AUGUST 1982

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# eti

ELECTRONICS TODAY INTERNATIONAL

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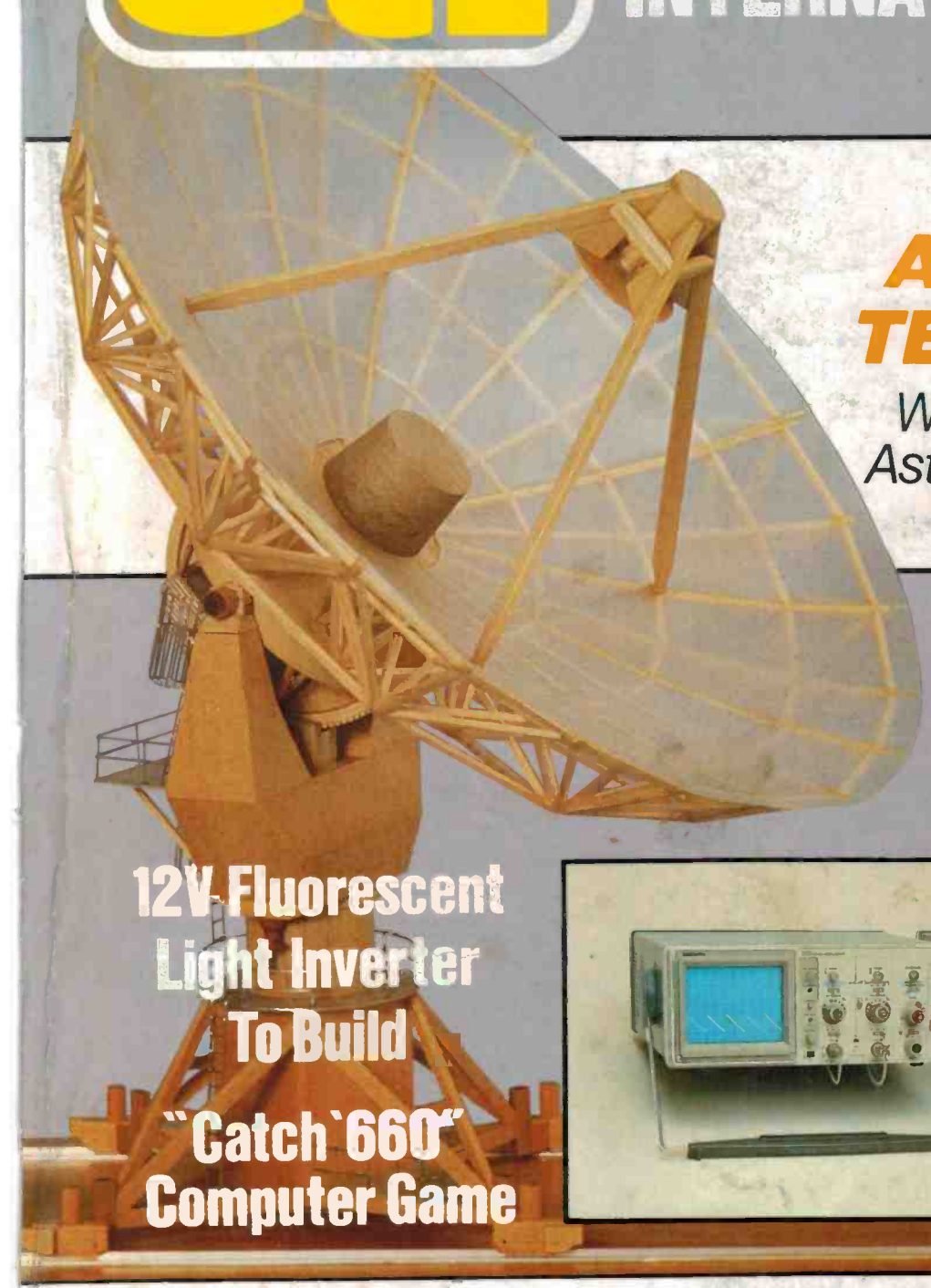
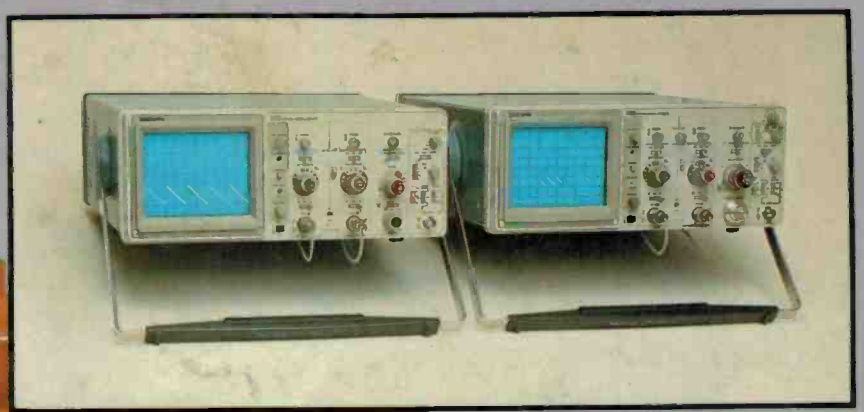


## THE AUSTRALIA TELESCOPE

*Will Australian Radio Astronomy Move into the 21st Century?*

## FANTASTIC OFFER

*NEW Tektronix CROs*

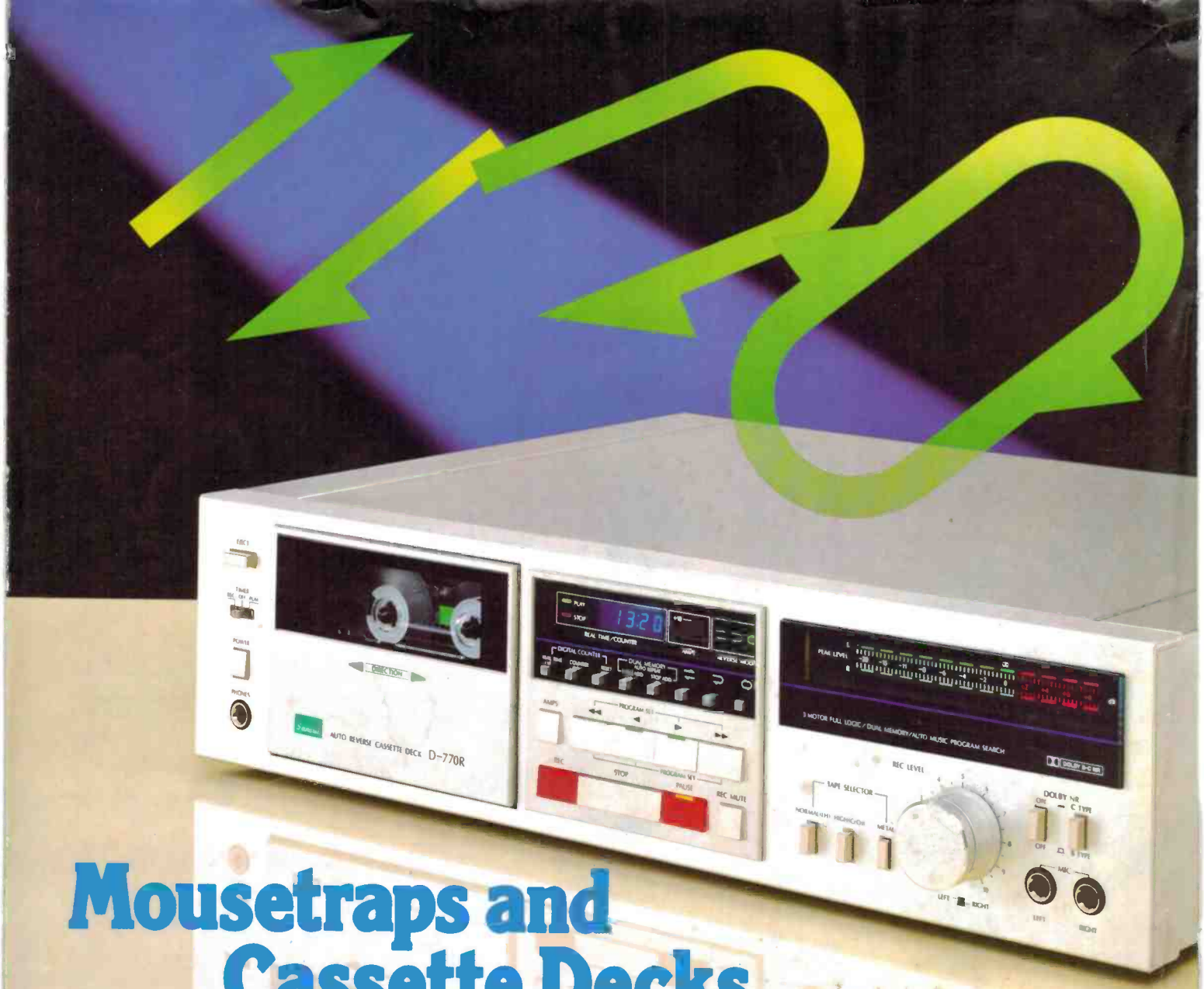


## 12V Fluorescent Light Inverter To Build

## "Catch 660" Computer Game

## Setting Up a Public Address System

## Turtle Robot Offer Extended | Beating the RS232 Blues




# Mousetraps and Cassette Decks

If you build a better mousetrap, the world will beat a path to your door. At Sansui, we built a better cassette deck—the D-770R—and it's proving the truth of that old adage.

How is it better? First, auto reverse occurs so quickly (0.6 sec.), you'll hardly notice an interruption in your music, whether you're listening or recording. Second, the D-770R has convenient automatic features like Dual Memory and 15-program AMPS (Automatic Music Program Search). Third, we provide an electronic 4-digit tape/real-time counter. Yet another way the D-770R is better is new Dolby* C noise reduction, which provides a very high S/N ratio of 80dB.

Now you've seen a few ways Sansui products are better, so beat a path down to you nearest Sansui sales outlet today and see our complete lineup.

*"Dolby" and the double-D symbol are trademarks of Dolby Laboratories Licensing Corporation.

Sansui

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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

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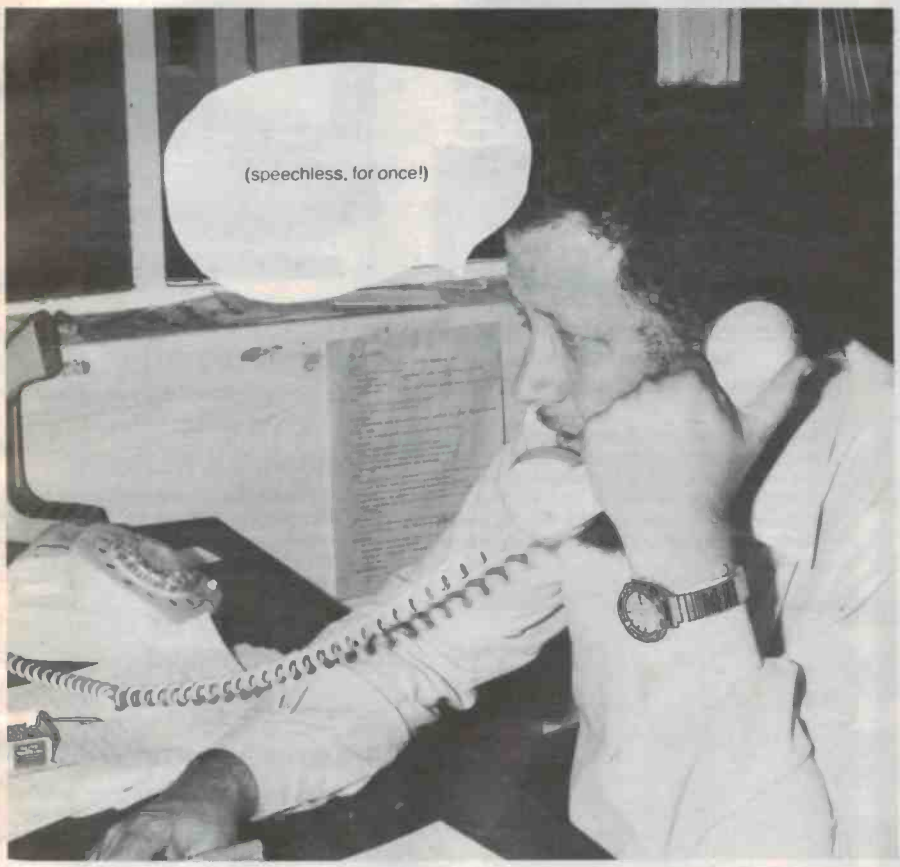



Roger Harrison
Editor



# QUICK INDEX

## FEATURES



## PROJECTS & TECHNICAL



## COMPUTING TODAY



## ELECTRONIC LIFESTYLE



## GENERAL

# advertisers



# eti ELECTRONICS TODAY INTERNATIONAL

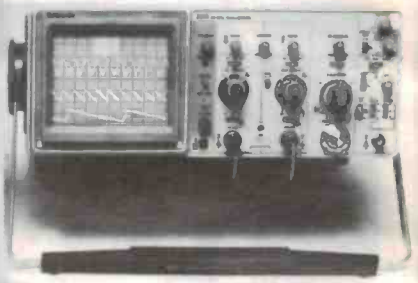

Setting Up a Public Address System

Turtle Robot Offer Extended | Beating the RS232 Blues

This month's feature, courtesy of the CSIRO, gives the background to the Australia Telescope proposal — a project that will allow Australian Radio Astronomy to lead the world, from now into the 21st century, if government funding permits. Picture shows the model of a low cost dish antenna for part of the project.

