessively long erasure times (of several hours duration) can also result in failure.
3. Lengthy exposure to direct sunlight can result in programmed bit changes. Although normal fluorescent lights have practically no effect, it is recommended that the glass face be covered with a screening label.

With these warnings in mind, you should carefully read the operating instructions supplied with the EPROM eraser which you are using.

With all the information provided in this article you should now find programming your own EPROMS quick and efficient, and you will soon discover the advantages of having your very own computerised EPROM programmer. ●

64K SS50 STATIC NOW AVAILABLE $399 + TAX
64K S100 STATIC NOW AVAILABLE $399 + TAX
DON'T FORGET TO CHECK WITH US BEFORE YOU BUY A COMPUTER OR OTHER PRODUCTS

ROD IRVING ELECTRONICS

425 HIGH STREET, NORTHCOTE 3070. MELBOURNE. VICTORIA

MASSIVE PRICE CUTS ON BIG BOARD COMPUTER

64K SINGLE BOARD COMPUTER KIT NOW ONLY $499 +TAX.

S100 COMPUTER PRODUCTS

16K EPROM CARD-S 100 BUSS

$89.50 KIT

BLANK PC BOARD $49

USES 2708's

Thousands of personal and business systems around the world use this board with complete satisfaction. Puts 16K of software on line at **ALL TIMES!** Kit features a top quality soldermasked and silk-screened PC board and first run parts and sockets. Any number of EPROM locations may be disabled to avoid any memory conflicts. Fully buffered and has WAIT STATE capabilities.

OUR 450 NS 2708'S ARE $5.90EA. WITH PURCHASE OF KIT

ASSEMBLED AND FULLY TESTED ADD $36

32K S-100 EPROM CARD

NEW!

$99.95

KIT
USES 2716's
Blank PC Board — $59
ASSEMBLED & TESTED ADD $30

SPECIAL: 2716 EPROM's (450 NS) Are $5.90 EA. With Above Kit.

KIT FEATURES
1. Uses +5V only 2716 (2Kx8) EPROM's
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible.
4. Addressable as two independent 16K blocks
5. Cromemco extended or Northstar bank select
6. On board wait state circuitry if needed
7. Any or all EPROM locations can be disabled
8. Double sided PC board solder-masked, silk-screened
9. Gold plated contact fingers
10. Unselected EPROM's automatically powered down for low power
11. Fully buffered and bypassed
12. Easy and quick to assemble.

• • • AVAILABLE AGAIN • • •

- 16K Dynamic Ram Board
- Fully Expandable to 64K
- Assembled, tested and guaranteed
- S100 Compatible

16K Dynamic RAM Board assembled and tested. Special $269 plus tax (4mHz) $298 plus tax (4mHz) This must be the best offer available on quality tested dynamic RAM boards.

32K Assembled and tested $289 plus tax (4mHz)
48K Assembled and tested $309 plus tax (4mHz)
64K Assembled and tested $329 plus tax (4mHz)

16K STATIC RAM KIT-S 100 BUSS

KIT $179
A&T $199

KIT FEATURES
1. Addressable as four separate 4K Blocks
2. ON BOARD BANK SELECT circuitry (Cromemco Standard) Allows up to 512K on line
3. Uses 2114 (450NS) 4K Static Rams
4. ON BOARD SELECTABLE WAIT STATES
5. Double sided PC Board with solder mask and silk screened layout. Gold plated contact fingers
6. All address and data lines fully buffered
7. Kit includes ALL parts and sockets
8. PHANTOM is jumpered to PIN 67
9. LOW POWER under 1.5 amps TYPICAL from the +8 Volt Buss
10. Blank PC Board can be populated as any multiple of 4K

BLANK PC BOARD w DATA $55
LOW PROFILE SOCKET SET $22
SUPPORT IC'S & CAPS $29
ASSEMBLED & TESTED ADD $30

OUR #1 SELLING RAM BOARD!

16K STATIC RAM SS-50 BUSS

PRICE CUT!

$199 KIT
A&T $219

FULLY STATIC AT DYNAMIC PRICES

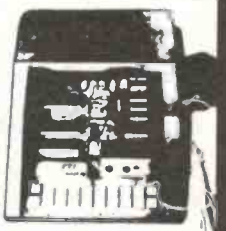
32K STATIC ALSO AVAILABLE

KIT FEATURES
1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Runs at Full Speed
4. Double sided PC Board Solder mask and silk screened layout Gold fingers
5. All Parts and Sockets included
6. Low Power Under 1.5 Amps Typical

FOR SWTPC 6800 BUSS!

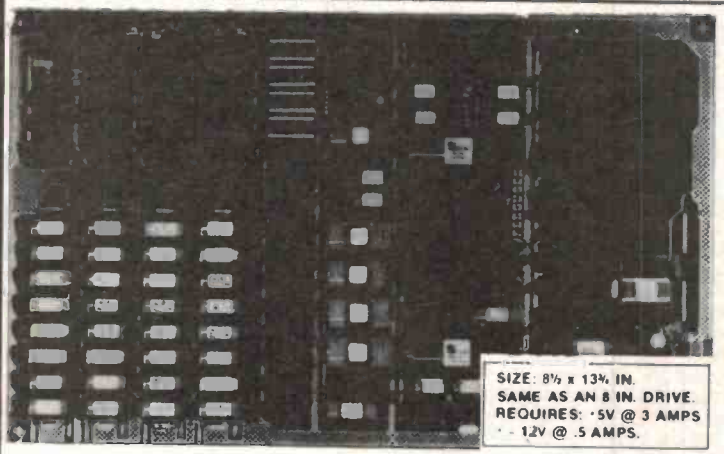
BLANK PC BOARD — $49 COMPLETE SOCKET SET — $22 SUPPORT IC'S AND CAPS — $45

ETI 660 THE $99 COMPUTER!



FEATURES INCLUDE
Colour capability, operates from optional 9 V plugpack. 1K memory expandable to 3K on-board, single-board construction, cassette interface, audio output, simple to program (uses Chip-8). Expansion projects coming up include ASCII keyboard, light pen, games software etc.
Starter Kit (1K RAM, B&W Video) $99.00
9 V, 1 amp plug pack to suit $12.50
Colour video option $13.50
RAM Expansion (add to PCB) $16.00

ETI636 7 SLOT MOTHERBOARD WITH ACTIVE TERMINATION
Kit of Parts $89.00. Assembled and tested $115.00, inc tax.
RITRON COMPUTER GRADE POWER SUPPLY: +5V Reg. 10A, ± 16V Unreg. Kit of parts $89.90 inc tax A&T $109.00 inc tax
Write for list of other power supplies. Tax free prices also available.



SIZE: 8½ x 13¾ IN. SAME AS AN 8 IN. DRIVE. REQUIRES: +5V @ 3 AMPS +12V @ .5 AMPS.

SINGLE BOARD COMPUTER KIT NOW ONLY $475 Including tax ($435 tax exempt)

Also available: Blank PCB's with Roms $275 + Tax.
Assembled & Tested $599 inc. tax.

THE FERGUSON PROJECT: Three years in the works, and maybe too good to be true. A tribute to hard headed, no compromise, high performance, American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M®. Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8 inch disc drives, power supply, and an enclosure; and you have a total Business System for about 1/3 the cost you might expect to pay.

FEATURES: (Remember, all this on one board!)

64K RAM

Uses industry standard 4116 RAM'S. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.

24 x 80 CHARACTER VIDEO

With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true.

Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERUPTS. Fully buffered and runs 8080 software.

SERIAL I/O (OPTIONAL)

Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 Int. Price for all parts and connectors: $65

FLOPPY DISC CONTROLLER

Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M® 2.2.

BASIC I/O

Consists of a separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

FOUR PORT PARALLEL I/O (OPTIONAL)

Uses Z-80 PIO. Full 16 bits, fully buffered, bi-directional. User selectable hand shake polarity. Set of all parts and connectors for parallel I/O: $29

REAL TIME CLOCK (OPTIONAL)

Uses Z-80 CTC. Can be configured as a Counter on Real Time Clock. Set of all parts: $19

PFM 3.0 2K SYSTEM MONITOR

The real power of the Big Board lies in its PFM 3.0 on board monitor. PFM commands include: Dump Memory, Boot CP/M®, Copy, Examine, Fill Memory, Test Memory, Go To, Read and Write I/O Ports, Disc Read (Drive, Track, Sector), and Search. PFM occupies one of the four 2716 EPROM locations provided. It does not occupy any of the 64K of system RAM!

Bankcard Mail Orders Welcome

ETI 10/82/4

Please debit my Bankcard
Bankcard No.
Expiry Date
Name
Signature

General enquiries (03) 489-8131. Mail order enquiries (03) 481-1436. Ritronics Wholesale (03) 489-7099. (Tax Exempt Enquiries)

Prices subject to change without notice. Send 60¢ and SAE for free Price lists. MAIL ORDERS PO BOX 235, NORTHCOTE, Vic. 3070. Minimum pack and post $5.00. Telex AA38897.

PLEASE WRITE OR RING FOR THE BEST POSSIBLE PRICES ON DISC DRIVES, PRINTERS AND OTHER COMPUTER COMPONENTS.

Versatile speech synthesiser

Part 2

This second and last part of the Turtle Talk speech synthesiser project covers interfacing the board to a computer and programming techniques.

Allan Branch
Flexible Systems, Hobart, Tasmania

NOW THAT you have your speech synthesiser up and talking with a set of switches, as described in the last article, you'll want to know how to connect it to your computer firstly, and then how to program it. We can only describe interfacing in a general way as computer I/O ports differ from machine to machine.

The MM54104 speech processor requires a number of control signals as well as data representing the word to be said. The ETI-647 board has circuitry allowing interfacing to the majority of computer parallel ports. There are two completely different ways that you can connect to the board. You simply connect to different ports on the board and include or exclude ICs depending on which way suits you. The two methods are called 'direct control' and 'control data'.

Direct control

Most parallel ports on computers supply sufficient data, address and control signals to the user to drive the Turtle Talk Speech Synthesiser directly. If your computer has the following signals supplied to pins of the user port or expansion port then you will be able to connect the board without any requirements other than a short length of cable and a soldering iron.

(i) eight data bits
(ii) five address bits
(iii) read/write line
(iv) device enable, port enable, in/out request lines or more address bits.

Connection is via J2 and J3 located either side of IC16's position on the board. ICs 18, 17, 16 and 15 are not used and should be removed from their sockets if you have them in place. Table 2 lists the signals and functions of each line in J2.

These signals from the data buss of your computer will dictate what word is to be said (no pun intended). They are unidirectional signals going to the speech synthesiser board so computer ports having separate in and out data busses will only use the out data signals.

Tables 3 and 4 show the functions and operations of each line in J3.

The *speak* signal comes from the write signal from your computer and must be active low. If you have a read/$\overline{\text{write}}$ or a $\overline{\text{WR}}$ signal then this can be used. You have to invert the signal from your computer if the signal is $\overline{\text{read}}$/write or WR or $\overline{\text{RD}}$.

The *busy* (or 'talking') signal on line 1 of J3 is used for handshaking between the speech synthesiser board and the computer. Since any speech machine will obviously be operating in real time and a computer could run through a thousand word addresses in a fraction of a second, it is necessary to slow the computer up. i.e: "Don't interrupt while I'm still talking". If you have an interrupt facility and want to use it then connect this busy signal to your computer's interrupt line and use a wait routine in your software.

Alternatively, you might have separate in-data and out-data signals available on your computer parallel port. Use the in-data 0 pin so that simpler programming can do the handshaking. If neither of the above options are suitable

J2 (line no.)	FUNCTION (word add. bit)	SIGNAL (from computer)
1	SW8	D7
2	SW7	D6
3	SW6	D5
4	SW5	D4
5	SW4	D3
6	SW3	D2
7	SW2	D1
8	SW1	D0

Table 2. **The functions of the J2 interface lines and the signals required. SW1-8 refer to the word address lines in Table 1 (Part 1, Master Word List). As the table shows, these can be hooked directly to your computer's data buss.**

J3 (line no.)	FUNCTION performed	SIGNAL (from computer)
1	Busy (talking)	Data In or Int.
2	Board select	A6
3	Command select	A5
4	Speak	read/write
5	ROM select	A3
6	C ROM	A2
7	B ROM	A1
8	Mute	A0

Table 3. **The functions of the J3 interface lines and the signals produced or required. The ROM B, C and select lines determine which of the four word lists is selected. Each word list is contained in two ROMs and up to eight ROMs, making a total of four word lists, can be accommodated on-board. Table 4 shows the logic for word list selection.**

ROM Select (J3/5)	C ROM (J3/6)	B ROM (J3/7)	List selected
H	X	X	Clear
L	L	L	List 1
L	H	L	List 2
L	L	H	List 3
L	H	H	List 4

Table 4. **The logic for selecting the word list ROMs. Two bits (J3, lines 6 and 7) are used to select the appropriate ROM pair while the ROM select line (J3, line 5) is held low. When this line is held high, it doesn't matter what signals appear on lines 6 and 7 (hence the X in the first row of Band C ROM columns). The ROMs are then readied for the list to be selected.** ▶

then don't connect anything to J3/1. It is still extremely easy to generate delays in the programming without handshaking. See the 'programming' section for these details.

Control data

This method will allow a bidirectional data buss to be used to control all of the speech synthesiser functions. The data signals are routed through unidirectional buffers to respective points by selecting different addresses. Connection this time is through J1 and ICs 18, 17, 16 and 15 must be plugged into their respective sockets. Table 5 lists the signals required by, and functions of, each line in J1.

Most computers will be connected this way since interfacing and programming are easy for the beginner and most ports on hobby computers are bidirectional.

An 8-bit code is presented at J1/1 to J1/8 to select the word required. J1/9-J1/11 used to select the correct address for this data to be stored by IC16. Next, another code, selected according to all the control signals required (as for J3), is presented to J1 and the correct address for this data is determined by J1/9-J1/11 so that it is latched by IC15. Speech is initiated when a third code, also a control code, is presented and latched in such a way that the $\overline{WR}$ line of the speech processor (pin 4) is toggled. i.e: taken low then high.

The 8-bit data bytes are directed to various destinations by the control signals A0, R/$\overline{W}$ and $\overline{DE}$ according to Table 6.

A0	R/$\overline{W}$	$\overline{DE}$	
X	X	H	board not selected
L	L	L	control byte (data 2)
H	L	L	word byte (data 1)
L	H	L	busy byte (data 3)
H	H	L	not used

Table 6. **Control signal logic on J1. (Note that X = 'don't care'.)**

The control byte (*data 2*) is the set of functions normally selected through J3, and the word byte (*data 1*) is used to select the word to be spoken. The busy byte (*data 3*) uses a single bit for the handshaking between the speech board and computer. All of these commands are introduced above in the Direct Control section and will be covered thoroughly in the programming section. The terms *data 1*, *data 2* and *data 3* for each of the three bytes are from the way they are used when programming. For example: POKE W+1,X will select the word with code number X from the vocabulary list when the speech synthesiser board is located at address W.- i.e: POKE W +1,0 will cause it to say "This is Digitalker". Or, POKE W+1,128 will have it say "right".

J1 (line no.)	FUNCTION	SIGNAL (from computer)
1	data I/O 0	D0
2	data I/O 1	D1
3	data I/O 2	D2
4	data I/O 3	D3
5	data I/O 4	D4
6	data I/O 5	D5
7	data I/O 6	D6
8	data I/O 7	D7
9	address 0	A0
10	read/$\overline{write}$	R/$\overline{W}$
11	device enable	$\overline{DE}$, I/O sel. etc.

Table 5. **Signals and functions for J1. This is the 'general purpose' interface port for the ETI-647 Turtle Talk speech synthesiser.**

Programming

Even the most inexperienced programmer will have few problems getting the ETI-647 Turtle Talk Speech Synthesiser to talk. All programming depends on simple POKE and PEEK or OUT and INP instructions. To say a word simply requires the programmer to know the code number for the word and which vocabulary list it is on (which ROM pair). This requires only three instructions, all of which can be placed on the one line:

POKE W, A: POKE W + 1, 8: POKE W + 1, 16 + (2 * B)

Where A is the code number for the word and B is the number of the ROMs the word is in. B will be 0, 1, 2 or 3 and the standard vocabulary list is ROM pair number 0. Hence, to say the word "GREAT" requires:

POKE W, 88: POKE W + 1, 8: POKE W + 1, 16

(W is the address of the Turtle Talk board.)

To prevent the Turtle Talk from trying to say words on top of each other is also a simple programming task:

100 IF PEEK (W + 1) < 255 THEN 100

This program line will cause the program to stay on the line until the word is finished being said.

The Turtle Talk board offers many other options which are discussed fully later, but they are just as easy to use, making the synthesiser very versatile indeed. The above examples provide the means to get the board up and talking immediately.

Command modes

The ETI-647 board utilises the CMS (Command Mode Select) facility of the Digitalker speech processor. This allows the programmer to select one of two modes:

(i) Reset the speech and initiate a new word,
(ii) Reset the speech only.

The interconnection of different word parts becomes possible by using the start of the word only.

Interrupt

Similarly, the interrupt facility is available to the programmer so that the next word can follow closely after the finish of a word. A programmer can also use delay loops to achieve the required timing for spacing between words.

Mute

The ETI-647 is the only speech synthesiser in the world, so far as we know, allowing the programmer access to the end or middle parts of words generated by the Digitalker speech processor. The versatility available with this facility makes the Turtle Talk possibly the most powerful speech generation system available to date.

Using the mute facility, words other than those in the ROM vocabulary can be 'constructed' from the existing vocabulary words.

Direct control programming

How you program the speech synthesiser depends somewhat on how you've interfaced it to your computer. Direct Control interfacing provides you with a range of options. The 'full' system, detailed in Figure 7, requires eight data bits at J2 — called data 1, which is your word byte or word data — plus seven address inputs at J3 (data 2, the SPC control data) and an output — data 3, an interrupt signal ('busy'). This is the 'all singing, all dancing' way to go about it. There is a gut-simple way to do it, because:

(i) The MUTE function is optional
(ii) The INTERRUPT function is optional
(iii) The COMMAND select function is optional
(iv) If only the Master Word List is used, the two ROM address select

STOP PRESS! — see page 51 for kit availability

lines and the ROM select line (A1/A2/A3, J3 5/6/7) are unused.

Thus, your minimal system will look like Figure 8. To program a system like Figure 8 you simply POKE the desired word number at the board address, as follows:

POKE W,A
where W = board (I/O) address
A = word code number (from Table 1)

To string words together, you program a word, then a wait loop, then the next word, etc. It's sort of cumbersome, but for short 'messages', it's fine and fulfils all the requirements of the KISS theory of machine design — '... keep it simple, Sam'.

To program a system implemented as in Figure 7 requires a bit more thought, but gives much more power. Firstly, your speech synthesiser board has two WRITE addresses and a READ address. Table 7 shows how the various functions are related to the write and read address forms.

ADDRESS	DATA	FUNCTION	R/W
W	data 1	word select	write
W + 1	data 2	control SPC	write
R	data 3	interrupt	read

Table 7. Relation between the three data groups, their functions and read/write addresses.

The role of data 1 has already been mentioned. Data 2 is used to control the speech synthesiser chip (SPC). The relationship between the data 2 lines in J3, their functions, values for addressing and states are illustrated in Table 8. Following is how to use the instructions (W is the address of the board):

To initiate speech

You set the ROM select and write lines on J3 high. Like this:

POKE W + 1, 8
POKE W + 1, 16

All other lines will be low and thus, word list 1 is selected and the mute is off.

To select word list 2 when initiating speech:

POKE W + 1, 8
POKE W + 1, 18

This sets your ROM select, B ROM and write lines.

Initiate speech, mute on

You set the ROM select, write and mute select lines high:

POKE W + 1, 8
POKE W + 1, 17

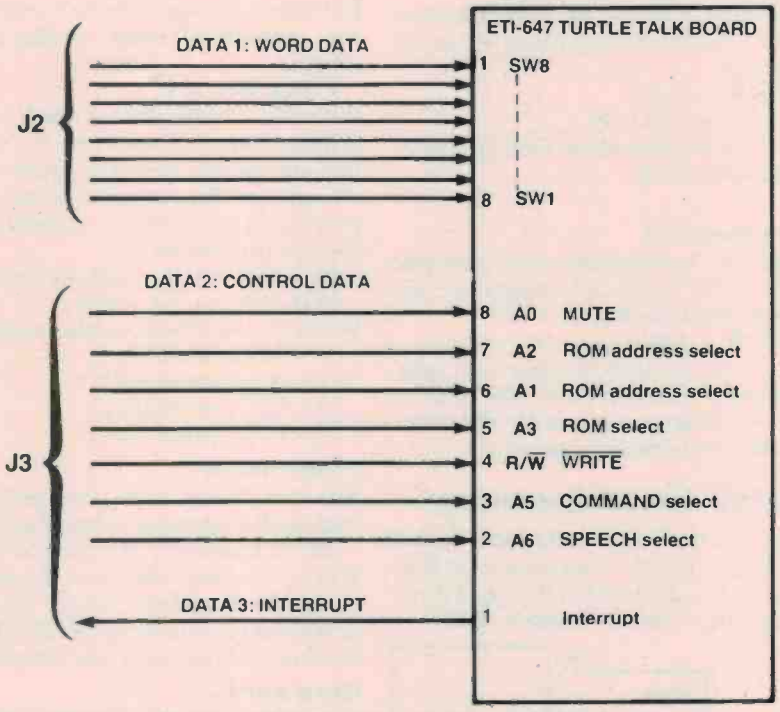


Figure 7. The synthesiser interfaced via J2 and J3, showing the role of each line.

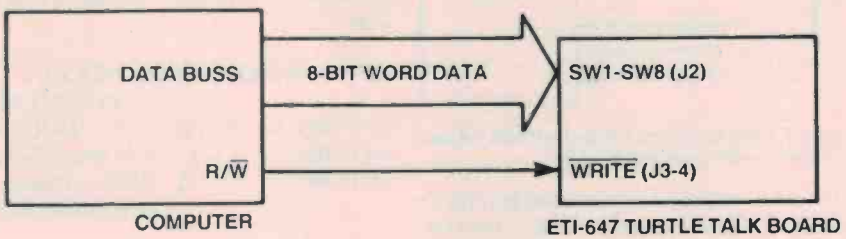


Figure 8. A 'minimal' system.

DATA 2 FUNCTION	DATA VALUE	STATE	ACTION
Mute select	1	0 1	speech on speech muted
B ROM address	2	see table 4	
C ROM address	4	see table 4	
ROM select	8	0 1	set ready to select
Write	16	0 1	write reset write set
Command select	32	0 1	reset and start speech reset only
Speech select	64	0 1	speech on speech off

Table 8. Using data 2. Note the following:
(a) The ROM select bit must be ready to select then set (see Table 4).
(b) The Write bit must be reset then set every time.
(c) The Speech select bit must be low during operation of the board.
(d) ROM address, Command select and Mute are able to be used whenever needed during, after or before speech generation.