Cover design by Ali White.

# features





# news



# projects

# next month

### 'UNIVERSAL' DC-DC INVERTER PROJECT

This dc-dc inverter can be configured to run from dc supplies of 12 V and upwards and can deliver power outputs up to 200 watts. Now you can drive our audio power amp modules from a 12 V battery etc, etc.

### XR2240 — SUPER TIMER!

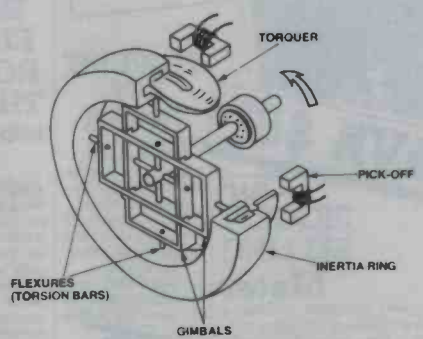
A Lab Notes on this super new timer that can produce accurate timing periods ranging from seconds to days!

### RS232 TROUBLESHOOTER

Having sorted out the ins and outs of the RS232 serial interface using the article in this issue, this follow-up article goes into the setting up and testing of RS232 interfaces. Very handy.

### PREY — APPLE GRAPHICS GAME

A predator/prey simulator game that demonstrates 'practical' use of Apple graphics. Fascinating.




### INERTIAL NAVIGATION

It took the human race over 900 years to progress from the primitive lodestone compass to developing a self-contained navigation system dubbed INS — the inertial navigation system. This article explains the background and how it works.

**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.**

# BIG SAVINGS for NZ hobbyists

**YOU DON'T HAVE TO PAY THE EARTH FOR QUALITY TOOLS!**

Compare Dick Smith's prices to those you've been forced to pay in the past... And don't forget, we'll send any item anywhere in New Zealand from our Auckland Mail Order Centre.

**SAVE $5!**

## OUR BIGGEST SELLING Meter

We've sold thousands of these to students, amateurs, hobbyists, technicians ... even repairmen! If you're into electronics as a hobby or as a business, and want a reliable economical multimeter this has got to be the one! Robust, high sensitivity, very easy to use. Comes complete with batteries, test leads and instructions. Cat Q-1024.

- 24 ranges
- 20,000 ohms per volt
- Diode protected movement

ONLY $NZ 29.95

~~WAS $38.00~~

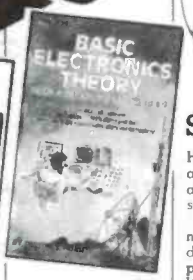
UNTIL SOLD OUT!


## TOWERS' INT. TRANS. SELEC.

If you deal with transistors — whether as a student, hobbyist, buyer etc, — this book can help you. It offers information on ratings, characteristics, terminal identification and substitution equiv. and more. Cat B-1826

NEW EDITION!

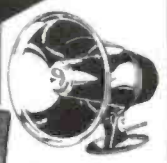
ONLY $NZ 27.90




## BASIC ELECTRONICS THEORY with projects & experiments

Want to learn about electronics? Then this is the book for you. It is an introductory text (with experiments) of basic electronics theory. Also, it is a convenient reference manual, with almost any piece of information readily accessible. Cat B-1615

A MUST! ONLY $NZ 17.50



## HORN SPEAKER

Here's a horn ideal for all PA work, burglar alarms, in fact any outside work because of its weatherproof nature. It has an impedance of 8 ohms and a power rating of 5 watts. It has a mounting bracket for easy installation and comes complete with lead. Cat C-2705

only $NZ 19.95

Look after your deck!

## TAPE HEAD DE-MAG.

Improve the sound quality and protect your recordings with this tape head demagnetizer. Ideal for all audio tape decks (NOT video recorders) it simply plugs into 240V AC mains, and is held near the head, then drawn away slowly. Full instructions are supplied. Cat C-7222

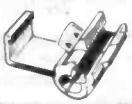
and only $NZ 14.95

## Why pay more? Ferric Chloride

Now supplied as beads of Ferric Chloride Hexahydrate — the no-mess, no-spill way. 250g makes 1 litre of etchant. Cat H-5652

only $NZ 2.95

## AMAZING CABLE JOINERS



Now you don't have to spend hours trying to join wires. These snaps make it so easy!

Cat H-6720 only 85¢ NZ

## PROTECT YOUR LIFE & EQUIPMENT

This fantastic kit electronically detects earth fault currents and trips a relay which immediately cuts the power. The relay cannot be reset until the fault has been corrected. Designed to run 240V AC the unit is portable and built into a tough molded plastic case. K-3315.

Core Balance Relay only $NZ 74.50


IDEAL FOR SPORTING EVENTS, DARKROOM TIMER, ETC!

## Build this Timer/ Stopwatch

Use as a stopwatch, countdown timer or event timer. Large LED and selectable timing rates between 0.01 and 1.0 secs. Cat K-3435

only $NZ 59.50

## Value Pack

The smart way to buy your resistors and capacitors:

1) Resistor pack: 300 computer selected ¼w types. Cat R-7010 ..... only $NZ7.50
2) Metal films: 300 precision 1% ¼w metal film resistors. Cat R-7015 ..... only $NZ15.00
3) Greencap packs: 60 greencaps Cat R-7040 ..... only $NZ8.50
4) Electrolytic pack: 55 electros Cat R-7030 ..... only $NZ6.50
5) Ceramic pack: Over 60 ceramics Cat R-7050 ..... only $NZ5.50

## HOLE PUNCH SET

An absolute necessity for anyone who needs a large hole cut through metal. Very easy to use, needs no filing and will cut a hole without distortion. Comes with five punches (16, 18, 20, 25 & 30mm) and will handle steel up to 22 gauge and aluminium up to 16 gauge. Excellent value!

Cat T-4900 ONLY $NZ 15.90

1,000's SOLD!

## MINI PC DRILL

Help make work on PCB's, jewellry, model making, etc, child's play! This mini PC Drill is extremely easy to use as the on/off switch is in a very convenient position. Excellent output, and no trailing power cords as it runs off 2 'c' cells.

EXCELLENT VALUE AT ONLY $NZ 29.95 Cat T-4750

## 6 PIECE PRECISION DRIVER SET

Very handy to have around! Quality screwdrivers at a low, low price! Chrome plated, they are presented in a plastic storage case and consist of 4 blade drivers from 1.4mm to 2.9mm, and 2 Philips drivers, No's 0 and 1. Cat T-4360

ONLY $NZ 7.95

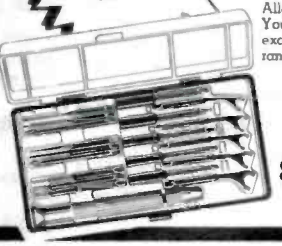
## 6 PIECE JEWELLERS DRIVER SET

Beautifully made screwdrivers, chrome plated body with a free running knob on top. Blades are the finest quality nickel chrome molybdenum steel, precision ground. Presented in a handy transparent moulded case. Sizes range from 0.8mm to 3.8mm. Cat T-4350

EXCELLENT VALUE! ONLY $NZ 6.95

EVERY HOBBYIST SHOULD HAVE ONE!

## AMAZING 20 PIECE METRIC UTILITY SET



Great value for money! 20 pce nickel chrome molybdenum steel with chrome plated handle in a handy transparent plastic box. Blade and Philips drivers, Allen keys, spanners and more. You will be proud to have this excellent quality set in your tool range! Cat T-4365.

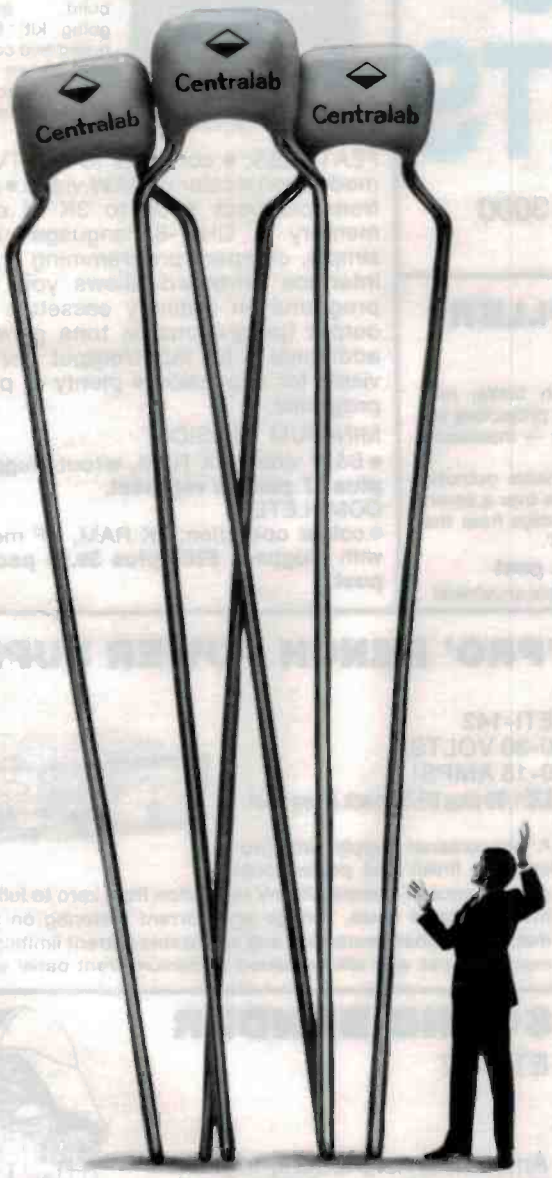
Great value at $NZ 14.95


**DICK SMITH Electronics**

98 Carlton Gore Rd, Newmarket
Auckland. Tel (649) 50 4409
Mail Orders: PO Box 9452 Newmarket NZ
Store Hours: Mon-Fri 8.30am to 5pm


DSE/A310/PAI

# Not all Monolithic Capacitors are created equal.




## ...Centralab by Philips.

While big on performance Philips monolithic Mono-Kap ceramic capacitors are very small in volume for use in circuit layouts where space is at a premium. Real value in a component package.

Manufactured by North American Philips — "Centralab"; these capacitors provide the designer with really high capacitances. And, because the chips are coated with expoxy they maintain complete environmental integrity.

The operational range of Philips Centralab capacitors span 10pF up to 10$\mu$F in three major series: NPO, X7R and Z5U dielectric types.

NPO, Negative Positive Zero series use COG dielectric to obtain ultra-stable capacitance over a very wide temperature range (+25°C to +85°C for example).

The X7R dielectric series are best used for general bypass, coupling and blocking with tight tolerances but where temperature stability is not so critical.

What should I use for basic bypass applications? The Z5U series is the answer with high K value to achieve even greater capacitance in similar package dimensions.

So when it comes to choosing the right quality capacitor, clearly Philips have the capacity to supply just the right component with Centralab.

For complete technical details on Centralab Capacitors or information about other capacitors in our range simply contact your nearest Philips Components office.

Sydney 427 0888 Melbourne 542 3333
Adelaide 243 0155 Brisbane 44 0191 Perth 277 4199

PHILIPS

Electronic Components and Materials

PHILIPS

AHEARN EL56

## *"PRO-FINISH" KITS*

Be proud of the projects you build. Our kits are presented with "professional" quality front panels (where specified), meters, knobs and components — everything, right down to the pc board. All AEC kits contain only top quality, prime specification components by recognised manufacturers. Give yourself and your project every chance of success. Don't be misled by "kits" which do not meet ETI and EA standards. Elsewhere you might pay less — but you get less. All parts are covered by manufacturers' warranty.

*All kits are sent by certified or registered post.*

# ALL ELECTRONIC COMPONENTS

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TELEPHONE: (03) 662-3506

## PROGRAMMABLE TIMER-CONTROLLER

ETI-650 'STAC TIMER'

Ideal for operating air-conditioning, fish tanks, hi-fi systems, tape recorders, slide and movie projectors for automatic displays, laboratory control etc — thousands of uses!

● This unit has four different programmable outputs, clock-controlled switch-on/switch-off times over a seven or eight day cycle (maximum). Selected days from the seven or eight day cycle may be 'skipped'.

**$135 plus $9.50 pack & reg. post**

Fantastic value! Nothing else like it available anywhere!

## BUILD YOUR OWN COLOUR COMPUTER!

ETI-660
Learners' Microcomputer

Get into microcomputing with this easy-to-build, easy-to-get-going kit! Quality pc board and components help ensure success. ● Learn by building and operating this great kit!