Command select, reset only
This is pretty simple, set the ROM select (value 8) and command select (value 32) lines high:
POKE W + 1, 40
Get it? — 8 + 32 = 40.

We'll talk more about using the command select later.

Turn board off
There will be occasions when you need to turn the board off. Simply set the speech select line high:
POKE W + 1, 64

We'll get around to some 'real' programming shortly, First, it's time to look at what goes on with the other method of interfacing using J1.

Control data programming

If you're interfacing via J1 you'll have a system set up like that shown in Figure 9 with eight data I/O lines and three control lines (hence 'control data') —

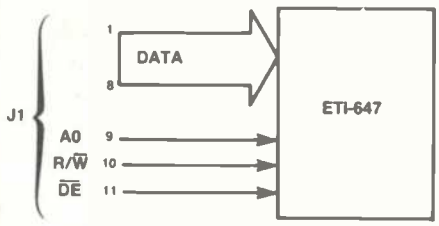


Figure 9. **Interfacing via J1. Note that lines 1-8 can be used for both input and output.**

A0, read/write and device enable (or I/O select). These three lines control whether you're sending data to the Turtle Talk board — data 1 (word code) or data 2 (SPC control), or reading data from the board — data 3, the interrupt or busy signal. Table 6 shows the logic. Note the following:

(i) It is possible to tie the DE line low so that the Turtle Talk board is on call at all times.

(ii) If the interrupt facility is not needed then the read/write line can be tied low setting the board such that it is always ready to accept data.

(iii) The A0 line can be any line from your computer, or even a switch, that can toggle J1/9 high or low as required. Programming requirements are simple.

To write to data 1
Your simply POKE the appropriate word code number at the board's address:
POKE W, A
Where W = board address and A = word code number from the appropriate word list. To select the appropriate word list (ROM pair), you write to data 2.

To write to data 2
For this, you look at Table 8 and POKE the appropriate value at the data 2 address:
POKE W + 1, V
Where W = board address and V = value of data 2 function (see Table 8). You can initiate speech, turn the mute on and off, operate the command select etc, as previously explained. In general terms, this is what you do:
POKE W + 1, 8 . . .initiate speech
POKE W + 1, (16 + 2B)
Where B = ROM pair number as follows:
0 = IC2-3 (word list 1)
1 = IC4-5 (word list 2)
2 = IC6-7 (word list 3)
3 = IC8-9 (word list 4)

To use data 3
You look to see if the data being sent back to the computer is less than 255:
100 IF PEEK (R) < 255 THEN 100
Where R = read address of Turtle Talk board. The board will return 127 if it is in the process of talking and 255 if it has finished talking and while it is silent.

Say a word
A complete program to cause a word to be generated would look something like this:

```
10 W = XXXXX : REM XXXXX =
                        BOARD ADD.
20 POKE W, 78 : REM 78 = "DOLLAR"
30 POKE W + 1, 8 : REM ready board
40 POKE W + 1, 16 : REM initiates
                        speech from ROM 0
```

Command modes

The ETI-647 Turtle Talk board provides the programmer with the facility to use the CMS (Command Mode Select) function of the Digitalker system. The facility provides the ability to reset the speech processor, hence stopping whatever speech was occuring. The programmer can then either start a new utterance immediately, thereby generating a new word by compounding words and parts of words or just cease further utterance, generating a new word from part of an existing word. e.g:

```
COMMA
      POUND
 = COMPOUND
```
or
```
AMPERE
 = AMP
```

When a second word is programmed after using the command selection, a new word is formed by the 'phoneme reconstruction' method or by using the first word part as a prefix. For example:

```
HAVE
VOLT
     SS
     PETER
= HOLSTER
```

When using the Command Mode Selection function the ROM select line must be held high. In BASIC, the instructions for CMS on and CMS off are like this:

For convenience, if CMS is on, we say that the command mode is on.

To page 88 ▶

(a) with CMS off

```
POKE W, 74              — "COMMA"
POKE W + 1, 8           — CMS off, initiate speech
POKE W + 1, 16          — ROM pair 0
FOR T = 1 TO TT: NEXT T — adjust TT for "COMM"
POKE W, 123             — "POUND"
POKE W + 1, 8           — CMS off, initiate speech
POKE W + 1, 16          — ROM pair 0
```

(b) with CMS on

```
POKE W, 74              — "COMMA"
POKE W + 1, 8           — CMS off, initiate speech
POKE W + 1, 16          — ROM pair 0
FOR T = 1 TO TT: NEXT T — adjust TT for "COMM"
POKE W + 1, 40          — CMS on, ROM select on
POKE W + 1, 123         — "POUND"
```

ZX80-81 16K RAM PACK ONLY $98.00

SICK OF GAMES?? NOW DO SOMETHING WITH YOUR ZX

PORT CARD: 8 input 8 output: $38.50

With simple Peek-Poke BASIC instructions, control, leds, relays, displays, our new peripheral cards, the ETI 647 Speech Synthesiser (see page 81 this issue) and MUCH MORE! Just plug in the back of your ZX and it's ready to go. Supplied complete with 10 pages packed with application programs and data. The Port Card operates alone on the 1K ZX or simultaneously with extra Ram and/or Printer via built in expansion plug.

NEW: Available now! These cards operate with our (or any) 8 bit Port Card.

MUSIC GENERATOR: $68.00

Monophonic, with programmable notes, note duration, vibrato, glide and Envelope shaping. Wide tone variation from triangle to sine wave and easy to programme.

ANALOGUE TO DIGITAL CONVERTER: 8 bit resolution $39.00

Convert your ZX into a datalogger or digital voltmeter.

DIGITAL TO ANALOGUE CONVERTER: 8 bit resolution $32.00

Control Faders, Light Dimmers, Music Synthesiser and other Analogue circuits.

ALL HARDWARE RUNS ON ZX80 4K or 8K ROM and ZX81, with or without extra RAM and/or printer (state which). All products guaranteed and supplied ready to go, with comprehensive application data and software.

Send S.A.E. for free information. Mail order only, add $1 P&P.

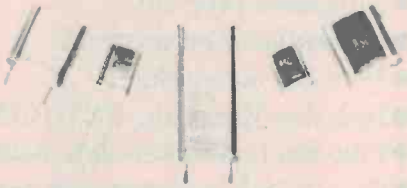
ZX81 STAR TREK $10
Requires 8K RAM
Supplied on cassette with listing.

T. J. PERIPHERALS 9/140-148 Crimea Rd., Marsfield, NSW 2122 41 Olympic Ave., Cheltenham, Vic. 3192

Bright Star Crystals Pty. Ltd.

PO Box 42, Springvale.
Ph (03) 546-5076 Telex AA36004

36 years in the business



AND STILL ON TOP

Manufacturers of

PIEZO ELECTRIC CRYSTALS

Contractors to Federal and State Government Departments.

REPRESENTATIVES:
NSW: Master Communications, 27 Woodville Rd., Granville N.S.W. (02) 682 5044.
SA: R.W. Electronics, 51 Woodville Ave., Riddleton S.A. (08) 464 571.
QLD: Fred Hoe & Sons P/L, 246 Evans Rd., Salisbury North, Brisbane. (07) 277 4311.
WA: Westest Electronics, 71 Jean St., Hamilton Hill 6161 (Mail Only) (09) 337 6393.
TAS: Dilmond Industries, PO Box 219, Bellerive, Hobart. (002) 47 9077.

CRYSTAL UNITS

- Decade Counting Units to 1 Hz.
- Wide Band Amplifier for your counter, 1MV sensitivity, band width 1-250 MHz.

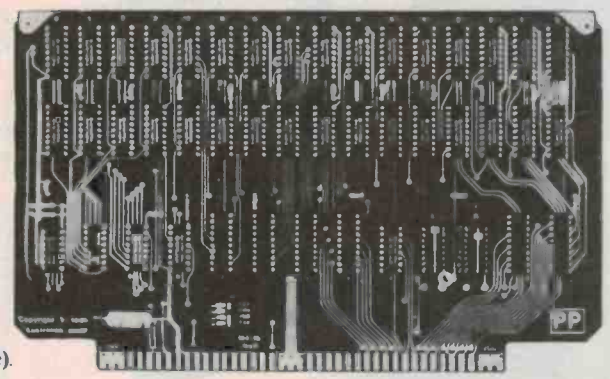
Send SAE for new catalogue or quote for your requirements.

RAM SPECIAL

16K Static Card for Motorola EXORBUS

Suitable for 6800, 6809, 6522.

- Uses 2114 1Kx4 RAMs
- Fully Buffered
- Two 8K Switch Addressable Blocks
- PCB Plated through, resist both sides
- Complete documentation



$79 PCB only

$99 PCB plus support ICs kit

$189 Full kit with Low Power 300ns RAMs

$4 Delivery. (Add 17½% if Sales Tax applicable).

PP Pennywise Peripherals

96 Camberwell Road, Hawthorn East, Vic. 3123.
PO Box 398, Camberwell, Vic. 3124. (03) 82 2389
MICROCOMPUTER EQUIPMENT

"Why buy just a video game when you can get a full colour computer for this price."

A computer like this would have been science fiction a few years ago. Now it's a reality. It's the Commodore VIC-20, a full-fledged, expandable colour computer that costs little more than video games.

Everybody loves video games and the VIC-20 has some of the best. But the Commodore VIC-20 can also help the kids with their homework and mum with her budgeting. Dad can even take the light, portable VIC-20 to the office for financial and business applications.

And Commodore has many more applications on the way.

With Full Capability For:

- Education programs
- Recreational programs
- Personal computing
- Includes Microsoft, PET BASIC
- Full-size typewriter-style keyboard
- Easy to follow instruction manual
- Memory expansion to 32K RAM
- Connects to any TV set
- 66 graphic characters
- 25K total memory
- 4 sound generators
- 16 colours

VIC-20
The computer for everyone.

The VIC-20 is the friendliest way we know to learn computing. It has a full computer keyboard even a small child can operate.

It plays music, has exciting graphics and lets you create pictures. It even tells you when you've made a mistake and how to correct it. The VIC-20 can take your children from pre-school through post-graduate studies.

Why get just another game that could end up in the closet? Get an honest-to-goodness computer for just $399. Get the Commodore VIC-20.

Learn more about Commodore, the micro-computer you can depend on. Call or write for the name and location of your Commodore dealer nearest you.

The Commodore Information Centre,
3 Campbell St., Artarmon NSW 2064. Phone: 437 6296.

commodore COMPUTER

MLVL1460a

Apple software from Micro-Educational

AUSTRALIA'S LEADING APPLE MAIL ORDER SUPPLIER SINCE 1979

WRITE OR PHONE NOW FOR
☐ FREE 20 Page Catalog
☐ FREE Copy SOFTALK magazine

Q: Why do one in five Australian Apple owners buy software and peripherals from Micro-Educational?

A: We offer (1) wide range (2) quality products (3) fast delivery (4) expert advice (5) money-back warranty (6) personal service (7) value for money (8) convenient ordering by Phone, Bankcard or Mail.

If you are an Apple owner why not join our thousands of satisfied mail and phone-order clients. Write or phone now for our free 20 page catalogue, (We carry over 320 products for the Apple) and we will send you a free copy of SOFTALK, the US magazine devoted entirely to Apple software. But hurry, we have only 1000 to give away.

Software supplied by IMAGINEERING

BEST SELLERS

BUSINESS

VISICALC. The world's top-selling modelling spreadsheet $375

VISISCHEDULE. Critical path analysis of complex jobs. Includes costing, time-slip, rescheduling, etc. $395

VERSAFORM. Flexible forms data base generator. Covers invoicing, receipts, orders, delivery dockets, statements, etc. User designed. $440

PFS. Top-selling, easy-to-use card-index system. Retrieve on any criterion or combination. Sophisticated reporting. $150

GAMES

CHOPLIFTER. The best new computer game around. Fantastic Graphics	$34.95
BANDITS	$35.95
APPLE PANIC	$32.95
DAVIDS MIDNIGHT MAGIC	$39.95
FALCONS	$32.95
FROGGER	$35.95
GORGON	$43.95
RASTER BLASTER	$32.95
SNAKE BYTE	$32.95
SNACK ATTACK	$32.95
SNEAKERS	$32.95
THRESHOLD	$43.95
TWERPS	$32.95

ADD $2 Min postage.

SIMULATIONS & ADVENTURES

FLIGHT SIMULATOR The original and best	$39.95
TIME ZONE (HIRES 5) The ultimate adventure on 4 double-sided disks	$120.00
WIZARDRY Top-selling 3-D dungeons and dragons	$57.50
HIRES GOLF	$32.95
MONOLOPY	$34.95
CASINO	$45.95
CASTLE WOLFENSTEIN	$32.95
NAPOLEONS CAMPAIGNS	$69.00
POOL 1.5	$39.95
SARGON CHESS	$39.95
SOUTHERN COMMAND	$44.95
TIGERS IN THE SNOW	$45.95
ZORK	$43.95

HARDWARE

(Add 17½% S. Tax if applicable)

STAR PRINTER + I/F	$715.00
VISION-80 COL CARD	$295.00
DIGITEK 16K CARD	$179.00
DIGITEK Z-80 CARD	$230.00
DIGITEK COLOUR CARD	$215.00
DIGITEK SERIAL CARD	$180.00
DIGITEK PARALLEL CARD	$180.00
SATURN 128K RAMCARD	$695.00
PADDLES	$44.95
JOYSTICK	$69.95

WORD PROCESSING

SANDY'S WORD PROCESSOR Great value at	$175
ZARDAX Top value at	$295

EDUCATION

M.I.T. LOGO Just released. Includes 2 manuals	$230
CARTELS & CUTTHROATS Excellent economics simulation	$45.95

SPECIAL

NASHUA DISKS	$39.95

GRAPHICS

COMPLETE GRAPHICS SYSTEM	$78.50
BUDGE GRAPHICS	$48.95
A2-3D1	$79.50
GRAPHICS MAGICIAN	$65.95

UTILITIES

APPLE-CILLIN. Complete Apple diagnostics pack	$59.95
DOS BOSS	$37.50
BAG OF TRICKS	$49.95
UTILITY CITY	$35.95

Yes! I would like to join the 5,300 Apple owners on your mailing list. Please send me ☐ a free SOFTALK. ☐ Your free winter catalogue
☐ The following goods with 10 days money back warranty if I don't like them

.....

.....

(Plus $2 post NSW $3 elsewhere)
☐ Bankcard or ☐ cheque enclosed
Bankcard number
☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Name .....
Address .....
..... Postcode .....

For our free catalog and a free SOFTALK Magazine send attached coupon or write to:
MICRO-EDUCATIONAL, 17 PARK ROAD,
GARDEN SUBURB, NSW 2288. Ph: (049)43 6805

*Apple, Apple II and Applesoft are registered trademarks of Apple Computer Inc.

Mute

Using the mute you can select parts of words other than at the start of a word. The Command Mode selection allows the programmer to determine what length of the start of a word is spoken. When this is used in conjunction with the mute control, any part of a word, from someplace in the word to the end of the word, can be selected. There is no other system available for general use with these features associated with set vocabularies.

With synthesisers employing phoneme reconstruction techniques, the programmer soon finds that a wide knowledge of linguistics is required before any progress can be made. Phonemes, by definition, are part of words which are perceived as discreet units.

Quite different sounds are often perceived as being identical when spoken within a word and therefore constitute a single perception called a phoneme. This can be demonstrated quite dramatically by editing spoken words from tape recordings to isolate parts of the words.

To construct a word from another word using the mute control you need know nothing about phonemes, linguistics or articulation. Simply select the particular sound by vocalising the word you want, then look for a word in the vocabulary having that sound.

The method of actually constructing the word is then quite simple. Suppose a word is represented by a rectangle:

The speech synthesiser will take time, Tt, to say the word. To mute a period, Ts, at the start of the word, first generate a time delay with a simple FOR-NEXT loop:

```
FOR T = 1 TO TT: NEXT T
```

The variable TT is adjusted until Ts is of the right length. The mute is operated by setting the Mute Select function in data 2 high, like this:

```
POKE W + 1, 1
```

After the required time you need to turn the mute off again, like this:

```
POKE W + 1, 0
```

Now, the normal instructions for initiating a word are:

```
POKE W, A : REM A=WORD NO.
POKE W + 1, 8
POKE W + 1, 16 + (2*B) :
REM B=ROM PAIR
```

With the mute control you can initiate a word but keep it silent like this:

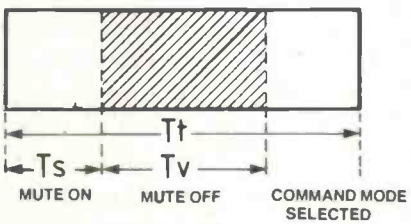
```
POKE W, A
POKE W + 1, 8
POKE W + 1, 16 + (2*B) + 1 : REM +1
                        SETS MUTE
```

The mute can be on for whatever time is required by the use of a FOR-NEXT loop. To remove the mute during the processing of a word you simply write the last line again, less the + 1. Hence, a complete program would look like this:

```
POKE W, A
POKE W + 1, 8
POKE W + 1, 17
FOR T = 1 TO TT : NEXT T
POKE W + 1, 16
```

For A = 0 and TT = 500, the above program will isolate the word "talker" from "This is Digitalker" in the master word list (ROM pair 0).

When the Command select is turned on, the speech processor is reset, thus ending the word sharply. This facility can be used with the mute control to isolate the central part of a word out of the total time normally taken to speak the word, call this time Tt (as before), you need to vocalise only a central portion, call this Tv, muting the first part, call this Ts (as before), and cutting the end portion with the Command select (CMS). If the word is again represented by a rectangle, the sequence of events becomes clear from this diagram:



Where Tt = total time of original word
Ts = period at start
Tv = period of vocalisation

A program to perform this operation looks like this:

```
M = 1
POKE W, A
POKE W + 1, 8
POKE W + 1, 16 + (2*B) + M
FOR T = 1 TO T1 : NEXT T1 :
REM T1 SELECTS Ts
M = 0 : REM MUTE OFF
POKE W + 1, 16 + (2*B) + M
FOR T = 1 TO T2 : NEXT T2 :
REM T2 SELECTS Tv
POKE W + 1, 40 : REM COMMAND
                    MODE SELECTED
```

If a word is required to follow the selected part of the word in this program, the Command select is left off. Like this:

```
M = 1
POKE W, A1 : REM A1 = CODE
FOR 1ST WORD
POKE W + 1, 8
POKE W + 1, 16 + (2*B1) + M :
REM B1 IS CODE FOR 1ST WORD'S
                        ROM PAIR
FOR T = 1 TO T1 : NEXT T
M = 0
POKE W + 1, 16 + (2*B1) + M
FOR T = 1 TO T2 : NEXT T
POKE W, A2 : REM A2 = CODE FOR
                        2ND WORD
POKE W + 1, 8
POKE W + 1, 16 + (2*B2) + M :
REM B2 IS CODE FOR 2ND WORD'S
                        ROM PAIR
```

With a little practice and imagination, you'll soon have your ETI-647 Turtle Talk Synthesiser saying all manner of things! (At this point, we would like readers to know that we take no responsibility for what any constructor's project might say . . . — Ed.)

ROM EXPANSION

The ETI-647 Turtle Talk Speech Synthesiser employs a method of speech generation which utilises whole words from a vocabulary list stored in pairs of ROMs. To expand the vocabulary it is only a matter of purchasing further ROMs. The Turtle Talk board has provision for expansion to a total of eight ROMs, that is — four word lists giving a vocabulary of around 550 words plus prefixes, suffixes, tones and silences. The kits are supplied with the 'standard vocabulary' ROMs (Master Word List, Table 1, Part 1) which includes all the letters of the alphabet and all the numbers needed to form any finite set of numbers. Having this vocabulary allows all words which are not on the list, to at least be spelt out.

National Semiconductor also have available ROMs containing vocabularies of foreign languages — German, French, Italian, etc. Associated with this large potential vocabulary, is the Turtle Talk's special power saving circuitry to cut down heating and power consumption by chopping the supply to the ROMs when they are not being used.