FEATURES: ● connects to any TV (via RF modulator) ● color or B&W video ● powered from plugpack ● up to 3K of on-board memory ● CHIP-8 language used for simple, compact programming ● cassette interface on-board allows you to store programs on ordinary cassettes ● audio output (programmable tone generator) ● additional 8-bit input/output port ● provision for expansion ● plenty of published programs.

MINIMUM VERSION
● B&W video, 1K RAM, w/out plugpack **$99 plus $7 pack & reg post.**

COMPLETE
● colour operation, 3K RAM, RF modulator, with plugpack **$207 plus $9.50 pack & reg post.**

## SUPER METAL DETECTOR

No other kit metal detector can match this one — performs like ready-made detectors costing two or three times as much!

FEATURES: ● VFL/TR design ● Four modes of operation ● ground balance control and auto-balancing button ● adjustable length handle ● pre-wound search head ● professional finish ● audio and meter indication ● discriminates between ferrous and non-ferrous metals ● adjustable sensitivity (rejects ring-tabs) ● lets you know when to rejoice!

**$193.50 plus $9.50 pack and reg post**

ETI-1500

We also stock lower-cost metal detector kits:
ETI-549 Induction balance metal detector with audio and meter indication — **$53.40 plus $5 pack & reg post**
ETI-561 BFO metal detector featuring low-drift crystal control and simple construction, audio output — **$30.45 plus $4.50 pack & reg post**

## 'PRO' BENCH POWER SUPPLY

ETI-142
0-30 VOLTS;
0-15 AMPS!
$221.99 plus $9.50 pack & reg post.

A phenomenal supply with professional finish and professional performance. It features 20 mV regulation from zero to full load, 10 mV ripple and noise, voltage and current metering on separate meters, overload protection and adjustable current limiting. Sturdy metal cabinet with silk-screened aluminium front panel supplied.

## 150W PUBLIC ADDRESS AMPLIFIER

ETI-498/499

This compact design, employing ETI's fabulous, rugged, reliable 150W MOSFET amp module has features unequalled on any P.A. you'll buy 'over the counter'. Professional look silk-screened aluminium front panel and sturdy metal cabinet provided.

FEATURES: ● two mic inputs ● auxiliary input ● preamp output (to other 'slave' amps or tape deck, etc) ● insert jack for equaliser or howl-round stabiliser ● low-Z and 100 V/70 V line outputs ● 'speech-weighting' filter to improve clarity ● ALC to provide 'punch'.

**$252.22 plus $11.50 pack & reg post**

## SOUND BENDER

ETI-492

Amaze the neighbours, frighten the cat! This marvellous little project can change your voice to sound like Darth Vader or a Dalek. A versatile project, it can also be used for special effects on guitars etc.

**$31.60 plus $4.50 pack & reg post**

# NEWS digest

# Information Technology Week

Information Technology Week, the national event covering the present and future uses of computers and information processing, will be held in August 1982.

**According to Judy Hammond, ITW state co-ordinator for NSW, "ITW aims to increase the understanding and awareness in the whole community of information technologies, of which those using computers are the most significant. ITW also provides the community with the opportunity to interact with these technologies and take part in informed debate about them."**

Planned activities include an industrial robot display, a community group management game, hands-on self-learning courses at some educational institutions, film screenings, library displays and seminars and forums at selected metropolitan and country centres.

A series of papers entitled 'Technological Change — Impact of Information Technology, 1982' will also be available on request.

Primary school pupils may obtain a colouring book, which is being released along with a teacher's guide, and a floppy disk, containing information on convicts who were transported to Australia on the First Fleet, will be available to secondary school teachers, who may apply to the ITW State Secretary through their school principal.

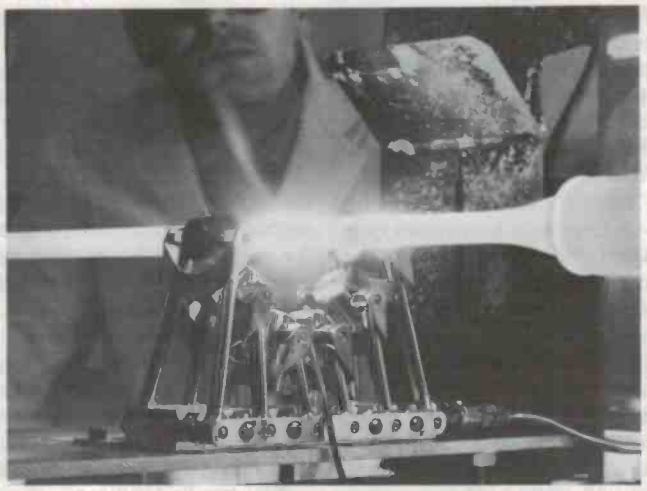
Business houses will conduct open house displays on the application of new technology to their business. Typical examples will cover videotext, teletext, networking, word processing, micrographics communications and bar codes as applied to grocery identification.

Country and suburban chapters of the Australian Computer Society will be organising activities which suit their local needs. For example, the Wagga Wagga chapter will use a computer to record sales at their local cattle auctions.

Information Technology Week, sponsored by the Commonwealth Department of Science and Technology and the Australian Computer Society, is actively supported by State Governments and is organised by committees comprising members of the education, government and business sectors of the community.

ITW will be held during 15-21 August 1982 in all states except Queensland and Tasmania. Details of activities are available from the Department of Science and Technology in the ACT and all state capitals.

## DIALLING A WORLD RECORD



**The photograph shows a silica tube being processed into a preform rod, from which hair-thin optical fibre — so pure that a block 20 km thick would be as transparent as a window pane — will be drawn to form part of Britain's telephone network of the future.**

**The technique, called modified chemical vapour deposition, has been developed by British telecommunications engineers, who have recently set a world record by sending pulses of laser light over a 102 km length of optical fibre without the need for amplification along the route.**

**Unlike present light transmission methods, which allow the pulses to travel in up to 200 different ray paths, the researchers use a light-carrying core so small that it supports only one ray path. This greatly reduces the light spread and allows it to travel much further.**

**The team now plan to repeat their laboratory experiment by installing a fibre cable underground in a 30 km loop that will test the system under normal operating conditions.**

# National Semiconductor delays decision on Canberra plant

**National Semiconductor Corporation is delaying any decision on construction of a fabrication facility in Canberra (see 'Chip shop for Canberra', p.9 May 1981 ETI), until the company is able to make a reasonable forecast of capacity requirements, which is largely dependent on improvement in worldwide demand for its semiconductor components.**

The company said that the Australian Government's "generous commitment to the construction of a large-scale facility and the favourable results of certain aspects of a 1981 feasibility study for such a plant construction notwithstanding, there is sizeable capacity available presently and expansion room at existing plants."

The company said its Arlington, Texas, fabrication facility, begun in March 1981 and halted in August that year, represented a several million dollar investment and would be its next new manufacturing site, although second-phase start-up has not been decided.

The company has 20 plant locations in eight countries. Its ability to fully utilise its present sites is the company's primary goal.

"Under present-day conditions it is extremely difficult to predict when that goal will be achieved," a company spokesman said.

The company's study of the feasibility of such an extremely large fabrication facility, although the results were favourable in many aspects, did not substantiate making a decision at this time, he said.

A decision on a plant of that scope is more than likely several years away, the spokesman said.

# Vitalcall saves a life

**When Mrs. Eva Voss's heart finally failed she had no time to ring for help on her telephone. Five seconds after the attack started she was unconscious on the floor.**

Normally it could have been nine hours or more before anyone noticed her absence. But Mrs. Voss wasn't entirely without help. By clutching at a pendant around her neck as the first spasms seized her, she was able to summon help and save her life. Mrs. Voss's family had installed Vitalcall in her home.

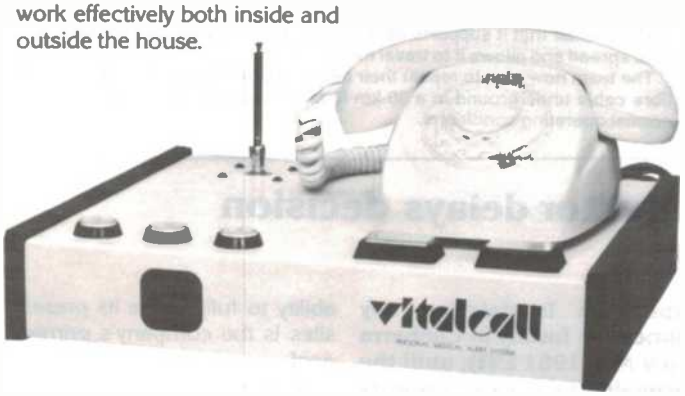
Vitalcall has two components — a tiny radio transmitter contained in the lightweight pendant, and an electronic device connected to the telephone. When the pendant is squeezed, the Vitalcall unit automatically dials three chosen contacts and delivers a personal pre-recorded message requesting help; if two out of the three fail to answer, the unit alerts a 24-hour emergency team.

The pendant has been designed so that even arthritic and disabled people can use it with ease, and it operates within a range of 100 m from the telephone, which means that it can work effectively both inside and outside the house.

Every day the Vitalcall unit automatically reports to the central diagnostic computer at the Vitalcall centre, enabling staff to check that it is functioning correctly. Vitalcall also has an independent power supply which takes over automatically if a power failure occurs or the unit is accidentally unplugged. It can operate on its automatically rechargeable emergency battery for at least 48 hours, and will even continue to work effectively if the phone is left off the hook.

Full service rental costs $5 per week, plus installation costs. There are flexible payment plans, and Vitalcall may be hired on a long or short-term basis, depending on individual needs.

You can find out more about Vitalcall by contacting Denise Davis at Jaeger Associates on (02)357-5255, or Dr. Richard Thomson or Tony Ashworth at Vitalcall on (02)438-3311.




## WORK VK2DIK CHOPPER MOBILE!

DICK SMITH will be seeking contacts on the HF amateur bands during his round-the-world helicopter attempt from August to October. Equipment on board will be a Collins HF 220 sideband transceiver (USB only, though). Frequencies are: 80 m — 3750 kHz (USA & Canada); 40 m — 7060 kHz; 20 m — 14 250 kHz (14 140 kHz secondary, VE & VK); 15 m — 21 285 kHz (21 265 kHz secondary).

Approximate itinerary as follows: Fort Worth, US — 5 Aug.; New York — 8 Aug.; Greenland — 14 Aug.; Iceland — 15 Aug.; UK — 19 Aug.; London to Sydney — 12 Sept. to 3 Oct.; Sydney to Fort Worth — dates to be announced. Flights will take place during local daylight hours, normally in the mornings.


# New ac/dc-dc low RF noise converter

**Scientific Electronics, Australian designers and manufacturers of "high-quality" power supplies, have just released details of their newest unit — the SM135D1.**

The SM135D1 is an ac/dc-dc converter primarily intended for applications where a 12 V source with battery back-up is required. Facilities are provided to automatically boost and float charge a lead-acid battery, as well as disconnect the load if the battery is discharged to a detrimental level.

The SM135D1 will accept a dc input in the range 20 V to 65 V, or an ac input in the range 23 V to 46 V. The output voltage is nominally 13.5 Vdc, which is the optimum float voltage for lead-acid batteries.

The total available output current to the battery and load is 10 A, with complete protection from both overloads and short-circuits and automatic recovery from either of these conditions. There is also automatic shutdown and recovery from over or under voltages on the input.

If at any time the battery voltage falls below 12 V a LED on the front panel will indicate that a low voltage condition exists, and a pair of isolated relay contacts can be used as a remote alarm indicator.

If the battery voltage continues to fall and passes below 11.4 V a relay disconnects the load from

# Switching regulator chip

**The uA494 voltage regulator contains all the 'building blocks' for designing a pulsewidth-modulated (PWM) switching power supply, including push-pull, bridge and series configurations.**

PWM operation results in a constant switching frequency, which simplifies output filtering and system stabilising.

Two on-chip uncommitted output transistors, capable of handling 200 mA source or sink current, are provided for push-pull operation. 'Dead Time' control assures that the two transistors are never on simultaneously. Single-ended or push-pull operation is selected via the output control pin. The uA494 operates at switching frequencies between 1 and 300 kHz with output voltages up to 40 V.

Other features include: an internal adjustable oscillator, an internal 5 V reference, an internal error amplifier and a current-limit amplifier. Designed for high-power switching systems, the uA494 is used in applications requiring slaving or high frequency operation.

Available in both industrial military temperature-range versions, the PWM switching regulator is packaged in a 16-pin DIP. Further information from Fairchild, Suite 1, First Floor, 366 Whitehorse Rd, Nunawading Vic. 3131. (03)877-5444, or Sydney (02) 439-5911.

# Differential DPM

**Technical details on the Intersil DM-31 single-board differential 3½-digit DPM are now available from Elmeasco.**

The DM-31 comes on a 50 x 90 mm board and features 14 mm high red LED displays. The input bias is only 5 pA, input impedance 1000M. It requires only a single 5 V supply at 280 mA. The inputs are true balanced noise-rejecting differential inputs, and the meter has a hold function to freeze the last reading. It accepts user-supplied components for higher voltage ranges, current ranges and digital ohmmeter (to 20M) applications.

Details from Elmeasco, P.O. Box 30, Concord NSW 2137. (02)736-2888.

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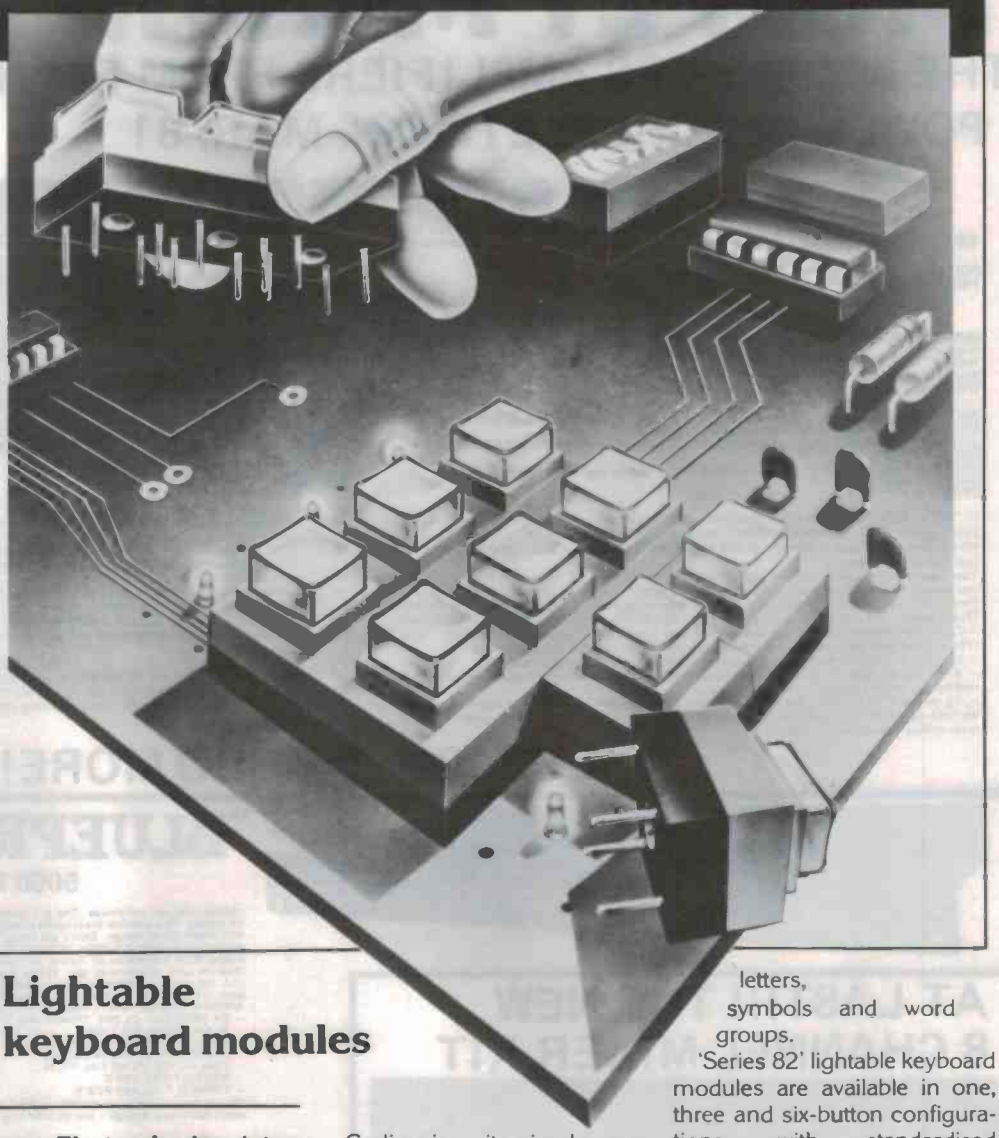
the battery to prevent permanent damage to the battery.

State-of-the-art design and filtering techniques have been employed to provide a unit with very low levels of radio frequency noise on both the input and output, according to Scientific Electronics.

The power supply has been designed according to Telecom Specification 1238, Regulated Power Supply Interface for Remote Subscribers. A transformer is available as an accessory to allow operation from the mains.

For further details, contact Scientific Electronics, 6 Holloway Drive, Bayswater Vic. 3153. (03)762-5777.



# Lightable keyboard modules

**Acme Electronics has introduced a new series of lightable keyboard modules with buttons that can be cheaply and neatly coded at the point when a keyboard is being assembled.**

Coding is quite simple — a slot in the button cap allows the assembler to insert an appropriately imprinted clear plastic tab. This is captured beneath the button top surface and subsequently illuminated by a lamp mounted in the circuit board.

Tabs can be improvised or cut from a pre-printed sheet. For convenience this sheet contains a full range of numbers, letters, symbols and word groups.

'Series 82' lightable keyboard modules are available in one, three and six-button configurations, with standardised dimensions for mix-and-match versatility. They feature a long-wipe design contact system for quick contact bounce (less than 10 ms) and long life (usually more than one million operations).

For further information, contact Acme Electronics, Melbourne (03)729-6211; Sydney (02)648-2255.

# Tektronix seminar on digital design

**Tektronix Melbourne will run a free seminar for engineers and engineering managers involved in microprocessor design and debugging.**

The half day seminar will be held at the University of Melbourne on Wednesday 18, August. The agenda covers applications in the digital design environment as well as a presentation of the latest Tektronix products for the digital designer.

Live demonstrations will include a Unix based multi-user software development unit, an integration unit with microprocessor emulation and integration logic analysis and the first colour Digital Analysis system (incorporating word generation and logic analysis).

To register for the free seminar or for further information please contact Jill Radford at the Tektronix Melbourne office. (03)813-1455.

# Kit manual

**Electronic Agencies has recently produced a 'Kit Constructors' Reference Manual' that is included with every kit over $20 but can be bought separately for a mere 50¢.**

The manual includes the basic things you need to know when you set about constructing a kit and should be a great aid for the hobbyist. It's chock-a-block full of useful data, hints and tips for constructors, in eight A4-sized pages. Get yours from one of their two stores, at 115 Parramatta Rd, Concord NSW, or 119 York St, Sydney NSW.

# MOSFET MAGNIFICENCE

## THE 5000 SERIES AMPLIFIERS FROM ETI HAVE NO EQUAL

## POWER AMP. REF: ETI JAN. MAR. 81

## "BLACK MONOLITH"

### SPECIFICATIONS

| | |
|---|---|
| POWER OUTPUT | Around 100W RMS into 8 ohms |
| FREQUENCY RESPONSE | 8Hz to 20kHz, +0 – 0.4dB<br>2.8Hz to 65kHz, +0 – 3dB<br>Note: these figures are determined soley by passive filters |
| INPUT SENSITIVITY | 1V RMS for 100W output |
| HUM | – 100dB below full output (flat) |
| NOISE | – 116dB below full output (flat, 20kHz bandwidth) |
| 2nd HARMONIC DISTORTION | <0.001% at 1kHz (0.0007% on prototypes) at 100W output using a ±56V supply rated at 4A continuous |
| 3rd HARMONIC DISTORTION | <0.003% at 10kHz and 100W |
| TOTAL HARMONIC DISTORTION | <0.0003% for all frequencies less than 10kHz and all powers below clipping |
| INTERMODULATION DISTORTION | Determined by 2nd harmonic distortion (see above) |
| STABILITY | <0.003% at 100W (50Hz and 7kHz mixed 4:1) |
| | Unconditional |

In "2001" Arthur C. Clarkes Black Monolith symbolised awesome power – Intelligence.
So too do the 5000 "BLACK MONOLITH" Power Mosfet amp kits from Jaycar.
Why would you choose a Jaycar "BLACK MONOLITH" 5000 Power amp over conventional kits? Because you, too are intelligent.
You have seen the specs, and you know that this amp IS the best. You want the best because (whether you know it or not) you are a perfectionist. You won't be conned by cheap and nasty compromises to David Tillbrook's brilliant design. You will want to know if there have been mods to the original design. (There have – and only Jaycar kits reflect them). But let's be specific about the improvements.
– Completely redesigned flag heatsinks for the Driver Transistors. Thoroughly endorsed by David Tillbrook. (The original ones were too small if the bias current was set high for low distortion).
– Ventilation grilles in the covers. These were not included in the original design.
– Blind tapped holes in the exclusive 'Superfinish'™ front panel. Heavy gauge screws used for stronger connection of the heatsink bracket to the panel.
– Jig drilled, EXTRUDED, deburred and black anodised heatsink bracket in heavy gauge. All other kits we have seen, a flimsy punched out piece of sheet metal is supplied. Not even anodised!! This is one of the most critical components in the kit.
– Beryllium Oxide heatsink washers supplied. A tube of heatsink compound is also supplied – with enough left over to use elsewhere.
– 'Superfinish'™ Front Panel. Despite what others may claim ours is still the best.
– Dual 3 Pin DIN 30V Power Outlets. This extra power outlet enables you to power extra 5000 series components as they arrive on the scene.
– And all of the extra features of our normal Superfinish 5000 amp, like: Metal 1% film resistors, Pre-wound Chokes, Fibreglass PCB's, Heavy Duty Earth Braid, Quality Capacitors, Original Chassis - bar design, Flux shorting straps on transformers etc., etc.
The Jaycar "BLACK MONOLITH" is worth far more than the inferior kits around the market today. That goes without saying.

BUT IT COSTS NO MORE!

That's right. FOR THE MOMENT we are holding our price on this kit to a staggering low $299. We probably won't be able to keep this quality kit below $300 for long.
We all enjoyed '2001' for the first time a long time ago now. You can enjoy your 5000 "BLACK MONOLITH" forever!

## ONLY $299– PAY NO MORE!!!

**'Superfinish' Panel has Blind Tapped Holes**

## "BLUEPRINT" * * *

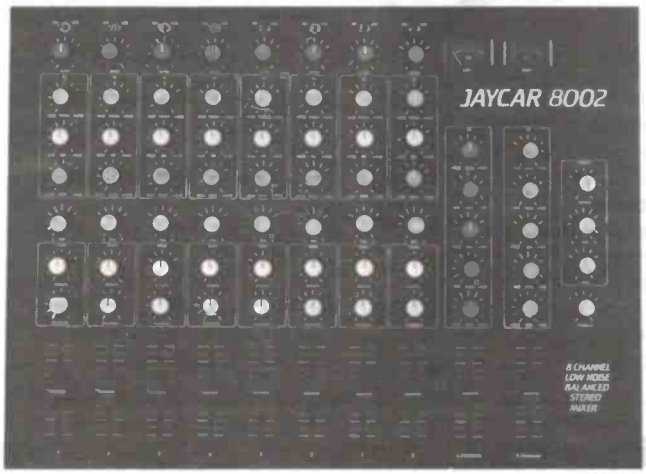
### 5000 PREAMPLIFIER

The refinement continues. The silk screen stencil for the front panel is renewed after every run of 25 panels. This enures the crispest possible lettering. Note that ONLY JAYCAR use the ORIGINAL ETI front panel design. Don't get caught with something you may not like the look of! We use the extra high quality LM394H in the M.C. preamp, and now AT NO EXTRA CHARGE supply gold plated RCA sockets on all inputs, not just the M.C. input.
Despite what others may say, their's is not as good as the original BLUEPRINT Preamp. They do not, for example, get special low capacitance screened cable made to Jaycar specs. just for the pre-amp. (It's made in Australia, not Taiwan).
AMONG OTHER FEATURES OF THE BLUEPRINT ...

- EXTREMELY CLOSE TRACKING TO RIAA EQUALISATION.
- ENGLISH 'LORLIN' LOW NOISE SELECTOR SWITCHES USED
- LOW NOISE 1% METAL FILM RESISTORS USED
- TINNED F/GLASS PCB'S
- QUALITY IC SOCKETS PROVIDED
- SPECIAL REAR PANEL
- MULTICOLOURED LED DISPLAY (EASIER TO READ & BETTER LOOKING)
- THERMALLOY HEASINK USED ON REGULATOR

We still have the standard $245 version of this kit which is better than the other $245 kits. We don't sell many though – the BLUEPRINT is better value. 'BLUEPRINT' ONLY $275.

## AT LAST!!! THE NEW 8 CHANNEL MIXER KIT




† Balanced (600 ohm) mic inputs/line inputs † Balanced output † input attenuators † Cannon connectors included in the price † Bass, mid & treble equalization on each input † "Effects" (i.e. echo etc) capability † Foldback on all 8 inputs † 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 and multicoloured knobs to assist function identification † Designed for quick easy service † VU metering † Only high quality components used † 5534A OP amp used for low noise and very low distortion.