A COUPLE OF DEMONSTRATION PROGRAMS

These programs were written for a Tasman Turtle Robot fitted with a General Purpose Interface board and a Turtle Talk board, interfaced to an Apple II via slot 2. In this configuration, the robot has address W (where W = −16224) and the speech synthesiser addresses become W + 2 and W + 3.

```
]LOAD COUNT TO 100
]LIST

1 W =  - 16224
2  DEF  FN DD(X) =  INT (X / 10)
3 TL = 600
4  PRINT I
100  FOR I = 1 TO 100: GOSUB 200: NEXT : END
200  IF I = 0 THEN WD = 31: GOSUB 1000: GOTO 230
210  IF I < 21 THEN WD = I: GOSUB 1000: GOTO 230
220  IF I < 100 THEN WD =  INT (I / 10) + 18: GOSUB 1000: IF  NOT  FN DD(I
     ) THEN WD = (I / 10 -  INT (I / 10)) * 10: GOSUB 1000
230  FOR T = 1 TO TL: NEXT : RETURN
1000  IF  PEEK (W + 3) < 255 THEN 1000
1005  IF I <  > J THEN  PRINT I
1010  POKE W + 2,WD: POKE W + 3,8: POKE W + 3,16
1015 J = I
1020  RETURN
```

```
]LOAD TO SAY A SENTENCE
]LIST

10 W =  - 16224: REM  TURTLE IN SLOT 2 OF APPLE
20  READ A,B
25  IF A = 0 THEN  END
30  POKE W + 2,A
40  POKE W + 3,8
50  POKE W + 3,16 + (2 * B)
60  IF  PEEK (W + 3) < 255 THEN 60
70  GOTO 20
100  DATA  65,0,65,0,66,0,71,0,18,0,119,0,96,0,102,1,61,0,126,1,87,1,116,
     1,71,0,26,1,78,0,123,0,61,0,128,1,
110  DATA  0,0
```

```
]LOAD SPELL
]LIST

5 T1 = 130
10 W =  - 16224
20 A$(1) = "BUTTON": C(1) = 10
21 A$(2) = "COMPLETE": C(2) = 18
22 A$(3) = "HELP": C(3) = 58
23 A$(4) = "NEXT": C(4) = 76
24 A$(5) = "SOUTH": C(5) = 110
45  FOR K = 1 TO 5
60  GOSUB 200
70  POKE W + 2,C(K)
80  POKE W + 3,8
90  POKE W + 3,18
100  INPUT B$
110  IF B$ = A$(K) THEN 300
120  GOSUB 400
130  GOTO 60
150  NEXT K
160  END
200  POKE W + 2,133
210  POKE W + 3,8
220  POKE W + 3,16
230  FOR T = 1 TO T1: NEXT T
240  POKE W + 2,43
250  POKE W + 3,8
260  POKE W + 3,16
270  IF  PEEK (W + 3) < 255 THEN 270
280  RETURN
300  POKE W + 2,22
310  POKE W + 3,8
320  POKE W + 3,18
330  IF  PEEK (W + 3) < 255 THEN 330
340  GOTO 150
400  POKE W + 2,61
410  POKE W + 3,8
420  POKE W + 3,18
430  IF  PEEK (W + 3) < 255 THEN 430
440  POKE W + 2,140
450  POKE W + 3,8
460  POKE W + 3,16
470  IF  PEEK (W + 3) < 255 THEN 470
480  POKE W + 2,58
490  POKE W + 3,8
500  POKE W + 3,16
510  IF  PEEK (W + 3) < 255 THEN 510
520  RETURN
]LOAD SENTENCE
]LIST

10 W =  - 16224: REM  TURTLE IN SLOT 2 OF APPLE
20  READ A,B
25  IF A = 0 THEN  END
30  POKE W + 2,A
40  POKE W + 3,8
50  POKE W + 3,16 + (2 * B)
60  IF  PEEK (W + 3) < 255 THEN 60
70  GOTO 20
100  DATA  73,0,76,1,73,1,2,0,86,0,
110  DATA  0,0
```

```
]LOAD VOCABULARY
]LIST

5  PRINT A;
10 W =  - 16224
20  POKE W + 2,A
30  POKE W + 3,8
40  POKE W + 3,16 + (B * 2)
45  IF  PEEK (W + 3) < 255 THEN 45
50 A = A + 1
52  IF C = 1 AND A = 131 THEN  END
55  IF A = 143 THEN G = 1:A = 0:C = 1
60  PRINT A,"  ",
70  GOTO 20
```

```
]LOAD TALKING KEY BOARD
]LIST

2  REM  TALKING KEYBOARD BY ALLAN BRANCH 1982
5 W =  - 16224
6  CALL  - 936
10  GET A$
15 TT = 100
20 X =  ASC (A$)
30  IF (64 < X) AND (X < 91) THEN 100
40  IF (48 < X) AND (X < 58) THEN 200
50  IF X = 32 THEN X = 132: GOTO 105
60  IF X = 13 THEN  END
99  GOTO 10
100 X = X + 33
105  PRINT A$;
110  POKE W + 2,X
120  POKE W + 3,8
130  POKE W + 3,16
140  GOTO 10
200 X = X - 48
210  GOTO 105
```

WORD LIST 2

Word	8-Bit Binary Address SW8 SW1
ABORT	00000000
ADD	00000001
ADJUST	00000010
ALARM	00000011
ALERT	00000100
ALL	00000101
ASK	00000110
ASSISTANCE	00000111
ATTENTION	00001000
BRAKE	00001001
BUTTON	00001010
BUY	00001011
CALL	00001100
CAUTION	00001101
CHANGE	00001110
CIRCUIT	00001111
CLEAR	00010000
CLOSE	00010001
COMPLETE	00010010
CONNECT	00010011
CONTINUE	00010100
COPY	00010101
CORRECT	00010110
DATE	00010111
DAY	00011000
DECREASE	00011001
DEPOSIT	00011010
DIAL	00011011
DIVIDE	00011100
DOOR	00011101
EAST	00011110
ED (NOTE 1)	00011111
ED (NOTE 1)	00100000
ED (NOTE 1)	00100001
ED (NOTE 1)	00100010
EMERGENCY	00100011
END	00100100
ENTER	00100101
ENTRY	00100110
ER	00100111
EVACUATE	00101000
EXIT	00101001
FAIL	00101010
FAILURE	00101011
FARAD	00101100
FAST	00101101
FASTER	00101110
FIFTH	00101111
FIRE	00110000
FIRST	00110001
FLOOR	00110010
FORWARD	00110011
FROM	00110100
GAS	00110101
GET	00110110
GOING	00110111
HALF	00111000
HELLO	00111001
HELP	00111010
HERTZ	00111011
HOLD	00111100
INCORRECT	00111101
INCREASE	00111110
INTRUDER	00111111
JUST	01000000
KEY	01000001
LEVEL	01000010
LOAD	01000011
LOCK	01000100
MEG	01000101
MEGA	01000110
MICRO	01000111
MORE	01001000
MOVE	01001001
NANO	01001010
NEED	01001011
NEXT	01001100
NO	01001101
NORMAL	01001110
NORTH	01001111
NOT	01010000
NOTICE	01010001
OHMS	01010010
ONWARD	01010011
OPEN	01010100
OPERATOR	01010101
OR	01010110
PASS	01010111
PER	01011000
PICO	01011001
PLACE	01011010
PRESS	01011011
PRESSURE	01011100
QUARTER	01011101
RANGE	01011110
REACH	01011111
RECEIVE	01100000
RECORD	01100001
REPLACE	01100010
REVERSE	01100011
ROOM	01100100
SAFE	01100101
SECURE	01100110
SELECT	01100111
SEND	01101000
SERVICE	01101001
SIDE	01101010
SLOW	01101011
SLOWER	01101100
SMOKE	01101101
SOUTH	01101110
STATION	01101111
SWITCH	01110000
SYSTEM	01110001
TEST	01110010
TH (NOTE 2)	01110011
THANK	01110100
THIRD	01110101
THIS	01110110
TOTAL	01110111
TURN	01111000
USE	01111001
UTH (NOTE 3)	01111010
WAITING	01111011
WARNING	01111100
WATER	01111101
WEST	01111110
SWITCH	01111111
WINDOW	10000000
YES	10000001
ZONE	10000010

The MPF-1 Micro-Professor — tool, or toy?

Jonathan Scott

Described in the brochures as "a learning tool for hobbyists, students and microprocessor enthusiasts . . .", the Micro-Professor is a new concept in computer or microprocessor products. Is it a tool, as the makers claim, or a toy?

THE MPF-1 Micro-Professor, manufactured by Multitech Industrial Corporation, is a Z80-based microcomputer system which fills a need which no other system we have yet to see or hear about can. It is more than an 'evaluation kit', but it is definitely not a 'home' or personal computer in the usual sense. It is a **most** marvellous device for actually ***teaching*** someone what a microprocessor is and how to use it. One emerges from a relationship with this little fellow with familiarity and skill enough to tackle the design of a microprocessor-based appliance, scientific instrument or even a pinball machine. These are the fundamental commercial uses of microprocessors, where the designer must have close contact with hardware, software and layout of the system. In these areas the MPF-1 will support a student in the processes of acquiring familiarity and technique. The MPF-1 is neither a games-player nor a computer for a serious computational task. If you want to play games go buy a VIC-20 or some such, and if you need to do serious calculations, go buy an HP. The MPF-1 can be fun, but only in the way that learning can be a pleasurable challenge for its own sake. If you seriously intend to expand your commercial ability in the digital area, or if you like to get at the roots of microprocessing, rather than fool about in pure software, this is probably the best system we have ever seen for you. Having now discharged my duty to ward off the games players and the heavy number crunchers, let me proceed to describe this fascinating system.

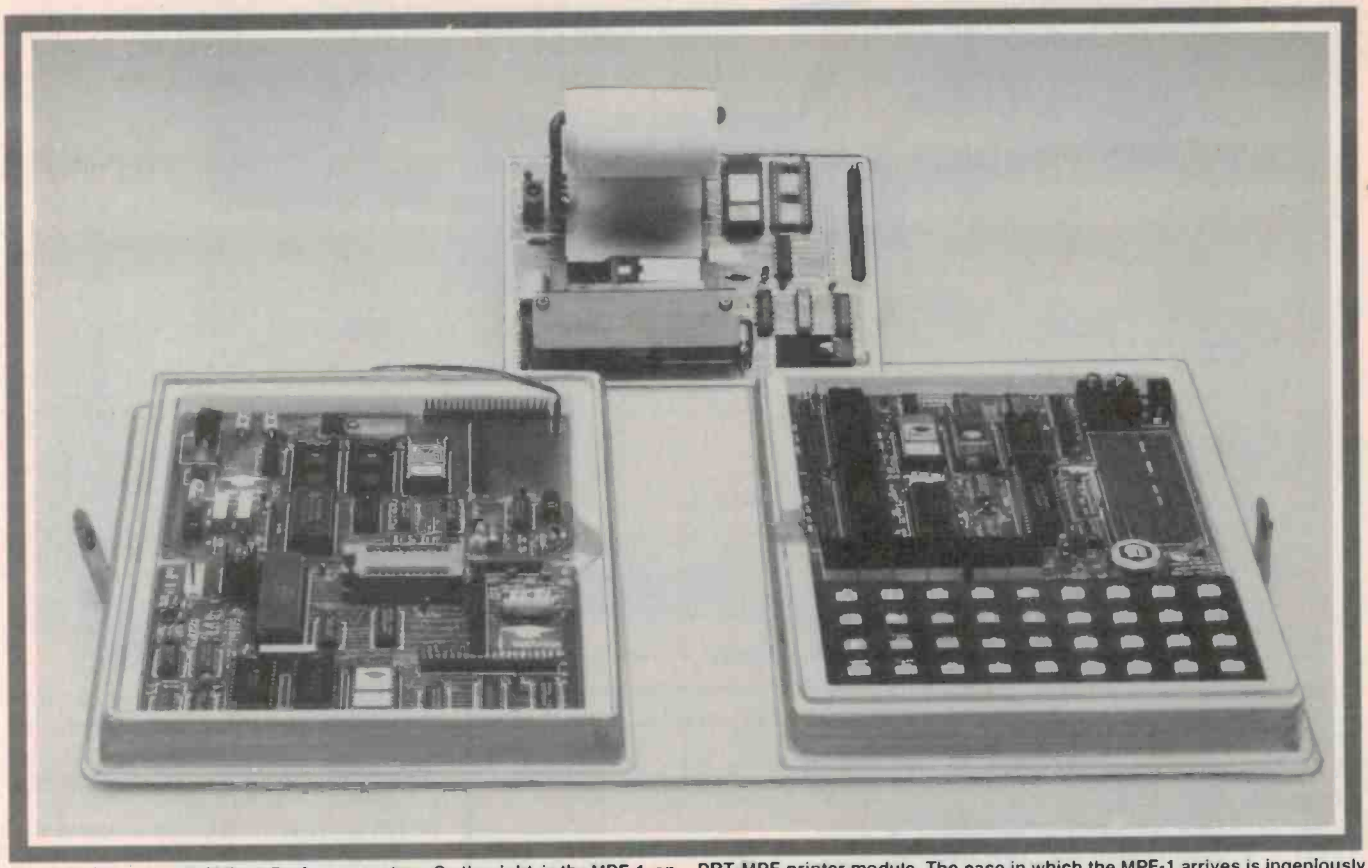
The basic board

The MPF-1 itself comes as a single pc board about 150 x 220 mm. This is powered by a plugpack and sports a 9 x 4 keyboard and a six-character 7-segment display. A cassette interface, a speaker and two separate indicator LEDs are provided. There is an area for user hardware expansion which would support about half a dozen 16-pin chips. There are four IC sockets unoccupied on the board. Two multipin connectors are mounted on the left side of the board. The keyboard is labelled with the monitor commands, and is also designed to accept overlays with new key designations, rather like an HP41. It has a nice feel and the keys are spaced quite comfortably. It is supplied with three books — The User's Manual, an Experiment Manual and the Monitor Source Listing.

Before going on to discuss the beastie, let me list all the options which we received along with the MPF-1 itself. The four empty sockets were filled with a CTC (Counter-Timer-Chip), a peripheral interface adaptor (PIA), which used the second connector on the pc board, an EPROM of BASIC, and further RAM or EPROM which could be used as desired. Chained on to the first connector we had the EPROM programmer option (EPB-MPF), a separate board half the size of the first, also powered by another plugpack. From this we chained the SSB-MPF speech synthesiser — same size, same power arrangement. Beyond this was the PRT-MPF printer, which carried more software in EPROM, and room for expansion. The speech synthesiser had room for further vocabulary, with which we were not supplied. This space could also presumably support RAM or whatever you wanted. Two of the added boards could be housed with the MPF-1 in its book-like mounting arrangement, though this turns out to be not very useful. Each additional board came with a small booklet, as did the BASIC EPROM.

The MPF-1 is very well built, in hardware terms. The pc board is good quality and has the component labels screened onto it. The keyboard, as I have said, is neat and has a good positive 'feel'. The only complaint we might level at the makers is that the LED display does not have an antiglare cover sufficient to eliminate reflections from bright lamps or to maintain contrast in a very light room. The display, speaker and keyboard are controlled by an on-board PIA, as is the cassette interface. The interrupt line and a reset facility are included in the keypad, so you can get at the hardware even before you add things to the user's addition area.

The monitor with which it is supplied is *excellent*. It provides easy and ergonomic inspection of registers and memory, and simple alteration facility. It permits single stepping, an important function absent from many monitors. It allows the setting of a breakpoint. It also automatically calculates and stores relative addresses, which is so useful an enhancement for anyone practicing hand assembly of machine level programs. Finally, it will insert, delete and move blocks of instructions. For a



The 'full kit & kaboodle' Micro-Professor system. On the right, is the MPF-1, on the left are the EPB-MPF EPROM programmer (foreground) and SSB-MPF speech synthesiser (behind the EPROM programmer). Right at the rear is the PRT-MPF printer module. The case in which the MPF-1 arrives is ingeniously designed so that manuals or the other boards (as shown here) can be accommodated.

student who is using hand assembly rather than an assembler program initially, this is superbly handy. I realise that no-one these days develops software seriously without assembler support, but it is nevertheless the best way to familiarise oneself with the inner workings of a processor. With all the options available, the best task a student can have on the MPF-1 is, in any case, to write and install in EPROM an assembler. For this grass-roots warm-up to microprocessors the monitor supplied is absolutely ideal. It is also well documented and has a good repertoire of utility subroutines to facilitate the user, including standard functions from the monitor in personally developed utility software.

The User's Manual and Experiment handbook are indeed comprehensive and cover the subjects well, but there is one serious flaw. They are, like every manual supplied with the MPF boards, written in ghastly English. I think they were translated hurriedly using a tourist's phrasebook. True, the Sydney agents, Emona, did supply a replacement BASIC manual, which was a great improvement over the preceeding comedy exercise, but it still used clumsy constructions. The original was frequency incomprehensible, and the humour wears off soon if you are trying to extract information. For this reason, I hesitate to recommend that anyone try to learn from the MPF course if there is not someone accessible who knows what is going on already, and is willing to be helpful when the task gets too hard.

The PIA and CTC integrated circuits were supplied without any documentation, as they quite reasonably state that the Zilog data sheets for the various ICs are the necessary and best instructions for using them. With the addition of these you are ready to embark on the jobs such as installation of custom hardware on the user expansion board area. This might mean the connection of analogue-to-digital (A/D) converters or position sensors, or whatever you need. A stepper motor controller and some sensor inputs might allow the computer control of a toy truck or model train.

BASIC

The BASIC EPROM contains a 4K tiny BASIC interpreter. It is supplied with a (hopefully revised) manual. As you might imagine, BASIC is pretty limited when you have only a 6-digit, 7-segment display. However, a very credible attempt has been made to allow full BASIC operation. You can edit and list, albeit rather clumsily. This software is enough to allow one to see how a machine expands from assembly language to a 'full high level language', as such. This is the only option which I do not recommend you buy with the MPF-1, and this is purely because the MPF-1 is plainly not a BASIC-orientated machine. For those who suspect that they will have to have a slight BASIC familiarity, it will do, as one could subsequently migrate to a proper machine solely by reading the list of instructions available on the machine's operating system and the list of functions supported by the system's BASIC. There is no criticism here against Multitech's programmers.

'Expansion' boards

All three expansion boards (the EPROM programmer, the speech synthesiser and printer) are constructed with the same high quality as the MPF-1 host board, and are well matched and integrated with it. So much so, they merge in the mind to become part of it, more than peripherals.

The EPROM programmer (EPB-MPF) has the standard zero insertion force (ZIF) socket, and supports a range of EPROMs, including the 2716, 2532, etc. It is supplied with a well set-out, if not fluent, instruction manual and a keypad overlay. It also comes with a plug-pack supplying the appropriate voltages. It allows programming and verification of EPROMs and listing of data in the buffer. On the whole it is a very neat and ▶

Plenty of documentation is provided — as this collection of manuals evidences.

adequate assembly. All the relevant main monitor subroutines are implemented on the buffer (4K) on-board. This RAM can, of course, be regarded as expanding the system RAM to 6K.

The speech synthesiser board uses the Texas Instruments chip set. This uses the 'linear predictive coding' method, and sounds just like a TI speak-and-spell. It is supplied with plugpack and instruction booklet. There is an EPROM on the board which contains a speak-the-time type of clock as a demonstration, as well as a very useful utility for quickly getting the system working with your software. It comes with the ability to say the numbers 'one, two, . . .' up to twenty, then by tens to fifty, etc, as well as things like 'good morning/afternoon', etc. This is, of course, exactly the vocabulary a clock requires. More words are listed in the booklet as being available, and expansion sockets are ready on the pc board to accept the new chips but we were not supplied with any others. There seems to be insufficient space on the board to hold all the words available at once, which might prove tricky as the complete vocabulary comes in alphabetical chunks, so perhaps you would have to either transfer appropriate data around by using the excellent EPROM programmer and put all you wanted in one of your own EPROMs, or limit yourself to what part of the vocabulary fits in three chips. Otherwise, you might use some of the expansion space on the other boards to hold the excess chips. All in all, this is a brilliant fun board, and provides a perfect introduction to this method of speech synthesis. The documentation is OK, though takes a little getting used to. It is clear that further vocabulary is necessary if you don't want to get bored quickly. I would have liked to see if the further vocabulary could be manipulated around using the other facilities. There seems to be no reason why this could not be achieved readily with the EPB board.

The MPF-1 Micro-Professor, accessories and expansion boards are marketed in Australia by Emona Enterprises P/L, CBC Bank Building, 661 George St, Sydney 2000. (02)212-4815. Prices are as follows (all plus tax):

MPF-1 'host' board, with manuals (plugpack $11.50)	$115
MPF-CPK CTC and PIO chip kit	$17
MPF-2KRAM, 2Kx8 6116 RAM or equiv.	$12.50
MPF-2KROM, blank 2K EPROM	$8
MPF-4KROM, blank 4K EPROM	$12.50
EPB-MPF EPROM programmer board with manual (plugpack extra)	$145
SSB-MPF speech synthesiser board with manual (plugpack extra)	$145
PRT-MPF printer (plugpack extra)	$95

The Micro-Professor equipment is distributed in Victoria by the Radio Parts Group, 562 Spencer St, West Melbourne 3003. (03)329-7888.

Finally, the printer (PRT-MPF). This is a marvellously compact unit, being all up the same size as the other options. It is supplied with a book and plugpack, as are the others. It prints, albeit at less than one line per second, up to 20 characters per line on thermal paper. The result is black on white and very readable. The board has space for the addition of one further EPROM or RAM chip, just as a method of using board space economically. It comes supplied with software to disassemble Z80 code (very nicely) and to list BASIC, as it is not of course limited to 7-segments as is the MPF-1 display. These, as well as a memory dump program, are contained with the driving utility routines in the EPROM on-board. Because of this freedom to print in dot matrix form rather than the inherent hardcopy output, this particular peripheral is very useful indeed. In addition, sufficient documentation is supplied to allow the programmer to get down to the very dot delivery level, so that one can obtain a complete hardware familiarity with this species of printer.

Summary

As I said when I started, the MPF-1 system is fundamentally a teaching system which exposes its designer's thoughts and techniques well to the student. It is comprehensive and detailed in its design and programming. It is also particularly good monetary value. Schools and other teaching institutions can afford several of these I am sure. While the ever popular 'home' computer plays games and BASIC is the language that people like kids to get into, games are not the stuff microprocessors are practically used for in commercial situations and BASIC is a language on the way out, I hope. Further, one printer, one EPROM programmer and a single speaking box can service several MPF-1 boards. Two of each mobile peripherals would support up to a dozen MPF-1s. This is the way schools and universities are going to have to go, to teach *microprocessing* as different from computing.

In conclusion, the MPF-1 system is a beautifully designed specific purpose gadget. I recommend it wholeheartedly for the purpose for which it is intended, but I must reiterate my warning that it is not general purpose and hence not to be regarded as the basis for an expandable system for playing or number crunching. In short — for the dedicated student, not the frivolous. ●

COMPUTER COUNTRY

Breaks the price barrier on Hitachi "Peach" Equipment

FOR OUR INTERSTATE CUSTOMERS ONLY

ITEM	REC. RETAIL EX. TAX	COMPUTER COUNTRY EX. TAX
Hitachi Microcomputer 24K, ROM, 32K, RAM, Microcoft Level 3 Basic	$1495	$1,199
Hi-Resolution Colour Screen	$1,149	$950
M.P.I. Disk Drive (includes cable)	$537	$475
Disk Drive Controller Card	$175	$150
Green Phosphorus Monitor	$370	$250
Star Dot Matrix Printer	$565	$499
16K RAM Card	$139	$120
Light Pen	$320	$280
Dual Double Density Double Sided Disk Drive Unit with Controller (1.5 Megabyte capacity)	$2,005	$1,700

These prices do not include sales tax, add 20% if applicable. Sale prices are effective till 31st October or until prior sale of existing stock.

Service on the "Peach" is available nationwide through the Peach network of dealers.

Terms are cheques with orders. Freight is collect. For schools and government departments who require terms. Please add 2% service charge for 7 days nett with official purchase order.

COME TO

COMPUTER COUNTRY (NATIONWIDE) PTY LTD

338 Queen Street, Melbourne Vic. 3000

Telephone: (03) 329 7533

The '660 Program Potpourri has had to be held over due to lack of space, but here's a couple of good programs to keep you amused in the meantime. Both are listed in compact form, showing program code only. We'll leave it to you to disassemble them and find out how they work.

WIPEOUT '660 STYLE

W.F. Kreykes
St. Albans, Vic.

This is not a remake of 'One-handed Pong' as published in the April '82 ETI. Firstly, this program is *in colour* and will absorb the player for much longer. Sound effects are included. You'll need to have installed the colour components and have 3K of memory on your '660.