BASIC MIXER KIT with all features. Includes 19" rack panel all knobs and electronic components AND 10 CANNON connectors $495

Console mount chassis in steel, plated and pre-punched. Includes power supply for mixer and wooden end pieces. $98

OUTPUT SHORT–CIRCUIT PROOF

FROM $495

## FROM $245
## BLUEPRINT $275

### SPECIFICATIONS

| | | | |
|---|---|---|---|
| Frequency Response | High level input: 15Hz-130kHz, +0, -1dB<br>Low level input – conforms to RIAA equalisation +0.2dB (see detail on Phono specs.) | ETI-478MM Moving Magnet input stage<br>Gain | %, 1kHz<br>Conforms to RIAA Equalisation +0.2dB |
| Distortion | 1kHz < 0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation) | Frequency Response<br>Total Harmonic Disorder<br>Headroom | < 0.003%, 1kHz, 10mV RMS input<br>> 28dB with respect to 5mV RMS input signal, i.e. 135mV RMS |
| S/N noise | High level input, master full, with respect to 300mV input signal at full output (1.2V)<br>> 92dB flat; > 100dB A-weighted | Noise<br>S/N ratio | Total equivalent input noise, 122nV 'A', input shorted. 216nV flat, input shorted<br>5mV 10mV<br>Flat 73dB 87dB 93dB<br>A-weighted 78dB 92dB 98dB |
| | MM input, master full, with respect to full output (1.2V) at 5mV input, 500 ohm source resistance connected<br>> 86dB flat<br>> 92dB A-weighted | ETI-478MC Moving coil input stage<br>Gain<br>Frequency Response<br>Total Harmonic Disorder<br>Noise | 24<br>7Hz - 135kHz -0, -1dB<br>< 0.003%, 1kHz, 30mV input<br>Total equivalent input noise<br>83nV flat, input shorted<br>42nV 'A', input shorted<br>54nV flat, after RIAA Eq. input shorted<br>34nV 'A', after RIAA Eq. input shorted |
| | MC input, master full, with respect to full output (1.2V) and 280uV input signal<br>> 71dB flat > 75dB A-weighted | | |


**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


JAYCAR DEALER– G&J ELECTRICS, FORRESTERS BEACH. NSW 2260. PHONE (043) 845787

## SEND SAE FOR FULL DATA ON 5000 SERIES &/OR MIXER

SEPTEMBER 1ST– OPENING AT CARLINGFORD!!!

The ZX PRINTER — designed for use with ZX81 and ZX80 with 8K BASIC ROM. Alpha-numerics! Graphics!

**$190** incl. Sales Tax


**$199** COMPLETE

sinclair

# ZX81

# PERSONAL COMPUTER

* *excluding mains adaptor*

## sinclair COMPLETE WITH BASIC MANUAL, LEADS, ONLY $199

## 16K-BYTE RAM PACK $150

### Higher specification, lower price — how's it done?

Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

The ZX81 comes complete with all leads to connect to your TV (colour or black and white) and cassette recorder.

### New, improved specification

- Z80 a microprocessor — new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function — useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer (not available yet — but coming soon)!
- Advanced 4-chip design, microprocessor, ROM, RAM, plus master chip — unique, custom-built chip replacing 18 ZX80 chips.

### ZX Software Cassettes

Send for free catalogue of Games, Business, Educational, Junior Education. Encl. S.A.E.

**FREE New Basic ZX81 Manual**

## ORDER FORM: SINCLAIR EQUIPMENT (A'SIA) P/L

**86-88 Nicholson St., Abbotsford, Vic. 3067. Ph. (03) 419 3033.**

| QUANTITY | ITEM | ITEM PRICE | TOTAL |
|---|---|---|---|
| | Ready assembled ZX81 Sinclair Personal Computer including leads, BASIC manual, excluding mains adaptor. | $199 | |
| | 16K-BYTE RAM pack (optional extra) | $150 | |
| | 1.2 Amp Adaptor | $ 17.50 | |
| | ZX Printer | $190 | |

I enclose cheque/Bankcard/Diners Club/Amex ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ **Total** _____

Name _____

Address _____ P'code _____

Signature _____

ETI

**N.S.W.:** ACORN ELECTRONICS, A.E.D. MICROCOMPUTER PRODUCTS, B.B.J. COMPUTER SHOP PTY. LTD., CISA MICROCOMPUTERS PTY. LTD., COMPUTER FACTORY, COMPUTER GALLERIE, COMPUTERLAND CHATSWOOD, COMPUTERLAND EAST SYDNEY, COMPUTERS GALORE, COMPUTER WAVE PTY. LTD., DAVID REID ELECTRONICS PTY. LTD., DICK SMITH ELECTRONICS, DIRECT COMPUTER SALES, L. & B. TELEVISION SERVICES PTY. LTD., THE LOGIC SHOP, L.S.T. ELECTRONICS, MICLA SALES AND SERVICE, MINIT COMPUTER SERVICE, PAUL DEREZ RADIO T.V. SERVICES, IRINITY COMPUTING. **A.C.T.:** COMPUTER WORLD, DICK SMITH ELECTRONICS, STEVE'S COMMUNICATION CENTRE. **TASMANIA:** BIRCHALLS, THE LOGIC SHOP, QUANTUM COMPUTERS, J. WALSH & SONS PTY. LTD. **N.T.:** ASCOM ELECTRONICS, EYLES COMPUTER SERVICES. **VICTORIA:** B.B.J. COMPUTER SHOP PTY. LTD., C. & G. COMPUTERS PTY. LTD., COMPUTERLAND OF MELBOURNE, COMPUTERLAND, CAMBERWELL, DICK SMITH ELECTRONICS, LOGIC SHOP, LOGIC SHOP, MIND BENDERS OF CROYDON, MINIT COMPUTER SERVICE, MYER MELBOURNE STORES, RADIO PARTS GROUP, ROD IRVING ELECTRONICS, STRACHAN OFFICE SUPPLIERS. **S.A.:** ACUIS AUST. PTY. LTD., DICK SMITH ELECTRONICS, MYER S.A. STORES, OMNI COMPUTING. **QUEENSLAND:** ALLIANCE COMPUTER PRODUCTS, COMPUTER CITY, CUSTOM COMPUTER SERVICE, DATACOM, DICK SMITH ELECTRONICS, MYER QLD., THE LOGIC SHOP, PURELY ELECTRONICS PTY. LTD., SCOTT'S AUDIO-OPTICAL, SOFTWARE 80, TEC ELECTRONIC IMPORTS. **W.A.:** DICK SMITH ELECTRONICS, MICROBASE.

R EXCLUSIVE ETI READER OF

# TEKTRONIX DUAL-TRACE HIGH PERFORMANCE 60 MHz PORTABLE OSCILLOSCOPES

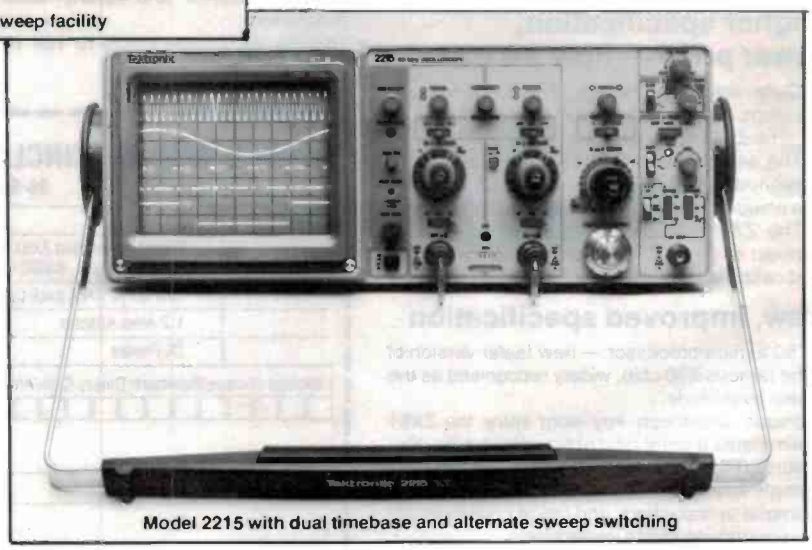
**Here is an excellent opportunity to buy a high performance 60 MHz oscilloscope from the world's leading oscilloscope maker at a very special price — exclusive to ETI readers.**

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 OF

## SPECIAL OFFER PRICES

☆ **Model 2213**
**$1139 excl. sales tax**
**$1322.38 inc. sales tax**
☆ **Model 2215**
**$1422 excl. sales tax**
**$1650.94 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.)*

**Tektronix currently list the 2213 at $1392 ($1616.11 inc. tax) and the 2215 at $1758 ($2041.00 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:**<br>ETI Offices<br>15 Boundary St<br>Rushcutters Bay NSW | **Melbourne:**<br>Murray Publishers<br>Offices<br>22nd Floor,<br>150 Lonsdale St<br>Melbourne | **Adelaide:**<br>Tektronix<br>128 Gilles St<br>Adelaide<br>(Phone 223-2811) | **Brisbane:**<br>Tektronix<br>737 Logan Rd<br>Greenslopes<br>(Phone 394-1155) | **Perth:**<br>Tektronix<br>66 Wellington St<br>East Perth<br>(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 @ $1322.38 each, inc. tax.**

**..... Model 2215 CRO(s) @ $1422 each, excl. tax or @ $1650.94 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).**

# ROD IRVING ELECTRONICS

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

## THIS MONTH'S KITS

### ETI-161 DIGITAL PANEL METER

An accurate, auto-zeroing, true polarity digital panel meter with 3½-digit LCD readout. This compact, versatile unit can be used for direct dc voltage or current measurement or ratiometric measurements.

### ETI-1505 FLUORESCENT LIGHT INVERTER

This unit will run one 20 W, two 20 W or one 40 W fluorescent tube from a 12 V battery with high efficiency and more light output than the tubes put out when run from the mains!

| | 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 | Dec 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 | $3.50 |
| ET 066 | 1.90 | Temp Alarm | Dec 79 | $4.00 |
| ET 068 | 2.20 | Led Dice | Oct 76 | $5.50 |
| ET 071 | 2.50 | Tape Noise Limiter | Jne 79 | |
| ET 072 | 1.90 | Two Octave Organ | Jne 78 | $9.50 |
| 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 Conveter | 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 | $98.00 |
| 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 | $34.50 |
| ET 158 | 3.50 | Low Ohms Meter | Nov 81 | $29.50 |
| 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 | | $19.50 |
| ET 257 | 2.50 | Universal Relay Board | May 81 | $12.50 |
| ET 258 | 2.50 | Mini Drill Speed Controller | Jul 81 | $ 8.00 |
| ET 259a | | Versatile 'Incremental' Timer | Jan 82 | $36.00 |
| 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 | $18.00 |
| ET 329 | 2.50 | Exp. Scale Vehicle Ammeter | Feb 81 | $18.00 |
| 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 | $18.00 |
| ET 363 | 3.50 | | | |
| ET 417 | 2.90 | Overload Indicator | Aug 73 | |
| ET 438 | | Led Level Meter | | $11.95 |
| EET 440 | 8.50 | 25 Watt Stereo AMP | Mar 75 | |
| ET 445 | 2.20 | General Purpose Preamp | Jly 76 | $8.50 |
| 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 | $27.50 |
| ET470 | 2.90 | 60 Watt Amp Module Series 4000 | TPV 6 | $25.00 |
| ET 471 | 9.90 | Audio Preamp Series 4000 | TPV 6 | $46.50 |
| ET 472 | 2.90 | Power Supply For Series 4000 | TPV 6 | $24.00 |
| ET 473 | 5.90 | Moving Coil Preamp Series 4000 | TPV 6 | $34.00 |
| ET 474 | 2.90 | Interface 60W Amp | Jan 80 | |
| ET 475 | 4.90 | AM Tuner | Spt 80 | $88.00 |
| ET 476 | 6.90 | Series 3000 AMP 25W Stereo | Nov 80 | $34.00 |
| 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 |
| ET 478MM | 3.90 | Moving Magnet Preamp (5000) | Spt81 | $18.00 |
| 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** | | | | $228.00 |
| ET 480 | 2.90 | 50 Watt Amp Module | 30 Ap | $17.50 |
| ET 480 | 2.90 | 100 Watt Amp Module | 30 Ap | $22.00 |
| ET480PS | 2.90 | 50-100 AMP Module Pwr Supply | 30 Ap | $22.50 |
| ET481M | 2.75 | Hi-Power P.A./Guiftar 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 No2 | Apl 78 | |
| ET 489B | 3.50 | Audio Spectrum Analyser No2 | Apl 78 | |
| ET 496 | | Series 4000-1 Speaker Kit | Feb 80 | $629.00 |
| 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 | $98.50 |
| ET 573 | 3.50 | Universal Timer | Oct 79 | |
| ET 576 | 5.90 | Electromyogram | TPV 6 | $98.00 |
| ET 577 | 3.50 | General Purpose Power Supply | TPV 6 | $38.50 |
| ET 578 | 2.90 | Simple Nicad Charger | Jne 80 | |
| ET 581 | 2.50 | 15V Dual Power Supply | Jne 76 | $9.50 |
| ET 583 | 2.90 | Marine Gas Alarm | Aug 77 | |
| ET 585R | 1.90 | Ultrasonic Receiver | TPV 6 | $10.95 |
| ET 585T | 1.90 | Ultrasonic Transmitter | TPV 6 | $9.95 |
| 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 | $8.007 |
| 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 | |
| ET 607mf | 2.90 | Sound Effectis Generator | Aug 81 | |
| ET 607mf | 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 S100 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 | | | | $14.50 |
| ET 682 | 69.00 | Versatile Eprom Card | Mar 81 | $115.00 |
| 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 | $37.50 |
| 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 | $14.50 |
| ET 824 | 2.90 | Slot Car Power Supply | Dec 81 | $18.00 |
| ET 825 | 5.90 | Slot Car Controller | Dec 81 | $79.00 |
| | | 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 | | | | $20.50 |
| 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 | $20.00 |
| 80ST10A | 3.50 | Stylus Timer | Oct 80 | |
| 80ST10B | 2.50 | Stylus Timer | Oct 80 | |
| 80TC12 | 2.90 | Bipolar Train Controller | Dec 80 | $29.00 |
| 80CM3A | 4.50 | Digital Capacitance MTR | Mar 80 | $32.50 |
| 80CM3B | 2.50 | Digital Capacitance MTR | Mar 80 | |
| 80PG6 | 6.50 | T.V. Pattern Generator | Jun 80 | $32.50 |
| 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 | $18.50 |
| 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 | $79.00 |
| 80GA12 | 6.50 | Guitar Amplifier | Dec 80 | |
| 80HLA5 | 2.90 | Car Headlight Alarm | May 80 | |
| 80LS12 | 3.50 | SELECTALOTT | Dec 80 | $22.50 |
| 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 | $19.50 |
| 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 | $48.50 |
| 80TM8B | 2.50 | Digital Engine Analyser | Aug 80 | |
| 80PP7A | 6.50 | Eprom Programmer | Jul 80 | $72.50 |
| 80PP7B | 2.50 | Eprom Programmer | Jul 80 | |
| 80RF5 | 2.90 | Rumble Filter | May 80 | |
| 80RM12 | 2.90 | Cylon Voice Simulator | Dec 80 | $18.50 |
| 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 | $10.00 |
| 81DT5 | 3.00 | Dream Tape Controller | May 81 | |
| 81GA3 | 11.50 | Colour Graphic Analyser | Mar 81 | $00.00 |
| 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 | $43.50 |
| | | | | $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 | $78.00 |
| 81SG9 | 4.20 | Led Sandglass | Sep 81 | $22.50 |
| 81P19 | | | Sep 81 | |
| 81C19 | | Digital Clock Thermometer | Sep 81 | $25.00 |
| 81SS11 | 4.90 | Slide Cross Fader | Nov 81 | $25.00 |
| 81GA9 | 3.90 | Photon Torpedo Game | Sep 81 | $23.50 |
| 81UC8 | | Universal Timer | Aug 81 | |
| 81MC7 | 9.50 | Moving Coil Preamp | Jul 81 | |
| 81SW7 | | Train Steam Whistle | Jul 81 | $17.50 |
| 81SM7 | 2.90 | Bagatelle | Jul 81 | |
| 81VM2 | 2.90 | High Impedance DC Voltmtr | Feb 81 | |
| 81HB4A | 7.50 | Heart Rate Monitor | Apr 81 | $84.00 |
| 81HB4B | 2.90 | Heart Rate Monitor | Apr 81 | |
| 81MA4 | 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 | $90.00 |
| 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 Pluqpac | | $51.50 |
| 81mill | 2.50 | Metronome (Low Current) | Jan 82 | $15.00 |
| 81wd12a | 2.50 | Wind Direction Indicator | Jan 82 | $24.50 |
| 81wd12b | 2.50 | Wind Direction Indicator | Jan 82 | |
| **HOBBY ELECTRONICS** | | | | |
| HE102 | 2.50 | Guitar Phaser | Jun 81 | $25.00 |
| HE103 | | Transistor Tester | | $8.40 |
| HE104 | $2.20 | A.M. Tuner | May 81 | $7.50 |
| HE105 | $2.50 | Basic Amplifier | May 81 | $9.50 |
| HE106 | 2.90 | F.M. Radio Microphone | May 81 | $8.50 |
| HE107 | 3.50 | Electronic Dice | Jun 81 | $5.95 |
| HE108 | 2.90 | Power Supply | | $11.00 |
| HE110 | | Umistakabell | | $8.00 |
| HE110 | | Ohmeter | | $10.50 |
| HE112 | 2.20 | Micromixer | | $11.00 |
| HE113 | 2.50 | | | $8.40 |
| HE115 | 2.50 | | | |
| HE117 | | House and Car Alarm | | $16.00 |
| HE121 | 2.50 | Scratch and Hiss Filter | | $8.00 |
| HE123 | 3.90 | | | |
| HE129 | 2.50 | | | |
| HE126 | 2.50 | | | |
| HE127 | | Siren | | $3.00 |

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# The Australia Telescope

## Expanding the frontiers of knowledge

Australia will have the most versatile radio telescope array in the world — provided the Australia Telescope proposal now before the Commonwealth Government is approved in the 1982 Federal budget. If construction can start in 1982, the Australia Telescope will come into operation in 1988, to give the nation a flying scientific start into its third century.

THE TWO FIELDS of scientific endeavour in which Australia is internationally renowned are: immunology — the study of the immunity from disease and the conditions governing it; and radio astronomy — the exploration of the universe by means of radio telescopes.

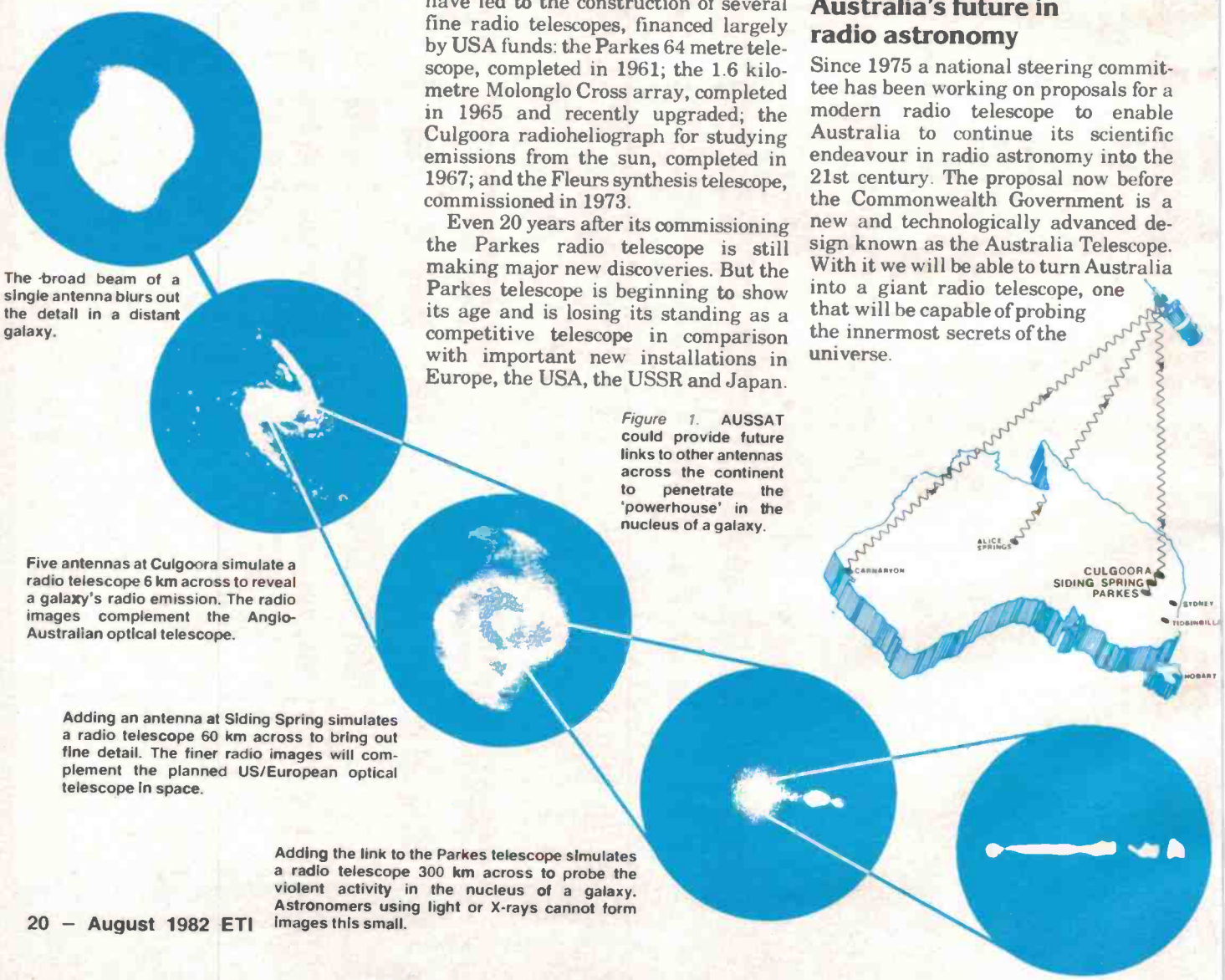
The construction of innovative radio telescopes and their role in unravelling the secrets of the universe were pioneered by Australian scientists following their wartime effort in the development of radar. The outstanding achievements of the scientists have brought great prestige to Australia and have led to the construction of several fine radio telescopes, financed largely by USA funds: the Parkes 64 metre telescope, completed in 1961; the 1.6 kilometre Molonglo Cross array, completed in 1965 and recently upgraded; the Culgoora radioheliograph for studying emissions from the sun, completed in 1967; and the Fleurs synthesis telescope, commissioned in 1973.

Even 20 years after its commissioning the Parkes radio telescope is still making major new discoveries. But the Parkes telescope is beginning to show its age and is losing its standing as a competitive telescope in comparison with important new installations in Europe, the USA, the USSR and Japan.

By 1990 the types of observations needed in radio astronomy will be beyond the capabilities of the Parkes telescope and also those of the Molonglo and Fleurs synthesis telescopes. The radioheliograph at Culgoora is already scheduled to cease operations in 1984.

### Australia's future in radio astronomy

Since 1975 a national steering committee has been working on proposals for a modern radio telescope to enable Australia to continue its scientific endeavour in radio astronomy into the 21st century. The proposal now before the Commonwealth Government is a new and technologically advanced design known as the Australia Telescope. With it we will be able to turn Australia into a giant radio telescope, one that will be capable of probing the innermost secrets of the universe.




The broad beam of a single antenna blurs out the detail in a distant galaxy.

Five antennas at Culgoora simulate a radio telescope 6 km across to reveal a galaxy's radio emission. The radio images complement the Anglo-Australian optical telescope.

Adding an antenna at Siding Spring simulates a radio telescope 60 km across to bring out fine detail. The finer radio images will complement the planned US/European optical telescope in space.

Adding the link to the Parkes telescope simulates a radio telescope 300 km across to probe the violent activity in the nucleus of a galaxy. Astronomers using light or X-rays cannot form images this small.

*Figure 1.* AUSSAT could provide future links to other antennas across the continent to penetrate the 'powerhouse' in the nucleus of a galaxy.

Provided funding is approved in 1982, the Australia Telescope will come into operation in 1988. Accordingly, the proposal has been put forward for consideration as a bicentennial project. This most significant and lasting project will pay tribute to our past accomplishments in science and ensure the continuation of this fine tradition by a new generation of Australian scientists.

## The concept

The Australia Telescope will consist of three main elements. One would be a linear array of five 22 metre dishes at Culgoora, near Narrabri in New South Wales. Another 22 metre dish would be located at Siding Spring near Coonabarabran, the site of Australian and British optical telescopes, while the third element would be the existing 64 metre dish at Parkes.