You start the game with 200 dots and a large bat. A ball moves around the screen and the object is to position your bat so that the ball bounces from it, and in doing so, wipes out as many dots as possible. For this, you score points. If the ball moves toward you and you don't get the bat under it, the ball goes off screen. Your progressive score is then displayed and you get another ball. You start the game with 15 balls. You get a bonus of one extra ball if 10 dots are wiped out with one ball. If you wipe out at least 20 dots with one ball you get a bonus of three extra balls. When you have wiped out a total of 100 dots, the bat size automatically decreases 25% — making the game from that point on a little harder! The game ends when you either run out of balls or run out of dots. The game restarts automatically after ending and the highest score to beat is displayed on-screen.

Use the following keys to control the bat:

KEY A — LEFT
KEY D — RIGHT

The bat does not go off-screen at extreme left or right travel.

If you want a monochrome game (or white on blue background), change 2822 at 0600 to 00FF then type in the program from 0600 to 07AC and disregard the rest (and for this you only need 1K of memory). Here are the colour setups:

00600	2822: calls colour routines. Set to 00FF for mono.
0822	07F7: sets background to black. For blue set to 00FF
0824	07B8: initiates colour operation
0828	6007: white — number of hits
082C	6006: pale blue — first divider
0830	6003: violet — highest score to beat
0836	6004: green — progressive score
083C	6005: yellow — third divider
0840	6001: red — number of balls left
0844-085C	colours the dots but jumps colour black
085A	6001: red — bat

TRADITIONAL SPACE INVADERS

Master P. Easdown
Kew, Vic.

Every computer *must* have a version of the traditional arcade game of 'Space Invaders'. This one has the familiar row of invading characters marching across and down the screen dropping missiles on you and which you fire at from behind shields at the bottom of the screen. This is a monochrome program and requires only 1K of memory. Sound effects are included.

Four invaders march across and down the screen, firing at you at random intervals. Your cannon is located at the bottom of the screen, just above which are four shields which help protect you from the invaders' bombs. The bombs dropped by the invaders and your cannon shots are single pixels on the screen.

Cannon control is as follows:

KEY 4	LEFT
KEY 5	FIRE
KEY 6	RIGHT

The game can end in two ways: one is, if you get shot, the other is if the invaders get so low that it is impossible for you to shoot them — i.e: you've been invaded!

When the game ends, your score is shown on the screen.

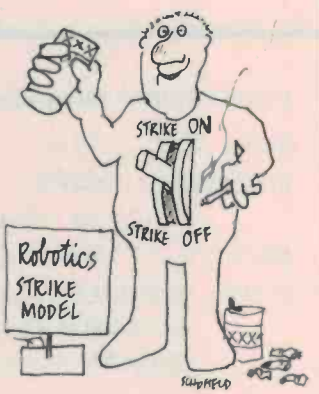
Save this program on tape and save yourself a fortune!

WIPEOUT '660 STYLE

```
0600  2822 6000 2798 00E0 6C0A 6D00 A7A6 DCD6
0610  6C1E DCD6 6C32 DCD6 A7A4 6D06 1620 A6B5
0620  6C00 DCD1 7C08 FD00 FD18 3C40 1622 7D03
0630  3D27 161E 60FE A7A5 F055 A7A5 681C 692E
0640  D891 670F 6D00 279C 6600 2758 632C 6B3E
0650  8B82 4700 1760 FF0A 4F0A 1660 3F0D 1656
0660  274A 6D00 2758 77FF 2758 A6D2 DB31 65FF
0670  C401 3401 64FF A7A5 6C00 6E0A EEA1 1690
0680  6E0D EE9E 169C 483A 169C D891 7C02 1698
0690  4800 169C D891 7CFE 88C4 D891 4F01 1704
06A0  4B00 6401 4B3E 64FF 4306 6501 432E 1712
06B0  A6D2 DB31 8E44 8354 DB31 3F01 1676 432E
06C0  1704 FB00 6A02 FA18 7D01 4D0A 2750 4D14
06D0  2750 80D0 8064 40C8 175E 3064 16F2 A7A5
06E0  D891 6A05 6110 FA00 F118 60F8 F055 A7A5
06F0  D891 A6D2 DB31 C401 3401 64FF C501 3501

0700  65FF 1676 F900 6A03 FA18 A6D2 DB31 73FF
0710  166A A6D2 DB31 271A 164C 274A 2720 86D4
0720  6E23 8060 6A00 A7AD F033 F265 4000 1740
0730  F029 273A F129 273A F229 DEA5 7E05 00EE
0740  3100 1734 3200 1738 00EE 6E00 80D0 1724
0750  2758 3D0A 7701 7701 6E38 8070 1724 271A
0760  A7A5 D891 A7AC F065 8065 4F00 2794 6A00
0770  A7A5 DA91 7A08 3A40 1772 6703 F715 F707
0780  FA00 FA18 3700 177E A6D2 DA91 7AFF 3A00
0790  177A 1606 279C 8060 A7AC F055 A7AC F065
07A0  6E0F 1724 BAAA 60F0 F0F0 6000 0000 0000

07B0  A7AD F255 07C8 00EE F839 AF96 BFEF F82C
07C0  5F62 2FF8 205F 62D4 F807 BEF8 ADAE EE72
07D0  FA07 BFF0 FA07 5E1E F0FA 1FFE FEFE FE5E
07E0  F80C 7C00 BDF8 80F4 AF9D 7C00 BD8F 2EF4
07F0  ADED 9F5D 63E2 D4E9 61D4 6F01 6100 27B0

0800  7101 3108 17FE 7201 7FFF 3F00 17FC 00EE
0810  6200 6F03 27B0 7201 7FFF 3F00 1814 7101
0820  00EE 07F7 07B8 6100 6007 2810 6006 2810
0830  6003 2810 2810 6004 2810 2810 6005 2810
0840  6001 2810 6203 6007 27FA 70FF 4213 1856
0850  3000 1848 1846 6F04 27FC 6001 17FA
```

SPACE INVADERS PROGRAM

```
0600 - 6100 6202 6C00 6B00   708 - 00E0 6410 A7FC FD33
608 - C530 6629 6D00 6004    710 - F265 F029 D345 7304
610 - 6E19 A72C D0E8 700F    718 - F129 D345 7304 F229
618 - DCE8 26D6 A724 D568    720 - D345 0000 1010 387C
620 - 8A10 8920 2762 DA98    728 - 387C FE00 3C7E FFE7
628 - 2744 7A0A 2762 DA98    730 - C300 0000 387C D6FE
630 - 2744 7A0A 2762 DA98    738 - 2844 8200 387C D6FE
638 - 2744 7A0A 2762 DA98    740 - 2844 2800 CC03 4C01
640 - CC03 4C01 2688 A724    748 - 2688 00EE 78FD A770
648 - 6E04 D568 EEA1 75FE    750 - D788 6B10 FB15 FB07
650 - 6E05 EEA1 26AE 6E06    758 - 3B00 1756 D788 A724
658 - EEA1 7502 D568 8A10    760 - 00EE 4000 176A A73C
660 - 8920 2762 DA98 7A0A    768 - 00EE A734 00EE 7001
668 - 2762 DA98 7A0A 2762    770 - 4002 6000 1620 4299
670 - DA98 7A0A 2762 DA98    778 - FB1A E500 0775 00FF
678 - 7101 311B 176E 7203    780 - 6B10 FB00 FB18 7B01
680 - 6100 4220 1708 176E    788 - 4B15 00EE 1782 00FF
688 - 83A0 8490 7407 A724
690 - 7401 D341 4F01 16E2
698 - D341 442F 00EE 1690
6A0 - 4429 1708 00FF 6B05
6A8 - F900 FB18 00EE 2780
6B0 - 00FF 00FF 8750 8860
6B8 - 78F8 A724 78FF D781
6C0 - 4501 16CC D781 4800
6C8 - 00EE 16BC 16EE A720
6D0 - 274C 7D01 00EE 700F
6D8 - D0E8 700F D0E8 6000
6E0 - 00EE 6B22 8C40 8BC5
6E8 - 3F01 1708 16A4 6B18
6F0 - 8C80 8BC5 3F01 16A6
6F8 - D781 6B20 FB00 FC18
700 - 7BFF 4B10 16D0 16FC
```



33% OFF ALL DISKETTES

WE BELIEVE THE OFFICE DATA PRODUCTS DISKETTES, NOW MANUFACTURED IN AUSTRALIA BY THE WORLDS LARGEST PRODUCER TO BE THE BEST IN THE WORLD.

·2 YEAR GUARANTEE·

8" DISKETTES (Hard or Soft Sectored)	Normal Price	Discount Price
Single Sided, Single Density	$ 4.50	$ 3.00
Single Sided, Single Density, Critically Certified	$ 4.96	$ 3.31
Single Sided, Double Density	$ 4.96	$ 3.31
Double Sided, Double Density	$ 5.40	$ 3.60
MINI DISKETTES (Soft, 10 or 16 Sectored)		
Single Sided, Single Density	$ 4.32	$ 2.88
Single Sided, Double Density	$ 4.32	$ 2.88
Single Sided, Quadruple Density	$ 5.68	$ 3.79
Double Sided, Double Density	$ 5.59	$ 3.73
Double Sided, Quadruple Density	$ 7.74	$ 5.16

EXTENDED odp PERFORMANCE

odp OFFICE DATA PRODUCTS

ODP Diskettes now have 7 improvements that will deliver a longer trouble free life than previously possible.

SPECIAL BONUS
All 5¼ Diskettes supplied with Reinforcing Ring and Plastic Library Case.

NOTE: Add 17½% Sales Tax & $1.00 Postage

NOTE: 1 Box only per customer must be accompanied by Order Form below

OFFER CLOSES 31st OCTOBER 1982

COMPUTER SUPPLIES (Australia) Pty Ltd

54 ALEXANDER STREET, CROWS NEST, NSW 2065, AUSTRALIA
Telephone: (02) 439 5533 Telex: 23216

ORDER FORM: Please supply the following: (Tick appropriate boxes)

SIZE... ☐ 8" ... ☐ 5"
SECTORED... ☐ SOFT... ☐HARD
... ☐ 10... ☐ 16... ☐ 32
DENSITY... ☐ SINGLE... ☐ DOUBLE... ☐ QUAD
SIDES... ☐SINGLE... ☐ DOUBLE
☐ STANDARD CERTIFICATION
☐ CRITICALLY CERTIFIED

NAME. . . . . .
COMPANY NAME . . . . . .
ADDRESS. . . . . .
. . . . . .Postcode . . . . . .
TYPE OF SYSTEM . . . . . .
USUAL BRAND OR TYPE. . . . . .
☐ CASH ☐ CHEQUE ☐COMPANY ACCOUNT
Phone Numbers. . . . . .Signature . . . . . .

BEWILDERED AND BAMBOOZLED?

The solution to your computing confusion is right here with these easy-to-understand books. Check them out and see!

TELEMATIC SOCIETY

An extensive update of 'The Wired Society', this book demonstrates how developments in telecommunications will affect the way we live.

02460-3 $17.50

DEVELOPING MICROCOMPUTER-BASED BUSINESS SYSTEMS

Directed specifically at intending developers of small computer-based systems who are not data-processing professionals. Advice on methods of developing efficient business systems with actual examples and up-to-date costs.

04552 $15.95

THE C PROGRAMMING LANGUAGE

C is a general purpose 'low-level' programming language. It is not specialised to any particular area of application, but its absence of restrictions make it convenient and effective for many tasks.

10163 $21.95

USING THE 6800 MICROPROCESSOR

This will guide the reader through the conception, configuration, writing and running of a variety of programs that demonstrate practical use of a 6800 system.

21512 $13.25

DESIGN OF ACTIVE FILTERS WITH EXPERIMENTS

Introduction to the theory. Implementation and design of active filters using the 741 op amp.

21539 $15.95

COMPUTER GRAPHICS PRIMER

Almost every page has a colour drawing, photograph, picture or a schematic to help you learn computer graphics quickly and easily. Programming concepts apply to all microcomputers, and examples are given in BASIC for the Apple II.

21650 $21.95

CIRCUIT DESIGN PROGRAMS FOR THE TRS-80

A number of programs written to aid you in using your TRS-80 and Level II BASIC for the design and analysis of many electronic circuits. The programs analyse information on rms values, periodic waveforms, integrated circuit timers and bipolar transistor circuits.

21741 $21.75

EXPERIMENTS IN ARTIFICIAL INTELLIGENCE FOR SMALL COMPUTERS

Artificial intelligence is the capability of a device to perform functions normally associated with human intelligence, such as game playing, problem solving, reasoning, creativity and verbal communications. With this book, a small computer with extended BASIC and some knowledge of BASIC language, you can conduct interesting and exciting experiments in artificial intelligence.

21785 $13.25

MOSTLY BASIC: APPLICATIONS FOR YOUR TRS-80 — BOOK 1

28 ready-to-use BASIC programs which have been completely tested and debugged. Programs include a telephone dialler, digital stop-watch, spelling test, house buying guide, gas mileage calculator, and others. Complete with explanations of each program, sample runs, and complete program listing.

21788 $19.25

CP/M PRIMER

A complete one-stop course on CP/M, the very popular operating system for 8080, 8085 and Z80-based microcomputers. Complete terminology, hardware and software concepts, start-up of a CP/M system, and a complete list of CP/M-compatible software.

21791 $21.95

PET INTERFACING

Demonstrates how to build numerous interfacing devices for PET hardware. BASIC language programs are used throughout, and the book includes a discussion of the microprocessor's internal architecture and general hardware/software interfacing.

21795 $25.25

6809 MICROCOMPUTER PROGRAMMING AND INTERFACING, WITH EXPERIMENTS

Gives a solid understanding of how to program and interface the high-performance 6809 microprocessor. The author completely explores internal structure, addressing modes, data movement instructions, registers, arithmetic logic and test instructions for the 6809.

21798 $21.95

INTERMEDIATE PROGRAMMING FOR THE TRS-80 MODEL I

Step-by-step instructions for the TRS-80 user who wants to progress from BASIC to machine and assembly language programming with the TRS-80 Model I system. A complete how-to guide with numerous examples.

21809 $14.95

THE S100 AND OTHER MICRO BUSES

The key to successful computer expansion is a complete understanding of the bus system, through which the computer communicates with peripherals. This book will give you that understanding.

21810 $13.25

APPLESOFT LANGUAGE

Written for Apple II micros that use the Microsoft language, this introduction covers each aspect of programming in non-technical language, from elementary concepts to advanced techniques.

21811 $13.95

TRS-80 — MORE THAN BASIC

Learn to program in Z80 mnemonics by using the book's error-tolerant interactive monitor program. Over 26 commands available, with total documentation that helps you change the commands to meet specific applications.

21813 $15.95

INTRODUCTION TO FORTH

The most complete book available on the MMS FORTH version of FORTH, but also a fundamental approach to programming in all versions of FORTH. Many programming examples are provided, with direct comparisons to the Microsoft Level II BASIC version of these programs.

21842 $14.95

TRS-80 ASSEMBLY LANGUAGE MADE SIMPLE

If you have an understanding of BASIC programming, this book will help you learn to plan, write and hand-assemble your own assembly language programs in memory, using the T-bug and Level II BASIC ROM subroutines.

21851 $19.25

THE 68000: PRINCIPLES AND PROGRAMMING

An easy-to-read, systematic approach to the 68000 advanced 16-bit microprocessor. The book guides you through the complex architecture, instruction set, pinouts and interfacing techniques. Written for design engineers, programmers and students.

21853 $19.95

APPLE INTERFACING

Using this book, you will be able to perform useful experiments which will provide a much clearer understanding of the fundamentals of computer interfacing and computer electronics. A better understanding of interactions between hardware and software will enable you to communicate more effectively with your Apple.

21862 $15.95

CIRCUIT DESIGN PROGRAMS FOR THE APPLE II

A series of ready-to-run Apple II programs ideal for electronics design engineers and others faced with solving problems related to plotting and verification of experimental data. The programs may be used as subroutines in larger programs, and many can be translated to run on other microcomputer systems.

21863 $23.75

MOSTLY BASIC: APPLICATIONS FOR YOUR TRS-80 — BOOK 2

32 ready-to-run BASIC programs, including two to test your ability in history and maths, a Dungeon of Danger that's strictly for fun, eleven household programs, seven on money and investment, two to test your ESP level, and more. Complete with explanations, sample run and listing for each program.

21865 $19.25

MICROPROCESSOR CIRCUITS VOL. 1

Presents basic microprocessor concepts in simple language for begineers and teaches you to construct a useful microcontroller system. Offers 30 demo circuits which take you through assembly, operation and programming of a microcontroller.

21877 $14.75

PROGRAMMING WITH ADA

This sourcebook features a thorough coverage of ADA language and stresses topics unique to ADA, such as packages, tasks, and order mechanisms for concurrent programming and multi-tasking. This text is best used by programmers with some experience in other high-level languages.

30697-0 $23.75

PROGRAMMING IN BASIC FOR PERSONAL COMPUTERS

Simple instructions show how to give BASIC commands and statements a wide range of applications, from programming video games to developing business or scientific programs.

30739-X $14.75

THE UCSD PASCAL HANDBOOK

Language descriptions organised in a quick and easy reference are given in this book for readers with no prior experience of Pascal programming.

35536-7 $23.75

COBOL FOR BEGINNERS

It is a solid text for introductory programming courses in Cobol, using a format that is easy to understand, yet comprehensive enough to make supplementary readings unnecessary.

39378 $21.95

STARTING FORTH

A clear and complete guide to FORTH, this book covers fundamental principles and then a full set of high-level FORTH commands. It concludes with advanced techniques and style.

42922-7 $23.75

BASIC FOR EVERYONE

349 pages of BASIC information for all purposes.

61481-5 $19.75

THE PET PERSONAL COMPUTER FOR BEGINNERS

This handy guide is written for use with all varieties of PET computer, from the original 2001 to the new 8032 Super PET. It is suited to novices with no practical experience and provides advice and practical examples.

61827-8 $20.95

COMPUTERS AND THE RADIO AMATEUR

For the radio operator who wants to know how computers function and how they can be used with other equipment.

66306 $28.00

BIG THINGS FROM LITTLE COMPUTERS

A layperson's guide to personal computing with all the basic information and lots of examples of how personal computers can be used.

77859 $19.25

BASIC FOR ACCOUNTANTS

Shows accountancy students and accountants how to use a computer to perform the repetitive tasks associated with record keeping, calculating and report writing. Using the BASIC language attention is concentrated on debtors, inventory and general ledger systems.

80098 $9.95

COMPUTER BASED BUSINESS SYSTEMS

A short introduction to the sorts of systems used by a typical business to handle its typical activities. The book aims at providing a general understanding and therefore avoids technological detail.

80192 $10.95

THE COMPUTER SOLUTION

It should be of interest to business people contemplating, implementing or already using computer data processing or to any non-technical person curious to know why and how computers are used in Australian businesses and organisations.

80195 $13.50

A FORTRAN PRIMER

Assumes no previous knowledge of program writing. It covers the fundamentals of the FORTRAN language, enables extensive program writing and concentrates on programming style.

80454 $6.95

SMALL BUSINESS COMPUTERS: A GUIDE TO EVALUATION AND SELECTION

Ideal for the inexperienced user, this text emphasises management considerations in determining the feasibility, economics, evaluation, selection, contracts and practicality of installing a computer.

81134-6 $14.95

SMALL BUSINESS COMPUTER SYSTEMS

This book provides a bridge between the accountant and the DP professional by explaining every step of the trading and reporting process in DP terms. It is especially useful to people engaged in the specification process or in auditing DP accounting systems.

81136 $14.95

Z8000 CPU USER'S REFERENCE MANUAL

A technical manual from Zilog, this book discusses all aspects of the Z8000 package, including instruction sets, data types, addressing modes, systems inputs, timing, memory address space, registers, bit manipulation instructions, external interface devices, etc.

83890-2 $20.75

APPLE MACHINE LANGUAGE

This straightforward book teaches machine language programming through BASIC, the transition being made step-by-step. Many sketches of video displays are provided, as well as exercises with answers.

90230-7 $21.95

BASIC FOR BUSINESS FOR THE TRS-80

This book covers the application of BASIC language to business uses on the TRS-80 models II and III.

90352-4 $22.25

INTRODUCTION TO PASCAL

The second edition of this popular book has been updated to conform to the new international standard of Pascal. The contents illustrate the design and construction of Pascal programs, involving a wide range of basic computer algorithms in a practical context.

91522-4 $19.95

PASCAL PROGRAMMING FOR THE APPLE

This book teaches UCSD Pascal on the Apple II. Many examples, programs for financial applications, graphics, file structures and sound reproduction are supplied.

95454-4 $18.95

PET GAMES AND RECREATIONS

Presenting an interesting mixture of diversions guaranteed to entertain and educate. Ideal for beginners, yet also challenging to computer veterans, the book features progressive levels of difficulty and five different types of games.

95529-X $18.85

EXPLORE COMPUTING WITH THE TRS-80 (AND COMMON SENSE)

This introduction to microcomputers and the BASIC language is suitable for novices and users of the TRS-80. Among the topics covered are creating tables, arts and graphics, games and simulation.

96137-7 $17.95

START WITH BASIC ON THE COMMODORE VIC 20

Helpful exercises and step-by-step instructions show you how to program in BASIC utilizing all the graphic functions of the Vic 20.

97070 $14.75

THE VISICALC BOOK — APPLE EDITION

If you are using Visicalc on your Apple II and want to learn more about its expanded uses then this book will show you how to build a model, enter your data and solve problems about profit/loss projections, pricing/costing estimates etc.

98397 $22.25

ORDER FORM

Send to ETI Book Sales, 4th Floor, 15 Boundary St, Rushcutters Bay NSW 2011.

Please allow 4-5 weeks for delivery. Post & Handling $2.00 per book.

Effective until December 31, 1982.

Please supply

No.	Qty.						
02460	....	21798	....	30697	....	80454	....
04552	....	21809	....	30739	....	81134	....
10163	....	21810	....	35536	....	81136	....
21512	....	21811	....	39378	....	83890	....
21539	....	21813	....	42922	....	90230	....
21650	....	21842	....	61481	....	90352	....
21741	....	21851	....	61827	....	91522	....
21785	....	21853	....	66306	....	95454	....
21788	....	21862	....	77859	....	95529	....
21791	....	21863	....	80098	....	96137	....
21795	....	21865	....	80192	....	97070	....
		21877	....	80195	....	98397	....

I enclose $..... inc. p&h

Name .....

Address .....

..... Postcode .....

Please debit my ☐ Bankcard ☐ American Express Card Expiry Date .....

Number: .....

Signature .....

SYSTEMDEK III

'A very well engineered unit... capabable of a high standard not readily surpassed.'

HiFi BUYERS' GUIDE JAN '82

Hi-fi journalists are raving about the Systemdek III as an outstanding example of audiophile signal source technology. With good reason.

Advanced design and engineering have been combined to produce a unit that allows an unobstructed flow of information from the disc with minimal interference from vibration and resonance — to provide a quality of sound that you thought could not be achieved by your current hi-fi equipment.