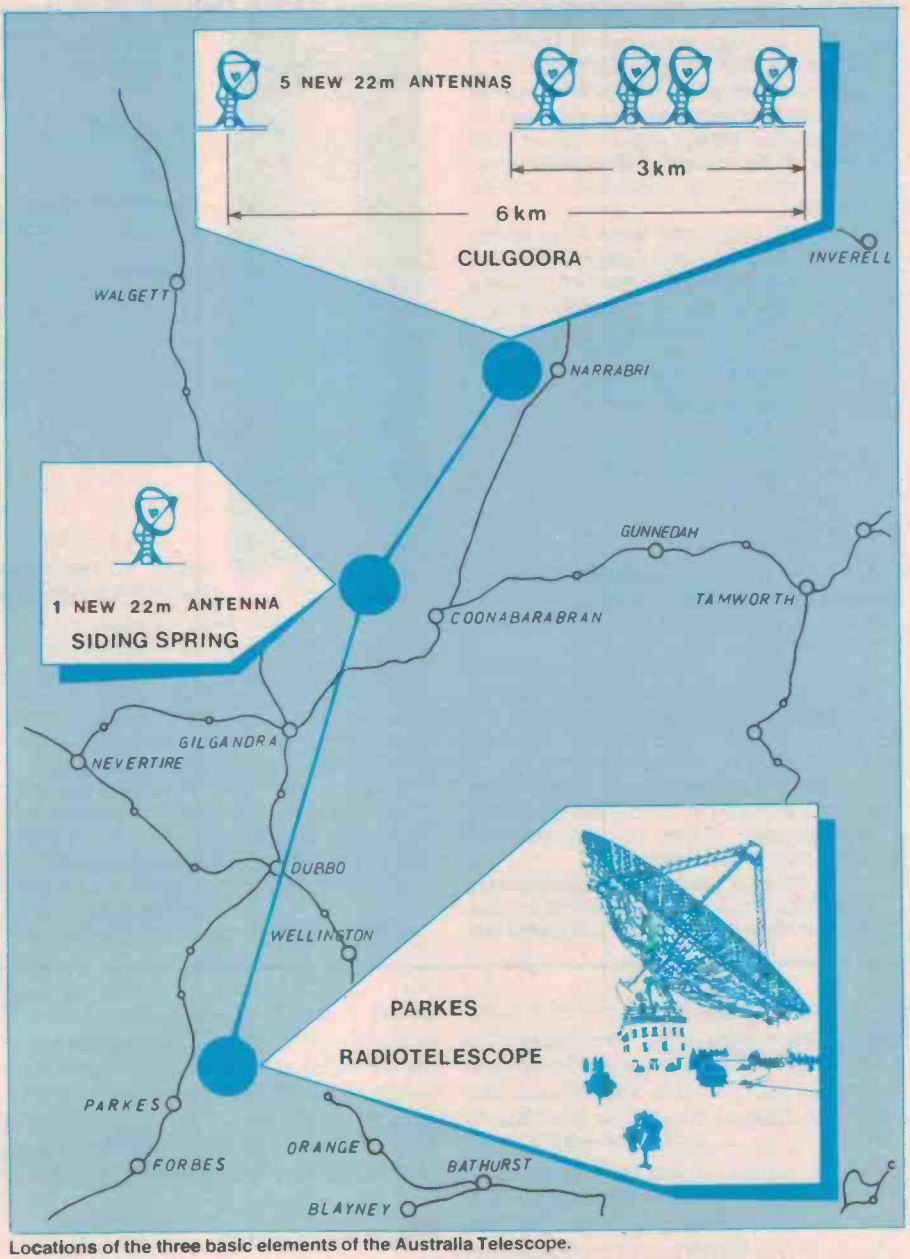
The array at Culgoora alone will simulate a telescope six kilometres in diameter; this array will allow mapping of the broader features of radio sources and investigations of spectral line emissions from giant molecular clouds in our galaxy. By linking the Culgoora array to the Parkes and Siding Spring dishes, the proposed telescope would form an array equivalent to a single dish 300 kilometres across. As such it will be the most versatile synthesis telescope in the world and will have the potential to make major discoveries well into the 21st century.

But the possibilities for the Australia Telescope do not end with the proposed array itself. The Australia Telescope array, which would be the first of its type in the southern hemisphere, could be linked, via satellite, to span the entire 3000 kilometres of the Australian continent. It would link radio telescopes in Culgoora, Siding Spring, Parkes, Fleurs near Sydney, Tidbinbilla, Hobart, Alice Springs and Carnarvon, as shown in Figure 1.

With this enlarged array, Australia would have the highest sensitivity high resolution telescope in the world, an array which will recognise details 1000 times smaller than even the most powerful single telescopes can detect.

## What makes the Australia Telescope unique?

By linking radio antennas across the country via satellite and ground links, the Australia Telescope will be able to see finer details than any optical telescope, either ground-based or space-borne. A unique and fundamental feature of the telescope will be its ability to 'see' the radio sky on all angular scales; that is to have an effective zoom ratio of 10 000 to 1.



Locations of the three basic elements of the Australia Telescope.

By itself, the 6 km array at Culgoora will be able to form radio images with detail matching the one second of arc image size of the Anglo-Australian optical telescope at Siding Spring. With the array stretching from Culgoora to Parkes, we will be able to complement the 0.1 second of arc images of the US/European Space Telescope due for launching in 1986. Higher resolutions still, to one thousandth of a second of arc, are available at radio wavelengths by linking radio dishes across the continent; this level of resolution is not obtainable at optical, X-ray or other wavelengths.

In everyday terms, such high resolution is equivalent to a person being able to see a ten cent coin in Sydney whilst stationed in Melbourne.

But there are other aspects which make the Australia Telescope unique. It will be the only instrument designed specifically for spectral line observations.

It will be the only large array in the southern hemisphere. Other existing and proposed arrays of radio telescopes are all in the northern hemisphere. They reveal very fine details of radio sources visible from the northern latitudes. However, many of the most interesting radio sources lie too far south in the skies for these telescopes. The Australia Telescope array in the southern hemisphere is ideally located to explore these sources.

The Australia Telescope will also have some very down-to-earth applications as well. The proposal opens up a whole new range of possibilities for the geophysics and geodetic communities. ▶

## MASER AMPLIFIERS

In 1953 J. Weber (University of Maryland) suggested that if the population of a quantum mechanical energy-level system in some material could be unbalanced so that a higher energy level contained more atoms of the material than a lower level, then a new type of amplification might be available.

Gordon, Zeiger and Nobel Prize winner Townes at Columbia University, NY, in the following year put the notion into practice using ammonia gas, and obtained amplification at the characteristic frequency of ammonia, 23 870 MHz. They called the device a MASER — the word is an acronym:

Microwave (because of the radio band where it occurred)
Amplification by
Stimulated (because the natural equilibrium has to be upset)
Emission of
Radiation

Later the more famous acronym LASER came along, in which this type of amplification was produced at the frequencies or wavelength of visible *light*.

The maser amplifier is of particular interest to radio astronomers because of its extremely high sensitivity. The price one has to pay for this characteristic is that the amplifier must be cooled to 4.5 K (—268.5°C) for it to operate. This environment is provided in the CSIRO Division of Radiophysics' masers by a closed-cycle helium refrigeration unit.

The Division has constructed two maser amplifiers, one operating at 22 GHz and the other at 43 GHz. The physical layout of the

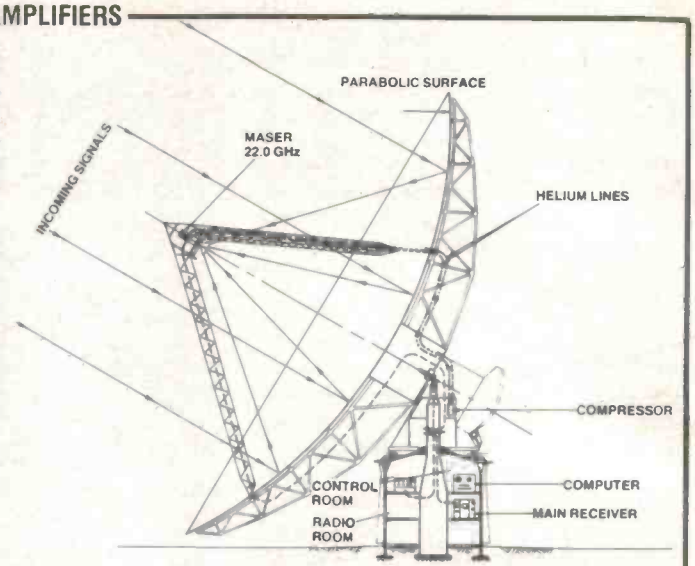



*Figure 1.* **The maser amplifier will be located behind the prime focus feed of the Parkes dish.**

maser amplifiers when mounted on the Parkes 64 metre radiotelescope is shown in Figure 1. The maser amplifier is situated at the focus of the telescope and is mounted on the cold station of the refrigeration system. High-pressure helium gas is supplied to the focus from a helium compressor located in the main structure. The low pressure gas from the cold station is returned to the input side of the compressor, thus forming a closed-cycle system.

Another interesting point about the Division's maser amplifiers is the use of a superconducting magnet to provide the necessary magnetic field for the maser. As the wire used in the electromagnet becomes superconducting (i.e: has *no* resistance) at low temperature (less than 10 K), once the field is established in the magnet the external source of energy (for example, a power supply) may be removed with very little effect on the magnetic field. It has been estimated that it would take approximately 500 years till the field in the magnet decayed to about 0.7 of its original value.

**J.W. Brooks**
**CSIRO Division of Radiophysics**

It will allow the operation of a high sensitivity, very long baseline interferometry (VLBI) array in Australia. Using a small portable antenna and the VLBI technique it will be possible to survey to an accuracy of millimetres over the whole of the continent. Such measurements will enable scientists to see how far and in what direction the plates of the Earth's crust are moving. The movement of these plates is believed to be a crucial factor in the causing of earthquakes. Knowledge of fault lines associated with the movement of plates is useful also for mineral and petroleum exploration because deposits often occur along fault lines in the Earth's crust.

## Australian involvement

The Australia Telescope is a totally Australian project with an Australian content in excess of 80%. It draws on Australian astronomy expertise, which is acknowledged world-wide as being at the forefront in all relevant areas. This is the same sort of expertise that attracted, in different circumstances, substantial overseas funding for previous major telescopes in Australia.

The Australia Telescope is to be operated as a national facility available to all Australian scientists. Hence it will provide stimulus and opportunities for continuing development work in a range of Australian institutions. It will provide the basis for sophisticated higher degree work at universities in both astronomy and technical areas.

## Cost estimates

The rate of expenditure for the six-year construction period of the Australia Telescope is shown in Figure 2. Antenna costs, based on the design study by the Sydney consulting engineers Macdonald, Wagner and Priddle, account for almost half the total cost of $25 million.

In the 1982/83 financial year only $820 000 is required to commence the project.

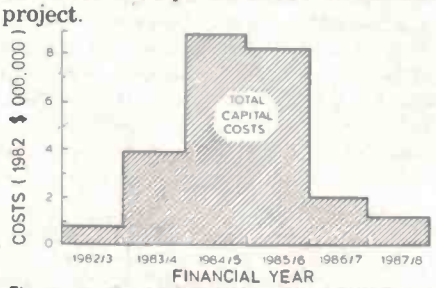



*Figure 2.* **Expenditure rate over period of construction.**

## Technological innovation

The Australia Telescope project is one of great scientific merit and technological innovation. As with past advances in radio astronomy, major technological spin-offs relevant to Australian industry will result. Much of the skill and expertise developed will be directly applicable to the design and construction of domestic satellite reception and transmission facilities. Such skills will give local industry a stake in the very important telecommunications market.

CSIRO designs have already provided substantial benefits to the Overseas Telecommunications Commission (OTC) for its ground stations at Moree and Carnarvon.

Work on the image processing capabilities of the Australia Telescope will be of direct relevance to biomedical and industrial applications.

The major design studies which form the basis of the proposal are:

### Antennae

Very high performance-to-cost ratio has been achieved in the antenna design by Macdonald, Wagner and Priddle in association with Ir B.G. Hooghoudt, and new ways of achieving precision dish surfaces at low cost have been devised.

The expertise will allow efficient ground stations for satellite communications to be designed and built in Australia.

### Antenna Feeds

The antenna feeds for the Australia Telescope will be ultra-wideband and will allow simultaneous multi-frequency observations. The 'polarisation purity' of such feeds, achieved by engineers of the CSIRO Division of Radiophysics, has been crucial for developments in satellite communication. New ideas in feed design for the Australia Telescope have been used to build new feeds for the OTC dish at Moree, so saving OTC some $4 million.

### Cryogenic Receivers

CSIRO has a major centre of expertise in low-noise receiver and cryogenic technology, thus assuring high sensitivity for the Australia Telescope.

### Satellite Distribution of Time and Frequency

The Australia Telescope will pioneer the use of satellites for the distribution of precision time and frequency references for local oscillator synchronisation.

### Data Transmission using Optical Fibres

The Australia Telescope will employ high-speed digital techniques to transmit information from the antennae to the central control area. Optical fibres and higher-speed links than those used in current practice will be required.

Flared corrugated horns, developed by the CSIRO Radiophysics Division, improve radiation pattern symmetry and provide low cross-polarisation with dish antennas — an important requirement in making accurate observations.

### Very Large-Scale Integrated Circuits

Specific new VLSI circuits have been designed for the correlation system and for the signal processing and display systems for the Australia Telescope.

### Image Processing

The Australia Telescope will use unique image processors and display systems of Australian invention to provide better facilities and faster turn-around in processing of images. ▶

## THE LIFE CYCLE OF A STAR

A star can exist more or less unchanged for millions of years; a long time compared with the age of our civilization — a short time when compared to the age of the universe.

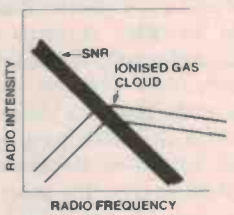
We can say that there have been many generations of stars since the universe began, and each new generation enriches the universe with heavy elements produced in the nuclear furnace that powers each star.

In general a star begins to die when all the hydrogen in its core has converted to helium. If the nuclear reactions in the core cease, then radiation pressure no longer prevents the star from collapsing under its own gravity. After collapse, new nuclear reactions can take place which can blow the star out to a diameter larger than that of the entire solar system. It is then a red giant.

If the mass of the star is at least four times the mass of the sun the collapse will trigger violent nuclear reactions which produce heavy elements in the outer shells of the star. The reaction releases an immense quantity of energy, which in turn blows the outer shells of the star far out into interstellar space, where they become visible for thousands of years as a supernova remnant. The core of the star undergoes simultaneous contraction and compaction, reaching incredible densities of greater than 1000 kg per cubic centimetre. Depending on the initial mass of the star, a white-dwarf star, a neutron star or a black hole is thus formed. A neutron star so formed that spins while rotating is called a pulsar.