Enhanced definition and dimension, a deeper bass response and a stream of subtle aural information that is lost by most other turntables, will ensure your optimum listening pleasure.

So test drive the Systemdek III at your local Systemdek dealer now. And discover what all the hi-fi journalists are raving about.

Arm & cartridge not included.

SYSTEMDEK II

an enviable standard for its price, representing fine engineering & acoustic value for money.

$399

Incorporating many of the design and performance features of our most advanced unit, the Systemdek III, this completely new concept in a budget turntable provides the opportunity for audiophiles to experience the immense benefits that an advanced signal source is able to achieve.

An improved suspension system isolates the specially designed glass platter from the base and its surroundings to provide a level of performance unheard of in this price bracket. And compared with its competitors, the Systemdek II offers a two speed option, simpler alignment procedures, levelling feet and easier arm fitting.

If you are serious about your hi-fi and interested in 'acoustic value for money', then the Systemdek II is worthy of your attention.

See your Systemdek dealer today and discover the true meaning of value for money . . . Systemdek II.

Arm & cartridge not included.
Record clamp optional extra.

For further information contact
Convoy Sydney, 400 Botany Rd., Alexandria 2015. Telephone (02) 698 7300

ELECTRONIC LIFESTYLE

Row brewing over Sydney FM broadcasting

An argument is brewing between Sydney's FM broadcasters and the Federal Government over siting of the transmitters, the broadcasters claiming that a 'towering headache' faces the Government if a suitable site is not found where all services can share an antenna mast.

Sydney, unlike the other capitals, does not have a Black Mountain, Mount Dandenong, Mount Lofty or Mount Cootha etc and siting of broadcast antenna towers is a planners' headache if adequate coverage of what is Australia's biggest audience area is to be obtained.

For some reason, as yet unrevealed, the Federal Government appears to have passed up the opportunity to acquire what would appear to be an excellent site to locate all the FM broadcasters — Centrepoint tower.

Ideally, all services should be located on a single site, with allowance made to add further broadcasters as they become licensed. This means every listener can point their antennas in the one direction for reception of all the FM stations.

At present, FM station transmitting antennas are scattered between city sites, North Sydney and Artarmon. Some stations cannot be received over wide areas owing to Sydney's terrain.

In March, the Department of Communications proposed the cositing of FM transmissions at Centrepoint, with one antenna, shared by all stations, mounted on the tower. Discussions between the stations and the Department in subsequent months considered and compared three sites: the ABC site at Gore Hill, the Northpoint building in North Sydney and the Centrepoint tower. For a variety of reasons, Centrepoint was the broadcasters' preferred site and discussions with D.O.C. proceeded.

Late in July the Department of Communications suddenly switched, naming Northpoint as their preferred option.

2MBS-FM immediately argued strongly against this switch, making submissions to the Minister for Communications against the Northpoint site. The station also objected to the failure of the Department to call for public comment on its proposal or to indicate the attitude to its plans of other affected authorities such as North Sydney council — Northpoint would have to have a 48 m tower built on its roof.

2MBS met with the Minister for Communications, Mr Neil Brown, on the 2nd of August and made submissions on the subject on 4th August. 2MBS says the Northpoint site, favoured by the D.O.C. is an expedient and makeshift decision and will only lead to further problems and expense for Sydney's FM broadcasters.

One wonders why the D.O.C. is being so coy about the switch to Northpoint and why they have made no move to call for public comment on the various proposals.

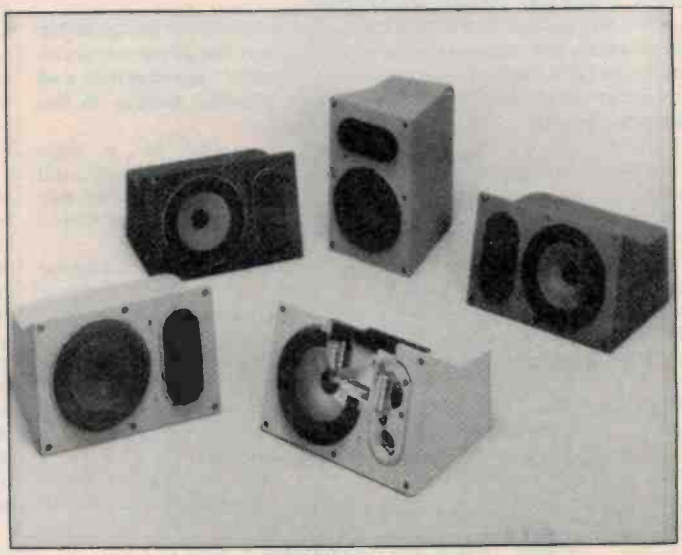
B & W's leisure monitor

B & W's new LM1 'leisure monitor' design is aimed at providing a high-fidelity loudspeaker for use in cars, boats and caravans etc, as well as the home.

Its modest dimensions (240 mm x 195 mm x 155 mm) enable it to be placed unobtrusively in small rooms, on bookshelves etc, or on the rear window-shelf of a car. The LM1 is also available in a panel mounting version.

The LM1 has a number of unique design features for its reliable operation in the high ambient temperatures often experienced in cars. These features include the use of a die-cast alloy enclosure lined with a heavy vibration-damping material and B & W's Kevlar construction for the bass/mid-range loudspeaker cone. The crossover network is provided with a switch which enables the frequency response characteristic to be adjusted either for use in normal rooms or for use in the car.

To protect the LM1 from accidental overload when used with high-power amplifiers the crossover network is fitted with B & W's patented automatic overload protection device, APOC.



LIFESTYLE NEWS

New range of Pioneer products

Pioneer has just released the new Black Avante range of equipment. There are six hi-fi systems which all include an amplifier, AM/FM tuner, cassette deck, turntable, speakers and a matching general purpose glass door cabinet.

The top-of-the-range system also includes a graphic equalizer for achieving a flat frequency response and you can adjust the output sound to suit your own individual needs. Seven separate controls for each channel handle tonal adjustments and the signal-to-noise ratio is 100 dB.

There are five Black Avante amplifiers with power outputs ranging from 20 watts RMS per channel to 70 watts RMS per channel. Three tuners and three cassette decks in this range provide a choice in terms of quality and price. The cassette decks feature Dolby noise reduction, music search and automatic reverse on the top performing deck.

Pioneer is also releasing new products in the Champagne Gold range. These are two new hi-fi systems, Syscom 5 and Syscom 6, and a range of add-on equipment. The add-on components include three graphic equalizers, the SG-9, SG-3 and SG-300, the RG-9 dynamic processor and the SR-9 reverberation amp. These components can be used with the accurate and convenient DT-5 and DT-510 digital timer/clocks.

SP-7 stereo headphones

The new Nakamichi SP-7 stereo headphones have been designed for exceptionally flat, natural response throughout the audio spectrum, broad dynamic range for unrestricted 'lifelike' reproduction and extremely low distortion for the highest possible fidelity to the source program.

These headphones offer the reproduction accuracy required for critical monitoring applications, as well as comfort and freedom from listening fatigue.

The original driver units are dynamic types featuring ferrite magnets 46 mm in diameter, 14.5 mm thick, and having a magnetic flux density of 5500 Gauss. This remarkably powerful magnetic circuit helps to achieve flat, resonance-free response from the extreme low-frequency range right up to the highest audible frequencies.

The diaphragm is formed of 25-micron thick polyester film with an effective diameter of 40.5 mm and a large 18.3 mm voice coil. The diaphragm edge is a high-performance tangential design, and diaphragm breakup distortion has been eliminated through a special double coating process.

Nakamichi claim that, in addition to heightened transient response and minimized harmonic distortion, there is a significant reduction in intermodulation distortion. Further, special earpad design has reduced the variations in subjective response usually caused by changes in earpad pressure.

For more information contact Convoy International, 4 Dowling St, Woolloomooloo NSW 2011. (02) 358-2088.

Kiss the hiss goodbye!

Well, so say BASF with the launch of their new Chromdioxid II high bias tape, claimed to have the world's lowest background noise combined with outstanding sensitivity in the critical high frequency range.

BASF, which invented tape almost 50 years ago, has designed the Chromdioxid II for hi-fi applications where high output at all frequencies is required with low modulation noise.

The tape consists of perfectly-shaped and uniformly-sized particles of pure chromium dioxide, free from the imperfections that can plague ferric oxide tapes.

The new Chromdioxid II is the industry standard reference tape, as judged by the International Electrotechnical Commission (IEC) for bias II — type magnetic recording tape.

The Mobile Fidelity Sound Lab chose Chromdioxid II tape and the latest BASF-developed cassette shell for their Original Master Recording Series. These state-of-the-art pre-recorded cassettes are duplicated in real time from the original recording studio master tapes of some of the world's most prominent recording artists.

The cassette shell housing the new formula tape is BASF's ultra-precision model where tolerances are measured in micrometres.

Tandy to private-label Intellivision

John Roach, president and chief executive of Tandy Corp, has confirmed that Tandy will private-label Mattel's Intellivision video game system.

"We will be stocking up our stores in the next few months," he said, noting that the retail price has been set at US$249. Tandy has purchased an estimated 100 000 systems from Mattel, and will market them under the Tandy Vision/Radio Shack label.

Mr. Roach said the court ruling enjoining Mattel from marketing six video game cartridges for the system "is not going to change our plans at all." Mattel was enjoined from marketing six cartridges for violating a patent that had been licensed to N.A. Phillips.

Meanwhile, one source said that Mattel planned to initiate a US$50 consumer rebate for its Intellivision video game which, when discounting is accounted for, would bring the price of an Intellivision game component down to around $190.

Filth and degradation!

Dirt degrades cassette deck performance. We all know that. What you mightn't know is that Allsop, makers of the Allsop 3 cassette deck cleaning system, have introduced a new model cleaner, called the 'Ultraline'.

The original Allsop 3 cleaner consisted of a cassette case housing a cam, driven by the deck's take-up spindle, driving a felt pad that wiped across the heads. A second felt pad was held against the capstan and pinch wheel. It could only be inserted one way into the deck.

The new 'Ultraline' Allsop 3 cleaner can be inserted either way into the deck and incorporates improved cleaning facilities, according to Allsop. Firstly, the head cleaning pad now has a longer stroke through an improved epicyclic gear drive mechanism. Two felt pads are included for improved contact with the capstan and pinch roller. All pads are held in removable clips so that, when their life is exhausted they can be replaced. Replacement packs are readily available.

The new Allsop 3 Ultraline is available through hi-fi stores and record bars. Distributed in Australia by CPI (Aust.) Pty Ltd, P.O. Box 246, Double Bay NSW 2028.

This remarkable amplifier was developed over 95 years from a primitive reed organ.

The reed organs that Mr. Yamaha designed and built would be considered primitive by today's standards.

But in 1887 they were hailed as the world's finest.

Since then, Yamaha has become the world's largest maker of high quality musical instruments; from flutes to flügal horns, from clarinets to concert grands.

But our audio equipment is perhaps our proudest achievement.

The pyramid-shaped B-6 amplifier illustrated above for instance, is just as much 'state-of-the-art' now as Mr. Yamaha's reed organs were 95 years ago. And though technology has changed, the Yamaha principle hasn't.

All of our audio equipment, just like our fine musical instruments, is designed, crafted and ruthlessly tested by musicians. Just like our reed organs almost a century ago.

Indeed, the trained ear rather than a computer will always be the final arbiter of perfection.

And naturally the perfection that our musicians require and that our heritage demands, cannot be achieved by cutting corners or trimming costs.

Which may explain Yamaha's premium pricing and the full five year warranty we give all our audio equipment.

Simply, Yamaha precision audio equipment will reward those whose passion for perfection matches their means with a lifetime of the finest, most natural sound reproduction.

5 FIVE YEAR WARRANTY

Please send me the latest Yamaha Hi-Fi Catalogue

Name _____

Address _____

_____

Send to: Yamaha Hi-Fi Catalogue,
Rose Music Pty. Ltd., 17-33 Market Street,
South Melbourne Vic. 3205

YAMAHA

MCR/RM3863E

Kiss the hiss goodbye.

Say hello to the world's quietest tape.
New BASF Chrome II.

The new BASF Chrome II – like no other tape on the market today. And why? Because it's made like no other tape.

Perfectly shaped and uniformly-sized particles of pure chromium dioxide provide a purity in sound never before possible. An absolute minimum of background noise with outstanding high frequency response ratios. With BASF Chrome II you hear all of the music and none of the tape.

And isn't that what everyone is looking for?

So, give the hiss a big miss and say hello to the world's quietest tape. The BASF Chrome II.

BASF Chrome II.

Put a BASF in yours.

Now available from most leading Hi-Fi retailers.

HEFK/BASF/261

Exclusive to Marantz. Very sophisticated. Very superior. Very expensive.

Very high fi indeed.

These Marantz Gold components represent the world's most advanced, most inspired, most stringently tested and sophisticatedly engineered audio equipment.

For the wealthy—exclusive toys.

For the connoisseur — the finest hi-fi money can buy.

The Marantz TT1000 (around $2500), with its precision-made high density glass and golden aluminium sandwich structure, is justifiably described as one of the most beautiful turntables ever.

'Playing a series of direct-recorded discs, warped discs, discs with nasty low frequency content and discs requiring unusual trackability performance, showed clearly that this system borders on the superlative in areas where even most good turntables only provide good to above average performance.'

'. . .the resonance characteristics of the TT1000 are the lowest we have yet seen from any turntable irrespective of its selling price.'

'This is top-of-the-line equipment for people who rate hi-fi as their greatest pleasure in life'. — *Louis Challis, Electronics Today International, April 1981.*

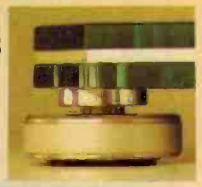
Similarly, the Marantz SM1000 Stereo Amplifier (around $5000) is designed to be the ultimate in luxury and performance.

When it was bench-tested by ETI Magazine in an exhaustive lab study, Louis Challis stated 'The Marantz SM1000 Amplifier has the capability to provide superlative performance at home, in a laboratory, in a studio, or in a rock band with the ease and panache of a professional.

'The power output claims are modest for the unit is readily capable of producing 625 watts into an 8 ohm load with both channels driven . . .'.

And when the Marantz ST8 FM/AM Tuner (around $700) was put through its paces so technically surprising was its performance that a second series of tests was devised to check the first results.

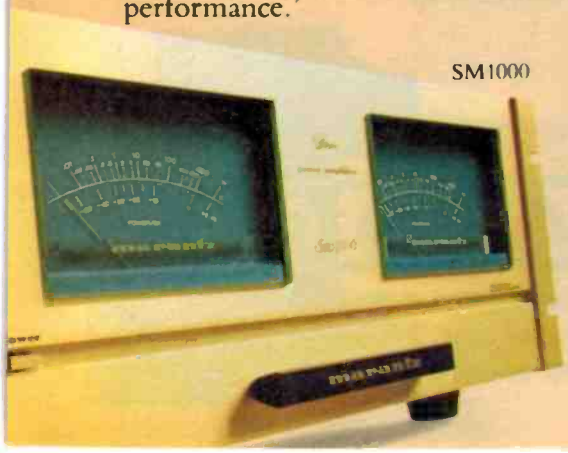
'As a result . . . the Marantz ST8 . . . far ahead of any tuner we have ever measured and better than any tuner we have ever seen reviewed in any other magazine, either local or overseas.' — *Paul de Noskowski, Electronics Australia, April 1981.*



The TT1000's adjustable, high-absorption air suspension audio insulator feet.

Marantz Gold. The New Audio Standard.

ST8



SM1000

Detailed specifications of these exclusive Marantz Gold components are available on request by writing to:

Marantz (Australia) Pty. Limited,
19 Chard Road, Brookvale, NSW 2100
Phone (02) 939 1900 Telex AA24121
Melbourne (03) 544 2011
Brisbane (07) 44 6477
Adelaide (08) 223 2699
Perth (09) 276 3706
Townsville (077) 72 2011

marantz

Best bass yet from a kit!

As featured in Electronics Australia Projects June and July 1981.

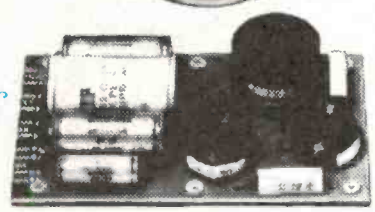
Now Peerless introduces another major advance to kit-set loudspeaker technology. A bass speaker with a rigid polypropylene cone that clearly outperforms traditional paper composite cone speakers to provide: • Cleaner, tighter bass sound reproduction • Low colouration and distortion • High efficiency, suiting 25W to 100W amplifiers • Consistent rigid panel, low mass speaker cones.

Other outstanding features of Danish-built Peerless speaker kit-sets are: • Sealed back mid-range with excellent linearity and low distortion • Latest Peerless 1" soft-dome tweeter • State-of-the-art crossover networks • Exceptionally flat response extending to 25,000 Hz.

Choose from these EA/Peerless speaker projects:
- PAS 100 12" 3-way 100W (100L)
- PAS 60 10" 3-way 90W (60L)
- PAS 25 8¼" 2-way 60W (25L)

includes drivers, crossover, wiring and instructions.

Peerless



Sole Australian Importer, G.R.D. GROUP PTY. LTD.
698 Burke Road, Camberwell, Vic. 3124. Trade enquiries welcome.

CONCORD/6480

N.S.W.

Bondi Junction
Danish Hi-Fi Aust. Pty. Ltd. Ph: (02) 387 5878
Concord
Electronic Agencies Ph: (02) 745 3077
Crows Nest
Deeva Hi-Fi Ph: (02) 439 3999
Dee Why
David Ryall Electronics Ph: (02) 982 7500
Sydney
Electronic Agencies Ph: (02) 29 2098
Wagga Wagga
Car Radio & Hi-Fi Centre Ph: (069) 21 4618

VIC.

Ballarat
Turner Audio Ph: (053) 32 2042
Camberwell
Danish Hi-Fi (Aust) Pty. Ltd. Ph: (03) 82 7348
Cheltenham
Beland Electronics Ph: (03) 550 2279
Geelong
Steve Bennett Audio Ph: (052) 21 6011
Hawthorn
Tivoli Hi-Fi Ph: (03) 818 8637
Warrnambool
Bruce Henderson Audio World Ph: (055) 62 5147

S.A.

Adelaide
Hi-Fi Acoustic Ph: (08) 223 6774
Adelaide
Danish Hi-Fi Aust. Pty. Ltd. Ph: (08) 51 2124
Goodwood
The Acoustic Foundry Ph: (08) 271 0276
Hawthorn
Sound Craftsmen Ph: (08) 272 0341
St. Peters
Miltronix Ph: (08) 42 3781

W.A.

Nedlands
Danish Hi-Fi Aust. Pty. Ltd. Ph: (09) 386 8564

QLD.

Brisbane
Brisbane Agencies Audio Centre Ph: (07) 221 9944
Barunda
G. Mills Stereo Ph: (07) 391 5606
Redcliff
Hi-Fi Sales Ph: (07) 284 2495

AUDIO ONE FOR RANGE
AUDIO ONE FOR SERVICE
AUDIO ONE FOR VALUE

SYSTEMDEK SALE!
Scotland's finest at a price you can't afford to miss –
ONLY $695

(while stocks last)

Welcome to AUDIO ONE – Sydney's most exciting range of **real** hi-fi equipment!

'ON DEMO: AUSTRALIA'S LARGEST RANGE OF ACTIVE LOUDSPEAKERS'

Relax in our comfortable showroom with a cup of coffee and choose from some of the world's leading brands.

AUDIO ONE

' MERIDIAN ' CHARTWELL ' ROGERS ' GRADO '
' HAFLER ' SYRINX ' MONITOR AUDIO ' WALKER '
' AIWA ' HADCOCK ' N.A.D. ' GYRODEC ' and many more . . .

71 MILITARY ROAD
NEUTRAL BAY 2089.
TEL: 90-6001

1 km from Harbour Bridge on the North Side

LIFESTYLE NEWS

New videodisc record/replay system

Although videodiscs and their associated equipment are generally much cheaper than video cassette recorders, they suffer from the great disadvantage that it is normally impossible to alter the material recorded on them during manufacture.

The Japanese Sharp Company has already announced (ETI May 82, p. 121) a videodisc system using a laser which can record and it is interesting to note that the Japan Broadcasting Corporation (NHK) has now also developed a prototype of another type of video disc which can be recorded and erased any number of times.

In the NHK system a neon-helium laser is used to focus 10 mW of light onto the disc which employs the thermomagnetic characteristics of a 0.2 μm thick gadolinium-cobalt amorphous film for recording. A small magnetic field causes local reversal of the magnetisation of the film at points where the laser beam strikes the disc. The whole disc can be erased by a strong magnetic field, but selective erasure is also possible at any selected points.

Most optical disc recording techniques use the writing laser light to vapourise a thin film so that subsequent erasure for re-use is impossible. However, in the NHK system the laser light is attenuated to only 1.6 mW during playback which uses the Kerr optomagnetic effect. Disadvantages of the current system under development are occasional dropouts caused by imperfections in the disc surface and the poor signal-to-noise ratio of only 38 dB. However, NHK are confident that improved amorphous gadolinium-cobalt thin film coatings on the discs will result in a greatly improved performance.

Domestic users naturally wonder whether the equipment required for such recordable disc systems will ever enable them to be cost-competitive with video cassette recorders. If cheap recordable discs are developed, they could have great appeal to business users who would keep them in large numbers, but I cannot foresee the current types of recordable videodisc systems appealing to the home user owing to the high cost of the record/replay equipment. Clearly there is a great market if someone can solve this problem.

Brian Dance

Portable digital electronic time switch

Wattmaster Alco Pty Ltd has added a new model to its range of digital electronic time switches.

The 'Digital 2' is the first portable digital electronic time switch on the Australian market, claim Wattmaster Alco.

The unit has capacity for 12 programmable switching instructions which can be selected on a daily or weekly basis, and offers the added flexibility of programming in day-blocks. The provision of day-blocks means that several days' switching instructions can be programmed without affecting memory capacity.

Portability is achieved by using a revolutionary adaptor plug which provides power for the switch as well as power for the unit to be switched.

Switching capacity is 10 A 240 V, and the time is displayed with green LED's which are brightness self-compensating to adjust for ambient light.

The 'Digital 2' can switch any period from a minimum of only one minute up to 24 hours, and can be programmed in one minute increments.

Wattmaster Alco says that the 'Digital 2' is ideal where accurate time switching is required up to one week in advance, such as for recording radio programmes, for switching medical equipment and other equipment where absentee switching is a benefit, as in the case of equipment with a long warm up period.

For further information contact Mr. John Cronly, Wattmaster Alco Pty Ltd, 11 Rachael Close, Silverwater NSW 2141. (02) 648-1332.

Audio amplifiers using nested differentiating feedback loops

Part 1 — The present state of the art

The use of nested differentiating feedback loops (NDFLs) is a new technique for reducing audible-frequency distortion in an amplifier to a vanishingly low level. As the name implies, NDFLs rely on negative feedback, but they use it in a new way.

Edward M. Cherry
Associate Professor
Department of Electrical Engineering
Monash University

IN ORDER TO UNDERSTAND just how far the new NDFL technique can improve an amplifier, we first need to know the fundamental limits to the reduction of distortion that can be achieved with conventional techniques. In this first of three articles we survey familiar negative-feedback theory.

Figure 1 is a block diagram of an amplifier with negative feedback. In this diagram, the forward path corresponds to the amplifier before feedback is applied, and its gain is traditionally designated by the Greek letter μ. The feedback network returns a fraction β of the output to the input circuit, where it is in some way subtracted from the true input to provide the actual input to the forward path.

In many practical amplifiers, the subtraction is accomplished by applying the input and feedback signals to the two inputs of a balanced differential first stage of the forward path. Figure 2 is an outline practical circuit. In this circuit the feedback factor β is the attenuation of the network comprising R_{F1} and R_{F2}

$$\beta = \frac{R_{F1}}{R_{F1} + R_{F2}} . \qquad (1)$$

A typical value for an audio power amplifier might be 1/20. The forward-path gain μ in Figure 2 corresponds to gain from input to output when the feedback network is removed. A typical value for a simple audio power amplifier might be 1000.

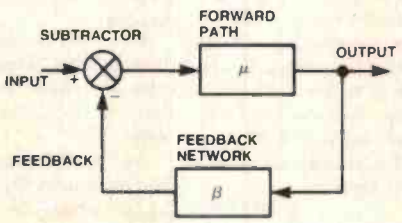


Figure 1. **Block diagram of a feedback amplifier.**

For Figure 1, the overall closed-loop gain A is given precisely by

$$A = \frac{\text{Output}}{\text{Input}} = \frac{\mu}{1 + \mu\beta} . \qquad (2)$$

The quantity $\mu\beta$ is called the loop gain. Physically, loop gain is the gain that would be observed if the feedback 'loop' in Figure 1 was cut at some point, a signal was injected into one side of the cut, and the resulting signal at the other side of the cut was measured.

If the values of μ and β are such that loop gain is small compared with unity, the closed-loop gain is very nearly equal to the forward-path gain (that is, the gain without feedback)

$$A \underset{\mu\beta \ll 1}{\longrightarrow} \mu . \qquad (3)$$

However, if loop gain is large compared with unity, the closed-loop gain approaches the reciprocal of the feedback factor and becomes almost independent of the forward-path gain

$$A \underset{\mu\beta \gg 1}{\longrightarrow} 1/\beta . \qquad (4)$$

The quantity $1/\beta$ is often called the demanded gain, as it is the value the overall closed-loop gain would take in ideal circumstances.

As a numerical example, if we substitute the above values $\mu = 1000$ and $\beta = 1/20$ into Equation 2, the gain of our 'typical' audio power amplifier works out as $A = 19.6$. The approximate Equation 4 predicts $A \rightarrow 20$, within 2% of the correct answer.

The quantity $1 + \mu\beta$ occurs often in feedback theory. It is called the return difference F

$$F = 1 + \mu\beta . \qquad (5)$$

Physically, return difference has the significance

$$F = \frac{\text{forward-path gain}}{\text{closed-loop gain}} \qquad (6)$$

For values of loop gain greater than about 10, loop gain and return difference are almost equal — in our 'typical' example the values are 50 and 51 respectively.

Simplified treatments of feedback theory show that, if the distortion generated in the forward path (that is, the amplifier without feedback) at a particular output signal amplitude is D_μ, then the resulting closed-loop distortion D_A at the same output signal amplitude is

$$D_A = D_\mu / F . \qquad (7)$$

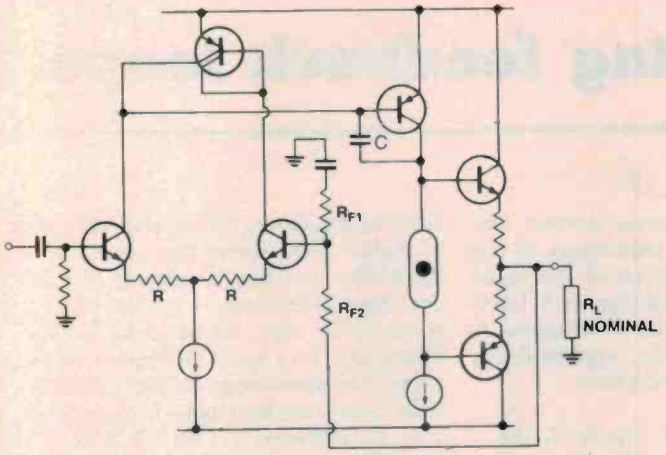


Figure 2. Outline circuit of an audio power amplifier.

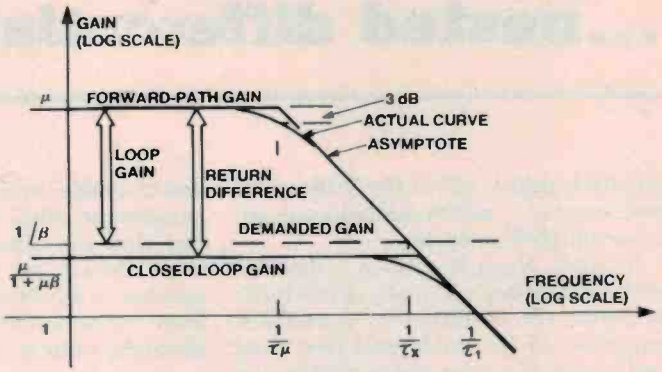


Figure 3. Logarithmic plots of gain versus frequency for Figure 1.

Distortion is improved when feedback is applied to an amplifier by a factor equal to the return difference. In our 'typical' amplifier, F = 51; if the distortion without feedback happened to be 10%, then feedback should reduce the distortion to 0.196%.

More rigorous treatments of feedback theory show that Equation 7 is no more than a poor approximation to the truth. In the first place, real amplifiers are far more complicated than Figure 1 suggests, because several different feedback paths (not all intentional!) can be identified. For example, the collector-base capacitances of transistors inevitably provide some unintended feedback at high frequencies. There is a very real problem in interpreting just what loop gain and return difference mean when there is more than one feedback loop. Once the correct interpretation is established, return difference invariably turns out to be a function of frequency, and the reduction of distortion corresponding to Equation 7 depends on the value of return difference at the frequency of the distortion, not the frequency of the input. Feedback therefore, does not reduce all distortion components equally.

Finally, it is found that the closed-loop distortion of an amplifier can contain new components that were not present in the distortion that existed in the forward path before feedback was applied. These new distortion components initially increase as loop gain is increased, but they fall away again towards zero as loop gain is made large.

Despite all these complications, the fact remains that adequate negative feedback, properly applied, does reduce distortion. Why, then, do amplifier designers not simply apply some arbitrarily large amount of feedback and reduce amplifier distortion to the vanishing point?

TIM, IIM, PIM, ...

In the last 10 years or so, readers of audio magazines have been made aware of a conjecture that goes something like this:

> "Harmonic distortion and the usual intermodulation distortion decrease with increasing feedback. Transient intermodulation distortion (TIM) increases with increasing feedback, and is approximately directly proportional to the feedback. Therefore, there is an optimum value for the feedback at which the subjective distortion sensation is least. This optimum feedback is unlikely to exceed about 20 dB."

More recently, there has been conjecture that heavy overall feedback should be applied with caution if interface intermodulation distortion (IIM) is to be avoided. An amplifier should provide a low open-loop output impedance so that the need for feedback-generated loudspeaker damping is minimised.

There has also been conjecture that negative feedback, which reduces the usual intermodulation distortion, may increase phase intermodulation distortion (PIM) by converting amplitude nonlinearities into phase nonlinearities.

Unequivocally, none of these conjectures has any basis in the new NDFL amplifiers. As an aside, there is a substantial body of opinion that none of these conjectures has any basis, full stop; interested readers should refer to References 1 — 12.

Instability and oscillation

A fundamental limit to the amount of feedback that can be applied to an amplifier is set by the onset of instability and oscillation.

If the magnitudes of the forward-path gain and demanded gain of the idealised Figure 1 are plotted versus angular frequency ω (in radian/second) on logarithmic scales, the resulting graph looks something like Figure 3. The 3 dB bandwidth of the amplifier without feedback is $1/\tau_\mu$, and the gain-bandwidth product (at which gain drops to unity) is $1/\tau_1$.

Because the graph is on logarithmic scales, the separation between the curves of forward-path gain and demanded gain is the loop gain (remember that, to divide two numbers, you subtract their logarithms; if you divide μ by $1/\beta$, you get $\mu\beta$). The magnitude of loop gain falls to unity at the frequency $1/\tau_X$ where the curves intersect and their separation is zero (remember that the logarithm of unity is zero).

By a similar argument, return difference is the separation between the curves of forward-path gain and closed-loop gain, as indicated in Figure 3.

We could make a similar graph to Figure 3, showing the phases of μ and $1/\beta$. Again, the phase of loop gain would turn out to be the separation between the two curves. However, there is a remarkable piece of mathematics due to Bode, who used a transformation evolved by Hilbert (1862-1943), which shows that there is a relation between the magnitude and phase of the response of any linear system. Subject to some qualifications, our proposed graph of the phases is completely predictable from Figure 3 and contains no new information. Interested readers may refer to Chapter 14 of Bode's book (Reference 13), but are warned that it is anything but easy going!

As an example, many readers will know that, if the forward-path in Figures 1 and 3 has a high-frequency cut-off rate variously described as single pole, 20 dB/decade, or 6 dB/octave, then ▶

...nested differentiating feedback loops

its phase shift is 45° at the 3 dB cut-off frequency $1/\tau_\mu$, and is asymptotic to 90° at very high frequencies.

In 1932, Nyquist applied a theorem which dates back to Cauchy (1789-1857) to derive the condition for a feedback amplifier to be stable and free from oscillation. If a polar plot is made of the magnitude and phase of return difference as frequency is varied, a vaguely 'snail-shaped' curve results. Such a polar plot is called a Nyquist diagram. Subject again to some qualifications, the stability criterion for a feedback amplifier is that its polar plot of return difference should not enclose the origin. Figure 4 shows one example each of a stable situation and an unstable situation.

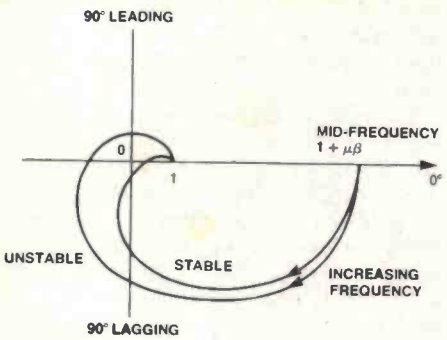


Figure 4. Nyquist's stability criterion. The curves are polar plots of return difference for changing frequency.

Because the phase of return difference can be predicted from Figure 3 via Bode's result a Nyquist diagram can also be constructed from Figure 3 and the onset of instability can be predicted. In 1945 Bode showed that Nyquist's criterion could in fact be expressed in terms of the gradients of the curves in Figure 3, thereby eliminating the work of finding the phase explicity and plotting the Nyquist diagram. Bode's exact rule is complicated, but a useful paraphrase is

> "If in graphs such as Figure 3 the separation between the forward-path gain and demanded gain decreases toward zero at a rate not exceeding 30 dB/decade, the amplifier is unlikely to oscillate."

This paraphrase makes no allowance for the tolerances on components. It assumes, in effect, that everything about the forward path is well known and constant. In the audio context, the paraphrase takes no cognizance of the fact that the capacitance of the leads that connect an amplifier and loudspeaker is anything but well known. A more conservative rule, applicable to the audio context, is therefore

> "In graphs such as Figure 3, the separation between the forward-path gain and demanded gain should not decrease towards zero at a rate exceeding 20 dB/decade."

The practical consequence is that the forward path of an audio amplifier with conventional resistive feedback should have a single dominant pole which sets the fall-off of gain at frequencies above $1/\tau_\mu$. The second and subsequent poles should all lie at frequencies substantially above $1/\tau_X$ (the frequency where the separation reaches zero), because each pole contributes a 20 db/decade downwards slope to the graph of forward-path gain.

Maximum available feedback

In Figure 2, the first stage is a long-tailed pair with a current mirror at its output; the input and feedback signals are applied to the two bases to perform the subtraction process of Figure 1. The second stage provides a large voltage gain, and the lag compensating capacitor C provides the dominant pole of the forward path corresponding to $1/\tau_\mu$ in Figure 3. The third stage is a complementary class-B emitter follower whose function is to transfer the output voltage from the second stage to the loudspeaker load. In practice, the transistors in the second and third stages are often Darlingtons, and the input transistors are often replaced by FETs.

In any amplifier, there is at least one pole associated with the finite transit time of electrons through each transistor. The transit time for typical small-signal transistors is a fraction of a nanosecond, but for power transistors of the ubiquitous 2N3055 class the transit time may be as long as a few tenths of a microsecond. Thus, the output stage of Figure 2 may have a pole in the vicinity of 1 MHz.

As we saw in the previous section, the unity-loop-gain frequency $1/\tau_X$ in Figure 3 must be substantially less than the frequency of all poles except the dominant pole $1/\tau_\mu$ if an amplifier is to be stable. If the power transistors are of the 3055 class then, no matter how fast the other transistors may be, there is going to be one pole at about 1 MHz. Therefore, $1/\tau_X$ must be chosen to correspond to something like 200 kHz. Even with more modern power transistors, $1/\tau_X$ is restricted to about 1 MHz. The art of designing a stable power amplifier involves choosing the lag compensating capacitor C such that $1/\tau_X$ is appropriate to the transistors actually used.

The geometry of Figure 3 is such that, no matter how μ, β and τ_μ are separately chosen, the return difference $F(\omega)$ at any angular frequency ω cannot exceed

$$F(\omega) \leq 1/\omega\tau_X \quad (8)$$

Thus, if $1/\tau_X$ is designed to correspond to 200 kHz, return difference at 20 kHz cannot exceed 10 (= 20 dB), and cannot exceed 200 (= 46 dB) at 1 kHz. An amplifier that boasts 80 dB of feedback (F = 10 000 at low frequencies) must have $1/\tau_\mu$ corresponding to about 20 Hz; return difference must begin falling above 20 Hz, and the former values at 1 kHz and 20 kHz (46 dB and 20 dB) still apply.

Returning now to Equation 7, the effectiveness of feedback in reducing distortion is set by the frequency of the distortion, not the frequency of the input. The audible frequency range is generally reckoned to extend to about 20 kHz and, with the foregoing constraints, return difference at this frequency cannot exceed 10. Remembering that 20 kHz is the third harmonic of 6.667 kHz, we see that feedback cannot reduce offensive odd-harmonic distortion of mid-treble input signals by more than a factor of 10. Remembering too that 20 kHz is the seventh harmonic of 2.857 kHz, we see that feedback cannot reduce crossover distortion of mid-range input signals by more than a factor of 10.

Until recently there has been no way around this problem except to increase the unity-loop-gain frequency $1/\tau_X$, and this demands that the frequencies of the transistor poles must be increased if stability is to be preserved. Fragile, expensive power transistors, with narrow bases to achieve short transit times, become mandatory. ●

(... to be continued)

References

1. E.M. Cherry, *Three audio-amplifier dragons*, Proc.IREE(Aust), vol 37, pp 354-360, Dec 1976.
2. P. Garde, *Transient distortion in feedback amplifiers*, Proc.IREE (Aust), vol 38, pp 151-158, Oct 1977. Reprinted in J. Audio Eng Soc, vol 26, pp 314-322, May 1978.
3. P. Garde, *Slope distortion and amplifier design*, Proc.IREE (Aust), vol 38, pp 200-207, Dec 1977. Reprinted in J. Audio Eng Soc, vol 26, pp 602-608, Sept 1978.
4. W.G. Jung, M.L. Stephens and C.C. Todd, *An overview of SID and TIM*, Audio, vol 63; part 1, pp 59-72, June 1979; part 2, pp 38-47, July 1979; part 3, pp 42-59, Aug 1979.
5. R.R. Cordell, *Open-loop output impedance and interface intermodulation distortion in audio power amplifiers*, 64th Audio Eng Soc Convention, preprint no. 1537, Dec 1979.
6. R.R. Cordell, *Another view of TIM*, Audio, vol 64; part 1, pp 38-49, Feb 1980; part 2, pp 42-59, March 1980.
7. E.M. Cherry, *Transient intermodulation distortion: Part 1 — hard nonlinearity*, IEEE Trans, vol ASSP-29, pp 137-146, April 1981.
8. R.R. Cordell, *Phase intermodulation distortion — instrumentation and measurement results*, 70th Audio Eng Soc Convention, preprint 1842, Nov 1981.
9. E.M. Cherry and G.K. Cambrell, *Output resistance and intermodulation distortion of feedback amplifiers*, J. Audio Eng Soc, vol 30, pp 178-191, April 1982.
10. E.M. Cherry, *Feedback, sensitivity, and stability of audio power amplifiers*, J. Audio Eng Soc, vol 30, pp 282-294, May 1982.
11. E.M. Cherry and K.P. Dabke, *Transient intermodulation distortion: Part 2 — soft nonlinearity*, IEEE Trans, to be published*.
12. E.M. Cherry, *Amplitude and phase of intermodulation distortion*, J. Audio Eng Soc, to be published*.
13. H.W. Bode, *Network analysis and feedback amplifier design*, van Nostrand (Princeton NJ) 1945.

* Manuscript copies available from the author.

ARE YOU MISSING OUT?

You've spent hundreds or maybe thousands of dollars on your hi-fi. Great amplifier, superb turntable, fantastic speakers. But are you getting all the sound you paid for?

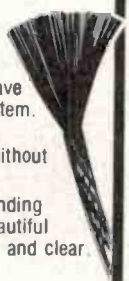
Probably not . . . if the vital connections between your hi-fi components aren't made using the Monster Cable system of precision cables, connectors and accessories.

Monster Cable is a proven interconnect system that will dramatically increase audio performance and provide the best acoustic value-for-money improvement you're ever likely to make to your hi-fi.

If you're really serious about your sound system and the listening pleasure you derive from it . . . read on!

MONSTER CABLE

AUSTRALIA'S LARGEST SELLING SPEAKER WIRE SYSTEM



The rapid improvements in power amplifiers and loudspeakers have focused attention on a major weakness — the speaker cable system.

By eliminating the problems associated with conventional wire, Monster Cable directly couples your amplifier to your speakers without loss, without distortion.

How? More copper, finer strands, higher purity and a unique winding configuration that lets your amplifier and your speakers make beautiful music together. For sounds that are dynamic and powerful, open and clear. The way real music should be.

And more! Monster Cable provides big performance for little dollars. You can significantly improve the performance of your sound system simply by switching from your conventional speaker wire to Monster Cable — it costs you less than buying better speakers, a better amplifier, or even a better cartridge.

However . . . beware the imitators. They offer price but not quality. Only the finest materials are used in producing Monster Cable. And it is safe to use with all amplifiers, regardless of design.

Monster Cable is available conveniently pre-packed in 3.7 metre (12 ft), 6.1 metre (20 ft) and 9.1 metre (30 ft) pairs, or can be professionally cut and terminated in custom lengths at your local Monster Cable dealer.

PERFORMANCE STANDARD SERIES

INTERLINK/PHONOLINK

Designed specifically for transmitting low level audio signals, Interlink sets a new standard of performance and value in interconnect cables — for turntables, pre-amplifiers, tuners and tape decks. (And video equipment as well.)

Interlink features a special ULTRA LITZ conductor — over 100 separately insulated strands of high purity copper. This inner core allows the most accurate signal transfer without high frequency loss.

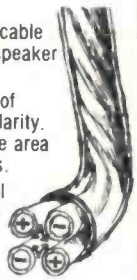
Monster Cable has also developed and produced the perfect termination for Interlink cable — Phonolink, a precision gold-plated RCA-type plug.

Phonolink features a split centre shaft for increased contact pressure and materials that reduce interference with the audio signal to an absolute minimum.

Sonically, Interlink/Phonolink combine to maximise your sound system's performance for increased clarity, greater dynamic range, lower distortion and reduced hum and RF interference.

Interlink/Phonolink is available in pre-packaged 1 metre pairs or can be cut and terminated to the exact length you require by your Performance Standard Series dealer.

POWERLINE



Powerline is a four conductor, controlled impedance speaker cable that has been designed as the ultimate link in the amplifier-speaker interface.

Based on the high purity, fine copper stranding construction of Monster Cable, Powerline utilizes two conductors for each polarity. This results in extremely low resistance and a greater surface area of conductivity for maximum power transfer at all frequencies.

Sonically, Powerline brings you one step closer to the musical event. Startling clarity in the highs, tight well-articulated bass, dynamic impact and the precise localisation of instruments within the sound stage enhance your aural experience.

Powerline is available in custom cut and terminated lengths from your local stockist. He'll also be able to demonstrate the advantages provided by this new technology, which make Powerline a lifetime investment in your listening pleasure.

AND WHATEVER THE CONNECTION . . . MONSTER CABLE CAN MAKE IT

Gold Pin. The smallest and perhaps the most universal of our amplifier- to-speaker connectors.

Gold Spades. Beautiful construction with hard gold surfaces to make the ideal connection with many of today's amplifiers and speakers.

Gold Banana. An elegantly simple connector, using a crimp-on design with multiple fingers, that can significantly reduce contact distortion.

X-Terminator. An expanding solid shaft tip provides both greater contact area and high contact pressure — the ultimate banana-type connector.

Cramolin. Oxidation and contamination, which attack every connection point in an audio system, can now be corrected and prevented.

Cramolin Red solution removes distortion-producing oxides and corrosions, while Cramolin Blue solution preserves and protects cleaned contacts from any further deterioration.

The Monster Cable interconnect systems and accessories are available at all leading hi-fi stores. Happy listening from all of us at Monster Cable.

Get all the sound you paid for...

MONSTER CABLE

Distributed by Convoy Sydney (02) 698 7300

RG/C1594

Simply more than better!

AUDIO 2000

- ☐ When you've decided you need that new turntable (meaning now unless you already have your Walker!) and you've checked out the fancy prices against engineering quality and performance of others – look at Walkerdeck CJ55.
- ☐ Simple, logical, economical design. Innovative use of materials. Fully sprung sub-chassis system. Precision belt drive. Universal arm mounting arrangements. And, all levelling and suspension adjustments can be made from above!
- ☐ Listen to it – and you'll know how much difference a truly good turntable can make.
- ☐ Buy it, and you'll know the satisfaction of owning a superior, reliable, consistently excellent product.
- ☐ Walkerdeck CJ55.
- ☐ When you're ready for something that's simply more than better!

Illustrated:
WALKERDECK CJ55 WITH HADCOCK GH220S TONE ARM AND GRADO GF1+ CARTRIDGE

DISTRIBUTED BY:

AUDIO 2000

P.O. Box 107, Brookvale NSW 2100. Tel: (02) 939-2159.

Please send me further information on the Walkerdeck CJ55

NAME:

ADDRESS:

Postcode

Ref: CW1

Vector Research VR 5000 FM AM receiver

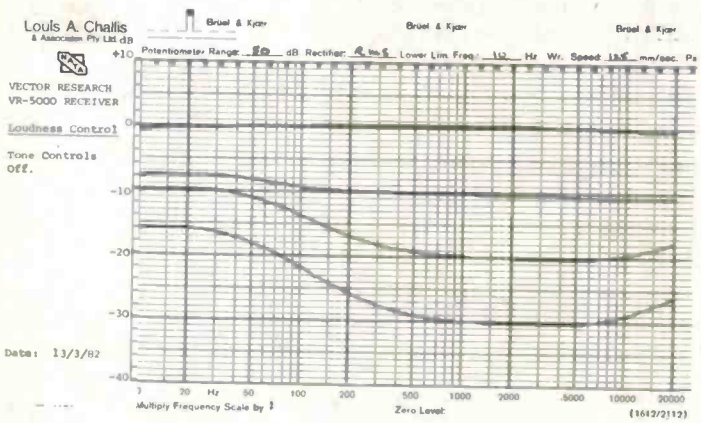
The Vector Research VR 5000 has some outstanding features and a few weaknesses. Ho . . . hum. If they had only reduced that hum level, the performance would have been even better.

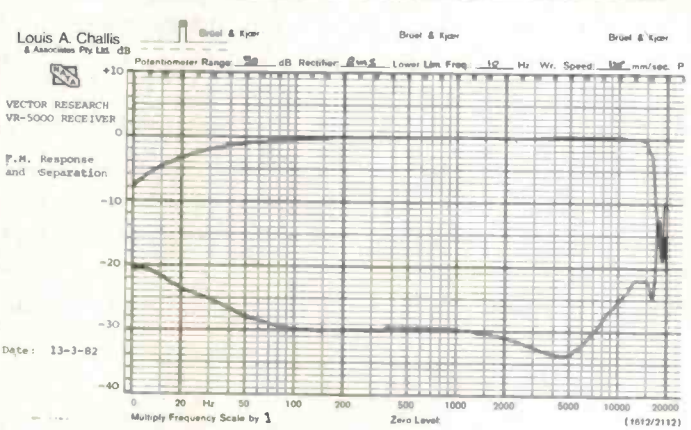
Louis Challis

GIVEN THE CHOICE of purchasing a good stereo amplifier and a separate FM tuner, most purchasers opt for the stereo receiver because of its convenience and generally slightly lower cost. The savings are real and the user benefits are unquestioned, for simply by throwing a single switch you can change from tuner to record player or cassette player. This minimises the number of controls that you have to twiddle in order to achieve convenience plus quality sound. The Vector Research VR-5000 is a good example of the new generation of FM/AM receivers developed for those people who like "uncluttered" designs.

VECTOR RESEARCH
VR 5000 FM AM RECEIVER

Dimensions:	*440 mm wide X 142 mm high X 376 mm deep*
Weight:	*11 kg*
Price:	*$499 rrp*
Manufactured:	*In Japan by Vector Research Inc. of Chatsworth California*
Distributor:	*Keio International Pty Ltd, 198 Normanby Rd, Sth Melbourne, Vic. 3205. (03) 64-3546*





Features

Vector Research, based in California, are not yet well known in Australia. The designers have gone to a lot of trouble to provide all the features that the intending user may be looking for and a few more which he may not have thought of. The receiver is designed with an extruded aluminium front panel with a matt black finish and white silk screened designations for controls. The top third of the receiver features a rear-illuminated panel with a signal sensitivity meter at the left and a centre zero tuning meter adjacent to it so that the FM station can be visually aligned and correctly tuned. Adjacent to this is a 250 mm long slide rule dial with an FM tuning of 87 MHz to 109 MHz, whilst the AM section covers 515 kHz to 1650 kHz.

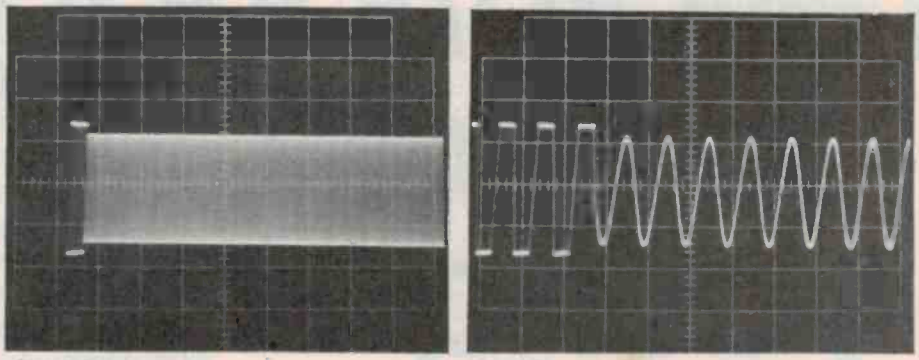
The central raised section of the receiver contains a power switch on the left hand side with two push button controls for high filter cut and FM muting on the right hand side. There are also function verification light emitting diodes to show the selection of AM/FM, FM stereo when the stereo signal is detected by the pilot tone carrier, phono and auxiliary.

The bottom row of controls includes a tip ring and sleeve socket for headphones and a speaker selection switch with OFF, A, B, and A+B. Unlike most other receivers on the market, as well as the bass and treble controls, the unit also has a mid range control. This provides modest but very usable and effective control for frequencies lying between 100 Hz and 10 kHz. The plateau region of this control covers the range 800 Hz to 2 kHz and provides the mid-range control in the frequency domain where it is most useful. The volume control and balance control are coaxially located centrally in the bottom panel. To the right of these are three toggle switches, one for Loudness ON/OFF, another switch is for selecting tape 1, source, or tape 2 and a third switch is for tape copy with selections of 1 to 2, out, and tape 2 to 1, for recording. The function selector provides direct switching for AM, FM MONO, FM AUTO, PHONO and Auxiliary. The 'auto' function indicates when the signal sensitivity is too low for good stereo reception to operate and then the receiver will automatically switch into the MONO mode. The tuning control operates through a counter-weighted drive system to smoothly select the required station.

The rear of the receiver has FM terminal connections of 75 ohms and 300 ohms. There is a ball-jointed moulded AM loopstick which has a greater range of adjustment than most other loopsticks on the market but the reception will only be good on local stations. There is an aerial and earth connection for an external AM antenna which can be used in fringe areas of poor reception. Coaxial sockets are provided for moving magnet cartridges and auxiliary inputs, such as a separate radio receiver. There are two sets of input and output coaxial sockets for two separate tape recorders. Obviously, one does not need to connect both, but if one does the functions provided on the front panel are effective and facilitate tape copying without impinging on the radio or amplifier functions.

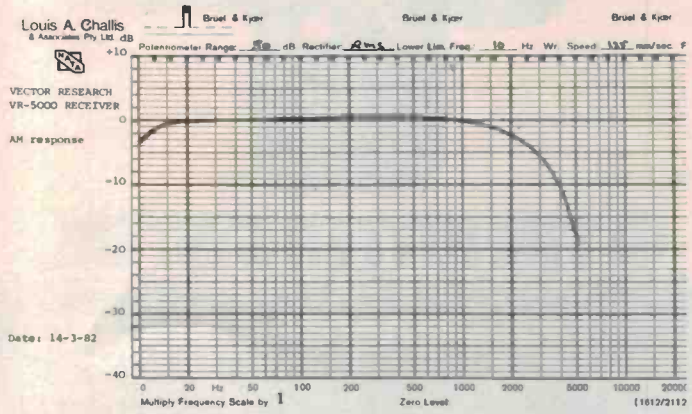
The speaker sockets are colour coded with effective spring loaded terminals which retain the bared speaker wires by means of sensibly designed taper entry moulded sockets. Above each of these sets of sockets is a speaker fuse with a 4 amp rating. These fuses are designed to blow in the event of an overload or as a result of shorting the speaker leads. ▶

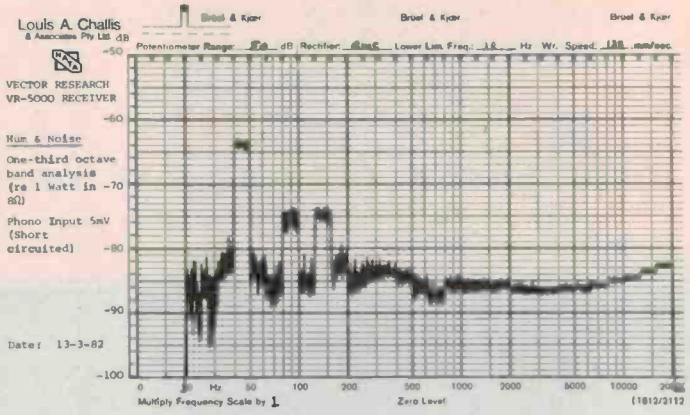
Transient overload recovery test (IHF-A-202). 10 dB overload re rated power into 8 ohms, both channels driven. Overload duration: 20 ms; Repitition rate: 512 ms.



50 ms/div

1 ms/div





A revolutionary way to grow younger.

Let's face it, every car interior gets old. But it needn't show. The Kitten System has created Revive All, the facelift that comes in a bottle.

Revive All will dramatically improve the appearance and feel of vinyl or leather upholstery, the dashboard, inside doors, roof linings, tyres, rubber bumper strips and vinyl tops.

Now this isn't just an extravagant claim. Revive All penetrates surfaces with a special silicone film to restore original beauty.

And if you use it regularly, Revive All will preserve against cracking and decay caused by natural elements.

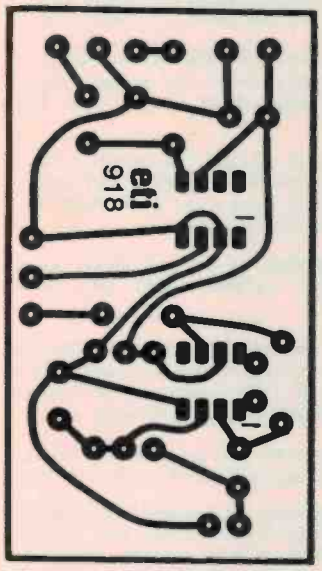
If you have an interior that needs cleaning, we recommend Kitten Interior Cleaner or Kitten Upholstery Cleaner before using Revive All.

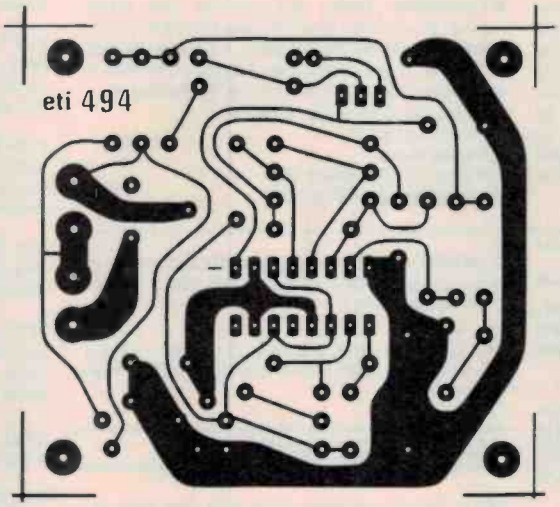
Otherwise, for your car's good health, use Revive All regularly and help your car grow young.

KIW 311/2

THE KITTEN SYSTEM.

THE CREAM OF CAR CARE.





Using ETI PCB Artwork

This method can be used to make negatives of ETI artwork from October 1977 on, provided the reverse of the page is printed in blue. The film used is Scotchcal 8007, which is UV sensitive and can be used under normal subdued light.

Cut a piece of film a little larger than the pc board and expose it to UV light through the magazine page. The non-emulsion side should be in contact with the page. This surface can be detected by picking the film up by one corner — it will curl towards the emulsion side. Exposures of about 20 minutes are normally necessary.

The film can now be developed by placing it emulsion side up on a table, pouring some Scotchcal 8500 developer on the surface and rubbing it with a clean tissue.

Further information on Scotchcal and pcb manufacture can be found in the September and December 1977 issues of ETI.

Please note that occasionally lack of space may prohibit the printing of blue type behind all pcbs. In this case the reader must resort to more conventional photographic techniques for pcb manufacture.

MINI-MART

Where readers can advertise — For Sale/Wanted/Swap/Join.

● We'll publish up to 24 words (maximum) totally free of charge for you, your club or your association. Copy must be with us by the 1st of the month preceding the month of issue. Please — please — print or type adverts clearly, otherwise it may not turn out as you intended! Every effort will be made to publish all adverts received; however, no responsibility for so doing is accepted or implied. Private adverts only will be accepted. We reserve the right to refuse adverts considered unsuitable.

● Conditions: Name and address plus phone number (if required) must be included within the 24 words. Reasonable abbreviations, such as 25 W RMS or 240 Vac, count as one word. Adverts must relate to electronics, audio, communications, computing etc — general adverts cannot be accepted.
Send your advert to:
ETI Mini-Mart,
4th Floor, 15 Boundary St,
Rushcutters Bay NSW 2011.

AUDIO

WANTED: Stereo IR remote control, any condition. And basic audio expander-compressor in working order. Write to D. Elder, 1 Beltana Pl, RAAF Base, Darwin NT 5789. (089)80-5560.

FOR SALE: Playmaster stereo amplifier 50 watts/channel MOSFET type. Assembled, in perfect working order. $150. Phone Phil Ferrier (055) 62-5747 or write to 7 Patricia St, Warrnambool Vic. 3280.

MISCELLANEOUS

TEKTRONIX OSCILLOSCOPE for sale. 60 MHz bandwidth, excellent condition. $780. G. Kingsmill, 11 Plunkett St, W. Heidelberg Vic. Phone (03) 497-4291 after 7 pm.

FOR SALE: Stepping motors, American SLO-SYN. M092 –FC08, 1.8° step angle, 3 V, 4 A. Three, new in pack. $100 each. Phone (05)261-3144.

WANTED TO BUY: Philips or Mullard Valve Data Book or Radiotron Valve Manual. R.A. Attwood-Alchin, 86 Main Rd, Solomontown SA 5540.

TRIO 15 MHz dual trace CRO with manual, no probes, hardly used. $500. Also EA2650 computer, 8K RAM, two I/O ports, cassette interface. $200 ono. (02)625-6058.

FOR SALE: Oscilloscope Philips PM3265E, 150 MHz, dual trace, delayed sweep, wide screen, probes and manuals, 4years old. Good condition. $1250. Moorabbin Vic. (03)555-5175.

SELL: Parts (some ex-united trade sales) all priced. T/FMR 240 Vac — 110 V 2A (x2). $35. Mark Sully, 61 Newman St, Niddrie Vic. 3042. (03)379-2879.

WANTED TO BUY: Set of Dreamer/6800 User Group newsletters, preferably complete, from Sept 80 to March 82. Phone (03)560-4438.

WANTED: AWA or similar 5" CRO, valve type. Tube and electrical condition unimportant. Phone reverse charge Bruce (068)42-1894 after 7 pm.

ELECTRONIC SOLDERLESS project kits for hobbyists of all ages. Normally $40, only $20. (046)26-5713.

DICK SMITH SERIES colour TV game set. Four plug-in cartridges and rifles included. Only $100 the lot. (046)26-5713.

CLARION — auto reverse AM/FM pushbutton car radio cassette. Deluxe model PU-758A. As new. $180. (046)26-5713.

VIDEO TAPE RECORDER. Shibaden SV-610. Working with tapes and monitor. $100. Phone (02)89-1450.

COMMUNICATIONS

SELL: DX-302 receiver, KX-2 ATU plus long wire antenna. $250 or swap for FRG7, ICF2001, R1000 etc. Write to Tim Dodsworth, P.O. Box 917, Ingham Qld 4850.

WANTED: Communications receiver DR22 Tandy FRG7 or similar. For general purpose SW listening. (02)46-3539.

FOR SALE: 18 channel AM CB plus power supply, carry case and battery pack. Good condition. $90. J. Hamilton, 7 Shirley Rd, Wollstonecraft NSW. (02)43-2672.

COMPUTERS

SORCERER 32K c/w all manuals, tapes, programs, inc. WP and Forth, cables for two tapes & printer, $900. R. Hogan, 72 Allonby Ave, Wagga 2651. (069)22-7246.

WORKING DG680 PCG, $120 ono. Write K. Golser, 49 Lord St, Sandy Bay, Hobart 7005.

APPLIED TECHNOLOGY DG640 VDU kit. Untouched, in original package, with manuals, $95. Phone Terry Day, working hours, (02)73-0433 ext. 440.

ICL 7181 intelligent VDU, 14" tube, detachable Honeywell QWERTY keyboard with editing and cursor control keys. 240 Vac operation, $300. Long, 46 Gloucester St, Sydney. (02)27-2982 a.h.

SELL: ZX-81, 16K RAM, full 'real' keyboard and case (super 80), ROM book, six AZUA newsletters and plenty of software. $350. S. Hodgson, 138 Tyler St, Preston Vic. 3072. (03)470-3240.

FOR SALE: Micro-Ace computer, 16K RAM, power supply, TV adaptor and documentation. $190. Phone John (02)525-1292 ah or (02)517-1851 ah.

FOR SALE: APF Colour Computer, including colour monitor, 8K RAM, 14K ROM and joysticks. $700. Phone (03)798-3319.

WANTED: Data sheets for MSM5523RS clock chip and MSL2312RS. S. Featherstone, 14 Pioneer St, Toowoomba Qld 4350. (076)34-3924.

SELL: System 80, Monitor, EDTASM, second tape recorder, cables and manuals. Used for master file update accounting. To be replaced by something bigger. $750. (079)34-4225.

ZX81 MEMORY EXPANSION kits. Increases 1K to 2K for $22 or 2K to 4K for $40. Send order to M.E., P.O. Box 834, Traralgon Vic. 3844.

SELL: Microcomputer 48K compatible with Applesoft programs and hardware add-ons. $790. Peripheral cards for Apple II available. Write to Choon M. Oi, P.O. Box 2354V, GPO, Melbourne Vic.

PDP11 16K memory and back plane. $500 or best offer or part trade for 8" DEC floppies. KSR 35 excellent condition $100 or best offer. Norm (03)534-1192.

FOR SALE: S100 I/O card. Two serial (full RS232), nine parallel (8-bit) with cables and comprehensive manual, never used. $300. Worth $370. Phone Russell (03)211-7671.

OSI SUPERBOARD 11, 8K RAM, power supply, manuals and software. $300 ono. Phone (07)205-3457.

FOR SALE: Micro-Ace computer, 2K RAM, VHF modulator. Including all leads, extra books. Value $250, sell $100. 33/51 Castlereagh St, Liverpool NSW 2170. (02)601-2460 take message.

SELL: System-80, 16K, green screen monitor, programs and books. $750. Phone (02)713-7116.

OSI SUPERBOARD, 48 character RAM, EPROM expansion, DABUG, power supply, disk interface, EXMON EPROM, FORTH, software, books, bits and pieces. Offers. Ray (02)938-4767.

SELL: Commodore 8K old ROM, hardly used. $700. Sound box fitted. David Christie, 34 Colville St, Highgate Hill Qld 4101. Phone (07)246-1474.

SUPER-80: Basic EPROM and power supply, $100 fully connected, all IC sockets, 16K expandable to 48K on-board, tone generator and all documentation. $339. Phone (053)32-6733.

FOR SALE: 'Wang 600' computer. Paper output but no separate display. Perfect condition. Best offer. (02)95-1599.

EPSON MX80 ribbon cartridges. Bought in bulk, have to sell excess. Send $25 for two + small SSAE. S. Petelin, 36 Northam Ave, Bardon Qld 4065.

FOR SALE: Four memory modules for HP-41C calculator. $20 each or four for $60. Phone S. Sidoti (02)660-5120 after 5.30 pm Mon and Tues or after 9.30 pm Wed, Thurs and Fri.

APPLE JOYSTICKS for sale. Single $18, twin $35. 7 day, money back guarantee. Phone D. Plummer (03)267-2596 (ah) or write to P.O. Box 16, Dareton NSW 2717.

PRINTER, Base 2 model 800, 100 cps, serial, tract/frict feed. $450 ono. Memory boards for Motorola Exorciser buss, 8K, $50, 16K $90 ono. All in good condition. C. Stockdale, P.O. Box 871, Morwell Vic. 3840. (051)34-7836.

MICROBEE and Super-80 three tone, seven octave sound generator. Effects range from tunes to UFOs. Circuit diagrams, documentation etc, $6. J. Burns, 6 Banksia St, Townsville Qld 4814.

ETI-660, colour, 3K RAM, audio amp, modulator, cassette leads and hex keyboard in quality metal case. Perfect working order. $260. D. Poole, 1 Spurwood Cl, Kenthurst NSW. (02)654-1473.

SELL: Sorcerer MK1 32K RAM S100 expansion. One disk, printer and paper. Video monitor. $3500. (062)91-8881 after 5.30 pm.

Otherwise it's likely that the output transistors would be destroyed. The mains supply is also separately fused with a 5 amp fuse which is also accessible from the rear panel of the receiver.

The chassis is well made and solidly constructed from coated steel. The top cover and base of the unit are well ventilated to allow for heat dissipation from the amplifier. Unlike many other receivers on the market, this unit does allow the direct connection of either one set of 4 ohms speakers or two sets of 8 ohms speakers in parallel.

Inside

The inside of the receiver is sensibly designed with a fairly neat split between RF and audio stages on the two sides of the chassis. The left hand side of the chassis is divided into three sections with the preamplifier and medium level amplifier stages at the front, the main output stage on a large vertically finned heat sink in the centre and the power output stage, power supply transformer and fuses, located at the rear. The designers have utilised extensive areas of slotted perforations on both the under side chassis and in the top cover, immediately under and over the power output and power supply stages.

On the right of the unit the RF stage utilises conventional tuning gang and dual gate MOSFET RF transistors to provide reasonable sensitivity and good selectivity. Most of the wiring around the top of the printed circuits is associated with dial illumination and a small number of wires, which are in the main screened, carry signals from the rear of the RF stage through to the audio frequency and switching circuitry at the front of the unit. One unusual feature is the design of the illumination circuits for the front of the slide rule dial. This features a fancy plastic moulding to carry the light through the clear plastic down to the front of the panel to provide a uniform light level. The designers have gone to some trouble to suppress switch-on transients with voltage dependent resistors and capacitors located across the power switch and so both switch-on and switch-off transients are positively suppressed.

Amplifier performance

The heart of the VR-5000 receiver is the amplifier which provides particularly good characteristics. The frequency response extends from 4.4 Hz to beyond 100 kHz, with the tone controls centred. The circuit provides particularly low distortion levels right across the frequency range at the rated output of 45 watts with both channels driven into 8 ohms. Under these conditions the distortion at 100 Hz is a modest .036%, at 1 kHz .047% and at 6.3 kHz .065%. At the 1 watt level these figures drop even lower being .012% at 100 Hz, .0056% at 1 kHz and .009% at 6.3 kHz. Any improvement beyond this is unwarranted in a piece of consumer electronics, although some manufacturers play the numbers game to have lower figures.

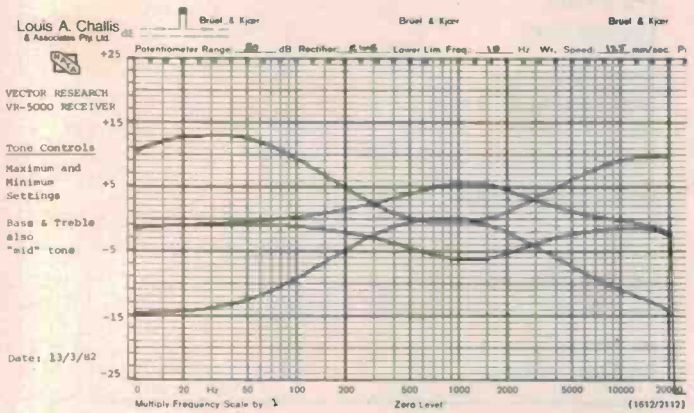
The transient intermodulation distortion is less than 0.1% whilst the hum and noise figures are a shade higher than we have come to expect from top line equipment, being —64.5 dB unweighted relative to the 1 watt level and −74 dB(A). The hum and noise levels on the phono input are very similar at −62 dB unweighted and −74 dB(A) relative to the 1 watt level. The maximum output at the clipping point is 66 watts which provides a dynamic head room of 1.7 dB relative to the rated 45 watts. The phono input level for 1 watt level is 390 microvolts whilst the overload point is 215 millivolts, which provides a very healthy overload margin to protect the amplifier.

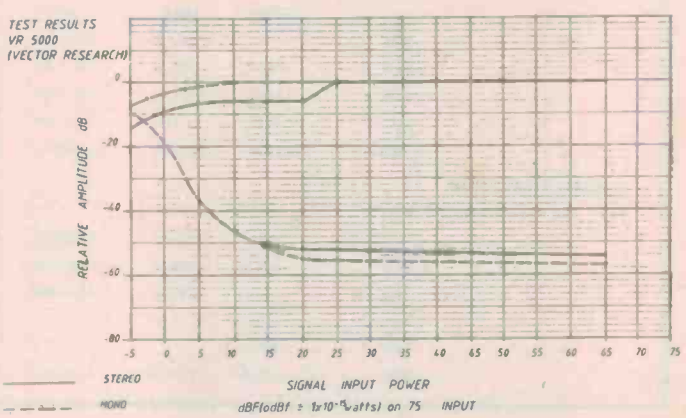
The transient overload recovery test proved to be impeccable and both channels recovered within one half cycle from a full overload. The cross talk between channels is good at low frequencies being typically 40 dB up to 1000 Hz dropping down to −20 dB at 20 kHz. This performance is adequate but not superlative. The tone controls provide ±14 dB bass boost and cut at 20 Hz, ±10 dB of treble boost and cut at 10 kHz whilst the mid-range boost and cut is ±6 dB at 1 kHz. The high cut filter provides a modest −10 dB of attenuation at 10 kHz extending to −15 dB at 20 kHz.

The amplifier section of the receiver is well designed and performs well considering the price of the receiver.

AM/FM tuner performance

The RF stage is not quite as well designed as the audio frequency stage. On FM the sensitivity is adequate, with 9 dB(F) input required for 26 dB signal to noise ratio on mono and 21 dB(F) required for 46 dB signal to noise ratio on stereo. The ultimate signal to noise ratio is limited by internal residual hum leakage. Because of this the maximum signal to noise ratio on FM stereo is 53.5 dB whilst the maximum signal to noise ratio on FM mono is limited to 57 dB. The frequency response, however, of the FM section is ruler flat from 100 Hz to 15 kHz and is only 3 dB down ▶





at 20 Hz. The cross talk component is better than 30 dB down from 100 Hz to 7 kHz with a slight rise between 10 Hz and 100 Hz and a comparable slight rise between 7 kHz and 15 kHz.

The FM section has a number of other attributes and even without an aerial it pulls in half of the local FM stations well. It provides a clean and healthy signal on all the stations once the simple dipole aerial, supplied with the unit, is connected to the terminal. The distortion on FM at 50 dB(F) is less than half a percent at 1 kHz on stereo and less than 0.3% on mono. Were it not for the hum level generated back through the FM section, the performance of the FM stage would be amongst the best that we have seen.

On AM the performance is desultory, as we have grown to expect from Japanese AM tuners, with a smooth but generally modest frequency response extending from 10 Hz to 2.5 kHz. This is adequate but not really good. The AM stage is only designed for local reception. However, when an external aerial is utilised at night time it pulls in distant stations from as far as 400 km away.

At home

I evaluated this unit at home with a wide range of cassette recorders, record players and with its own internal FM and AM receiver stages. When playing through either a set of B & W 801's or Fischer modular speakers, it provides impeccable performance with the amplifier. I played many records and tapes. Two new and very different records were Earl Klugh on "Fingerpainting" an exciting and superb original master recording from Mobile Fidelity (MFSL1-025) and the Johann and Josef Strauss "Waltzes, Polkas, Marches and Overtures" with the Berlin Philharmonic Orchestra conducted by Herbert von Karajan, which is a digital recording from Deutsche Gramophon (2741003). In each case the amplifier's performance proved to be superlative and the power rating of 45 watts proved to be more than adequate. I was able to appreciate the quality of the amplifer stage which is excellent.

The Vector Research VR 5000 is a basically good receiver with some outstanding features and a few weaknesses. If the designers only reduce the hum level on FM, they will then have a truly outstanding receiver that I would rate as near to 'top of the class'. ●

MEASURED PERFORMANCE OF VECTOR RESEARCH VR-5000 RECEIVER
(S.N. 5011739)

FREQUENCY RESPONSE: Tone controls Centred

(-3dB re 1 Watt, 0.5V Input to Aux) Left 4.4Hz to 100kHz; Left 4.5Hz to 100kHz

SENSITIVITY: (for 1 Watt in 8Ω)

	Left	Right
AUX	20.5mV	21.0mV
TAPE	20.5mV	21.0mV
PHONO M/M	390 V	430 V
OVERLOAD M/M	215mV	220mV

INPUT IMPEDANCE:

	Left	Right
AUX	19k	19k
TAPE	19k	19k
PHONO	52k	52k

OUTPUT IMPEDANCE: 230 milliohms (@ 1kHz)

HARMONIC DISTORTION:

(A) (At Rated power of 45 Watts into 8Ω = 40.1 Volts)

	100Hz	1kHz	6.3kHz
2nd	-76.1	-75.0	-72.2dB
3rd	-70.8	-68.5	-64.7dB
4th	-84.9	-83.0	-75.6dB
5th	-77.0	-73.4	- dB
THD.	0.036	0.047	0.065%

HARMONIC DISTORTION

(B) (At 1 Watt into 8Ω)

	100Hz	1kHz	6.3kHz
2nd	-81.8	-86.3	-84.8dB
3rd	-81.4	-90.9	-82.4dB
4th	-95.0	-	-
5th	-98.2	-	-
THD	0.012	0.0056	0.009%

TRANSIENT INTERMODULATION DISTORTION: < 0.1%

(3.15kHz square wave and 15kHz sine wave mixed 4:1)

NOISE & HUM LEVELS:

re 1 Watt into 8Ω) AUX -64.5 dB(Lin) -74 dB (A)
PHONO M/M -62 dB(Lin) -74 dB(A)

(with volume control set for 1 Watt output with, 0.5V input (Aux) 5mV input (Phono M/M)

MAXIMUM OUTPUT POWER AT CLIPPING POINT:

(1HF-A-202)
(20mS burst repeated at 500mS intervals) 65 V P-P = 66 Watts

Dynamic Headroom = 1.7 dB

F.M. SECTION

FREQUENCY RANGE: 87.5 - 109 mHz

USABLE SENSITIVITY:

(40kHz deviation)
Mono for S/N 26dB 9dBf
Stereo for S/N 46dB 21dBf

SIGNAL TO NOISE RATIOS: (40kHz elevation)

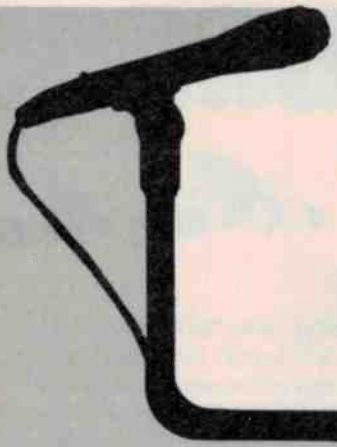
Mono (some residual hum) 57.0dB
Stereo (some residual hum) 53.5dB

FREQUENCY RESPONSE:

(see curves) 20Hz-16kHz

SEPARATION:

(includes generator) 30dB



NEED MICROPHONES? WE HAVE THE FOLLOWING IN STOCK.

DYNAMIC MICROPHONES

AKG
D 310
D 320
D 330
D 12E

BEYER
N 88
M 500 RIBBON

SENNHEISER
MD 416
MD 421
MD 441

ELECTROVOICE
PL 88 OMNI
RE 16 RE 50
RE 20

REPLACEMENT GRILLS TO SUIT
SM 58 ..... $25.00
MIC CLIPS SHURE TYPE ..... $4.00 ea
MIC CLIPS BUTTERFLY TYPE ..... $6.00 ea
BOOM STANDS $55.00
STRAIGHT STAND $45.00
ROUND BASE STAND $60.00
BANQUET STAND $42.00
BOOMS $29.00

SHURE
SM 57
SM 58
SM 77
SM 78
SM 10 Head-Set Mic
SM 11A Lavalier Mic
565 SD
545 SD

CONDENSER MICROPHONES

AKG
C 451 Pre Amp CK 5
CK 1 Capsules CK 8
CK 2 20 Db Pad

SENNHEISER
ME 80 Shot-gun Capsule
ME 88 Shot-gun Capsule
ME 40 Cardoid Capsule
ME 20 Omni Capsule
K 3U Pre Amp
MKH 816 (P 48 UB)

SHURE
SM 81
SM 85

PZM
30 GP
6 7P

SWITCHCRAFT CONNECTORS
FEMALE LINE ..... $5.00 ea
MALE LINE ..... $4.50 ea
CHASSIS FEMALE $5.00
CHASSIS MALE $4.50
BELDEN MIC CABLE (8412) ..... $2.85 per m

DI BOXES
LINE LEVEL SPLIT BOXES
MIC SPLIT BOXES
MULTICORE CABLE
MIKE STAND ADAPTORS

THIS IS ONLY PART OF THE LARGE RANGE OF MICROPHONES AND ACCESSORIES WE HAVE AVAILABLE. FOR FURTHER DETAILS SEND S.A.E. TO:

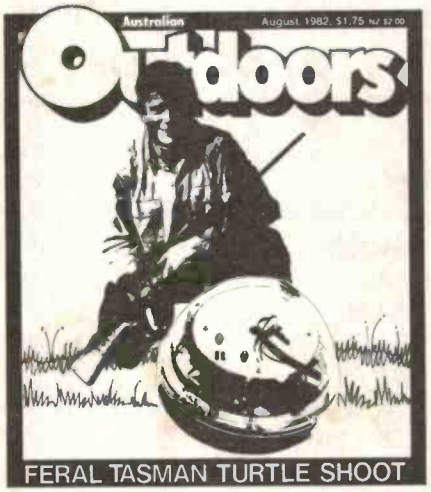
SOUND ON STAGE

405 KENT ST., SYDNEY NSW 2000.

Phone 29 4558 29 7426

DREGS

OUTDOORS is a magazine also published by ETI's publishers and the reason why they rate a mention in Dregs is because they had a very 'special' issue recently, the cover of which is reproduced below:



The cover story on Tasman Turtles (see also ETI, April-May-June 82) was headed:

FERAL TASMAN TURTLES
— the new menace!

The story went like this:

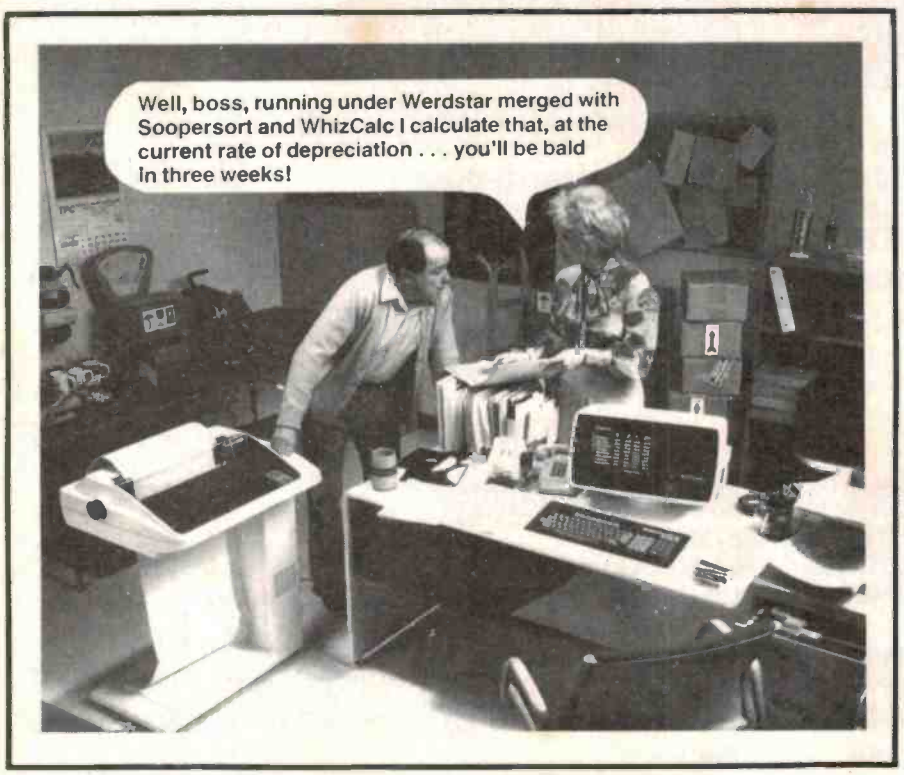
"Originally introduced to Australia by well-meaning computer buffs as robot projects, the Tasman Turtle has grown to become a threat to the Australian countryside. The feral population grew from the number of domestic Turtles being dumped in the bush because owners had lost interest or become bored with the programs provided. (After all, they couldn't play Space Invaders!)

"The feral population is now so large that Tasman Turtles have become one of the more popular game for local shooters.

"The Turtle is prized for several reasons. Because of its computer background it is a very cunning animal, making the hunt good sport. The Turtle's tough outer skin is prized by hunters who used them for everything from potplant holders to light shades!

"The Turtle is also prized for the unique pen that it carries secreted inside its body and which it sometimes projects out to dig up Telecom wires (its main source of food) and to ring-bark electricity poles. One especially good green specimen shot recently near Wagga was found to contain a gold-plated Shaeffer pen with diamond inlay, but this is acknowledged to be a rare case. Normally, the Turtle is found with either a Bic Finepoint or Ball Pentel, particularly around the Canberra-Monaro district where the pens carry a 'Commonwealth of Australia' mark."

The special issue of Outdoors proved a complete surprise to its editor, Peter Scott (one time editor of ETI's sister publication Hi-fi Review, now defunct). The whole thing was 'dummied-up' by ETI's advertising production manager, John Gerrie and layout artist, Githa Pilbrow!



The strangest things . . .

People talk about 'strange' things, at times. Perhaps only the physicists amongst Dregs readers will appreciate this one, but we pass it on for amusement's sake, anyway.

Conversation overheard in the Tilbrook household:

"I see they've demonstrated quark/anti-quark particle interactions."

"Well I'll be charmed!"

We leave it to readers to **imagine** what follows . . .

What's he talking about?

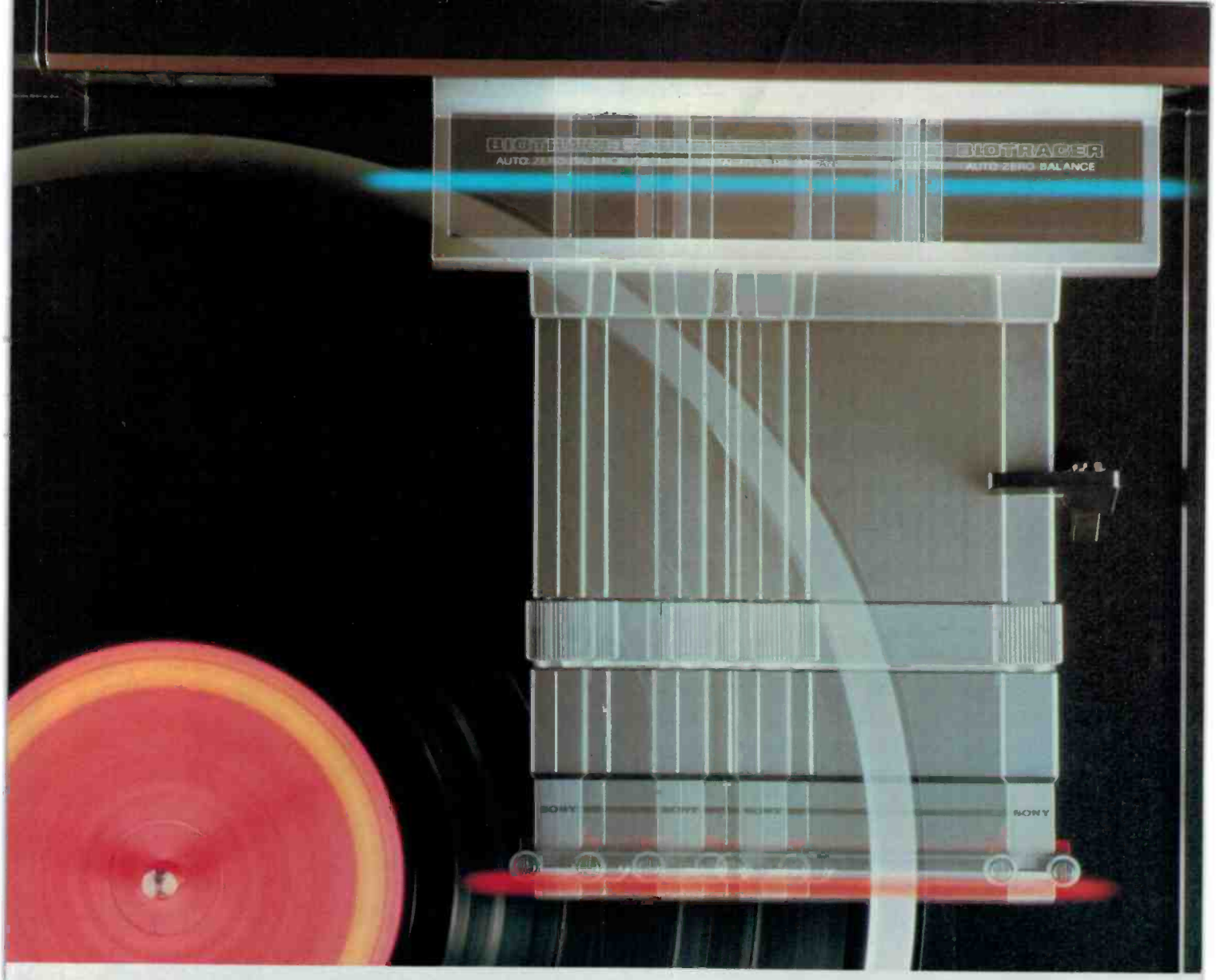
Conversation overheard in the ETI office.

"What's a quark?"

"Well, that's a particle that . . ."

"It's the sound a duck makes when you wring its neck!"

"That's funny. I thought it was the stuff electronics people got on their teeth!"



Off on a tangent with Sony.

We didn't jump into tangential tracking turntables right off the bat. And Sony hopes you didn't either. Because while most lateral tonearms don't exactly shift gears as they travel down their path, they do run into some rough spots. A hang-up called "cogging" that inhibits totally free flowing movement, and hampers left and right stereo separation.

Sony has alleviated cogging and out of phase problems with an invention called Tangential Tracking Biotracer.

Controlled by two microcomputers and four sensors, the motion of the Biotracer tonearm is continuously fluid for precise phase alignment of the stylus.

PS-X800

To the average person these differences may sound slight. But if your standards are as high as Sony's, you'll understand the angle we're driving at.

SONY®
THE ONE AND ONLY

SON 0116

Look for the components & accessories you need between these covers

Sourcing the huge range of components and accesories needed by today's electronics retailer can be a real headache. Here's the cure for that headache: Benelec's new catalogue. One of the widest ranges in Australia of active and passive components, instruments, antennas, connectors and cables. All listed with comprehensive data in the easiest to use catalogue in Australia. Benelec, formerly known as I.F.T.A. Australia, have been serving the needs of the electronics industry for over six years, with top quality products from around the world. Always at competitive prices. Always with fast delivery. Our ex-stock range includes:

- Mobile and base station transceiver antennas.
- Virtually all the popular coaxial cables, plus a variety of figure 8 styles.
- Instruments. Low cost RF test equipment and the famous Univolt range of digital and analogue multimeters.
- Power supplies ● Alarm equipment ● 27MHz transceivers ● Filters and noise suppressors ● Quartz crystals – standard and custom ● Microphones ● Speakers ● transceiver accessories ● Prepared leads ● Semiconductors ● Resistors ● Capacitors ● Fuses

If you're in the market for just about anything electronic, phone or write for your copy of our brand new catalogue – it could save you a fortune in time and money.

BENELEC

Benelec Pty Ltd. (Formerly I.F.T.A Australia)
1 Greville Street, Randwick 2031
PO Box 21, Bondi Beach 2026
Phone (02) 665 8211

Send this coupon today for your copy

Name .....
Company &
Position .....
Address .....
..... Postcode .....
Phone .....

Glover & Assoc. BEN/9