The supernova remnant will expand and become fainter and fainter until after maybe 100 000 years it is lost amongst the interstellar gas, so enriching this gas with its heavy elements.

Finally some of the gas may coagulate, due to gravitational attraction, to then form a new star — a star richer in heavy elements than those of a generation before. It is generally thought that the atoms of all of us have been through many such events. We are indeed 'children of the stars'.




### RADIO EMISSION

A supernova (SNR) expands violently at velocities of up to 12 000 kilometres per second (one Earth diameter every second!). It pushes the surrounding interstellar gas and magnetic field along like a giant snowplough to form a spherical shell around the site of the explosion.

The high energy electrons in this shell interact with the magnetic fields to produce intense radio emission by the synchrotron process. A supernova remnant is brighter around the edges because we see a greater depth of material through the edges of a hollow sphere.

Supernova remnants are generally fairly dim at visual wavelengths and are difficult to distinguish from the more abundant galactic ionised-hydrogen nebula regions. On the other hand, radio emission from supernova remnants has a characteristic non-thermal spectrum and it usually exhibits relatively strong polarisation effects. Because of this, almost all the known supernova remnants were found from radio searches. In fact, deep optical photographs reveal optical features in less than one quarter of the 125 radio SNRs known in our galaxy.

Supernova remnants are also powerful X-ray sources; however, because our atmosphere absorbs X-rays, the observations of the X-ray emission have to be made from rockets and satellites.

Members of the CSIRO Division of Radiophysics laboratory have been major contributors in this field of astronomical study. Most of the known SNRs were discovered with the Parkes radiotelescope, and our studies of the structure and polarisation of these objects have provided us with an insight into the evolution of this class of nebula.

**D.K. Milne,**
**CSIRO Division of Radiophysics**

### A FEW EXPLOSIONS

| | |
|---|---|
| 1 stick of dynamite | ≃ 100 000 bursting toy balloons |
| 1 atomic bomb (Hiroshima) | ≃ 10 000 000 sticks of dynamite |
| 1 hydrogen bomb (10 megaton) | ≃ 500 atomic bombs |
| 1 supernova explosion | ≃ 10 000 000 000 000 000 000 000 000 hydrogen bombs! |

## Exploring the universe with the Australia Telescope

Important exploratory astrophysical projects await the Australia Telescope at the end of this decade. Many of these projects arise because of our privileged position in the southern sky.

Some of the most interesting radio galaxies will be within the field of view of the Australia Telescope. At present astronomers have only a limited ability to probe the critical central regions of the southern radio galaxy Centaurus A. This galaxy is closer than any other radio galaxy and offers unparalleled opportunities for studying the energy source in such luminous objects. With the Australia Telescope such galaxies will be studied in detail.

The centre of our own galaxy passes almost overhead in northern New South Wales and thus this area is ideally situated as a base for detailed studies of the galaxy. The Australia Telescope will have unrivalled power to investigate the spectral-line emission from giant molecular clouds in our galaxy. The richest of these clouds, which are the birthplace of stars, lie in the southern hemisphere.

The telescope will permit detailed studies of the structure and dynamics of distant galaxies. The nearest galaxies — the Magellanic Clouds — are only visible from the southern hemisphere and provide unique opportunities for research.

Another very important research area in astronomy is that related to the major discrepancy between the apparent birthrate of supernova remnants and pulsars — the two products of a supernova explosion. Such objects can best be studied in the southern hemisphere. Scientists from the CSIRO Division of Radiophysics and the University of Tasmania have recently discovered pulsars in the Magellanic Clouds. The Einstein orbiting X-ray observatory has discovered 80 possible new supernova remnants in the Clouds. Initial radio observations of these sources being made with the Molonglo telescope will lay the basis for a major program with the Australia Telescope.

The Australia Telescope is an essential tool in the study of the following:

- Active galactic nuclei and quasars
- Faster-than-light motions
- Extragalactic astrometry
- The nucleus of our own galaxy
- Violent galactic stars — possible black holes
- Interstellar chemistry
- Maser sources — stars in the making
- Proper motions within our galaxy for radio stars and pulsars
- Compact ionised hydrogen regions

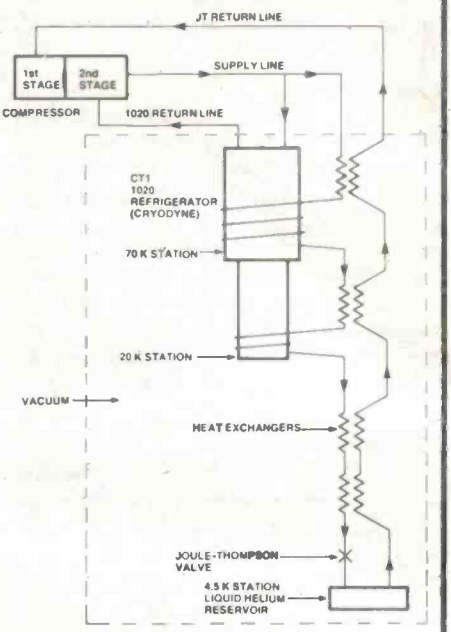
## CRYOGENIC TECHNIQUES

By 'cryogenic temperatures' we mean those temperatures at which common gases such as oxygen liquefy. They are extremely low — in general below 123 K (−150°C). Measurements are made in the absolute scale where 0 Kelvins or 0 K (absolute zero) is equivalent to −273.2° Celsius.

The first systematic investigation of low-temperature problems and gas liquefaction was made by Faraday in 1823. Cryogenics really came of age when the two most stubbornly gaseous of all the elements were finally liquefied: hydrogen (boiling point ≈20 K) by James Dewar in 1898 and helium (boiling point 4.2 K) by Kamerlingh Onnes in 1908.

Extremely low temperatures are essential in achieving high performance in radio astronomy receivers. The CSIRO Division of Radiophysics uses two types of refrigerator in its research program. Both have to be insulated from their surroundings by a vacuum. The vacuum container is called a dewar, which is an elaborate version of the well-known thermos flask. The first type is called a *cryodyne*, a commercially available refrigerator which maintains equipment dissipating 3 watts of heat at a minimum temperature of 15 K (−258°C). Four or five cryodynes are constantly in use in radio astronomy research.

The second type is far more complex. The cryodyne-type unit is used in the initial stages, but then a series of devices called heat exchangers and finally a Joule-Thomson valve achieve a minimum temperature of 4.5 K. (The Joule-Thomson effect is the fall in temperature of a gas when it expands without doing external work.) This temperature is achieved against a heat dissipation of the equipment to be cooled of about 3 watts. The system produces 8 litres of liquid helium per hour at its cold (4.5 K) station. Two such refrigerators have been developed and constructed in the Division's laboratory.




**SCHEMATIC DIAGRAM OF RADIOPHYSICS DIVISION'S 4.5K REFRIGERATION SYSTEM**

The accompanying figure is a schematic representation of the unit.

**B. Wilcockson,**
**CSIRO Division of Radiophysics**

*This article was prepared with the grateful assistance of the CSIRO, Division of Radiophysics.*

## 1982 — year of decision

The Australia Telescope has been conceived as part of Australia's continuing vital role in 20th century scientific endeavour in the field of radio astronomy — a field pioneered by Australian scientists in the postwar years.

The Australia Telescope proposal provides Australia with an opportunity to build, at modest cost, the most versatile radio telescope in the world. With it, Australian astronomers can look forward to solving some of the most perplexing problems in astronomy today; without it, one of Australia's most eminent fields of science will die.

1982 is the year of decision for radio astronomy in Australia. If the Australia Telescope is not funded, we are clearly left in a situation where the present radio telescopes will run down over five to seven years. A decision not to fund the Australia Telescope will be seen by the Australian and the world scientific community as a policy decision to discontinue radio astronomy in Australia.

Alternatively, if a start on the Australia Telescope can be made in 1982, the telescope will come into operation in 1988, Australia's Bicentennial Year. It would be a scientifically and technologically demanding project which would symbolise our past achievements in science and, more importantly, ensure the continuation of this outstanding tradition by a new generation of Australians. ●

**Do black holes swallow stars? The Circinus X-1 star system may be an example. This artist's impression shows the dense, compact star 'sucking' matter from a supergiant (lower left). The scale is very distorted — the compact star may only be 10 km in diameter.**

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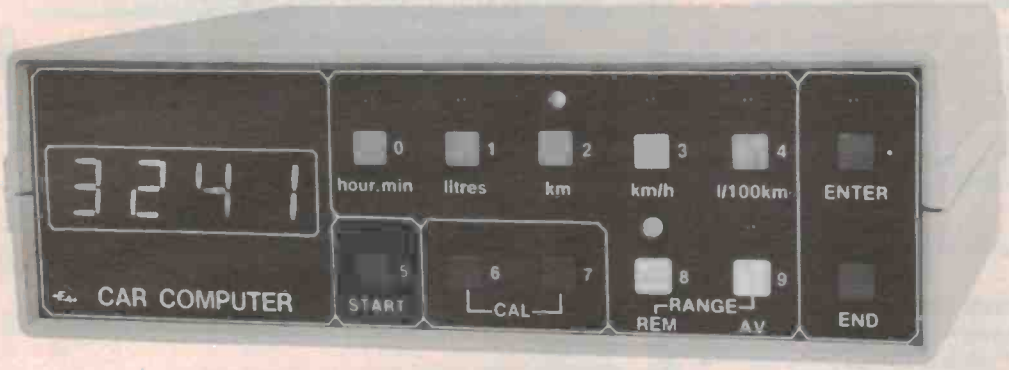


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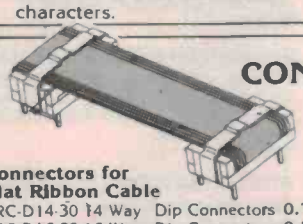

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TELEGRAM TO:

CONGRATULATIONS. . . YOU HAVE WON A MAGNIFICENT NEW DATSUN STANZA SEDAN, VALUED AT OVER $7000, IN THE DICK SMITH ELECTRONICS 'WIN A DATSUN STANZA' COMPETITION.

YOUR COUPON WAS DRAWN FROM THE ENTRIES RECEIVED FROM DICK SMITH ELECTRONICS CUSTOMERS WHO HAVE PURCHASED A HOME COMPUTER DURING THE PAST FEW MONTHS.

OBVIOUSLY, ONLY A LIMITED NUMBER OF COMPUTERS COULD BE SOLD DURING THIS PERIOD - SO YOUR CHANCES OF WINNING THE DATSUN STANZA WERE VERY, VERY GOOD.

WITH THE NUMBER OF COMPUTER SUPPLIERS AROUND, DECIDING WHO TO BUY FROM COULD NOT HAVE BEEN EASY. BUT, AS YOU HAVE PROVEN, WHO ELSE OFFERED YOU THE CHANCE TO WIN A DATSUN STANZA?

OF COURSE, WE ALSO GAVE YOU A SEVEN DAY MONEY BACK SATISFACTION GUARANTEE . . . HUGE SOFTWARE BACK-UP . . . TECHNICAL HELP FROM OUR COMPUTER HOTLINE . . . FULL SERVICE FACILITIES WITH FACTORY TRAINED TECHNICIANS . . . AND FRIENDLY , HELPFUL STAFF IN ALL OF OUR STORES READY TO ASSIST YOU.

WITH ALL THIS GOING FOR YOU, IT'S PRETTY OBVIOUS YOU MADE THE RIGHT CHOICE IN COMING TO DICK SMITH ELECTRONICS - AND NOW WINNING THE CAR MAKES IT AN EVEN BETTER CHOICE.

ONCE AGAIN, OUR CONGRATULATIONS - AND MAY YOU BE AS HAPPY WITH YOUR NEW DATSUN STANZA AS WE'RE SURE YOU ARE WITH YOUR NEW COMPUTER FROM DICK SMITH ELECTRONICS.

REGARDS,

DICK SMITH.
DICKS AA20036+

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**How would you like to receive this telegram?**

The magnificent new Datsun Stanza must be won by a Dick Smith customer in the next few weeks. What a superb Christmas present to receive!

And we're not kidding about your chance to win this superb prize: you've a much better chance of winning this competition than any other competition you could think of!

Every purchaser of a System 80, a Sorcerer or a VIC 20 computer from Dick Smith Electronics will receive a free entry form.* So if you're thinking about buying a computer, hurry and get yours soon: this competition must close shortly.

As well as getting the best in computers, you could be driving a new Datsun Stanza!

See details of these exciting computers in the next three pages.

# DICK SMITH ELECTRONICS

*Competition not valid in states where it might contravene State Laws. Permit No TC82/278 issued under the Lotteries and Art Unions Act.

DSE/A313.1/PAI

*"Overall, we are very impressed with the Blue Label System 80. On a dollar per function basis it probably represents the best value around for a ready-built computer. Other systems can be bought for less, but ultimately they are not as powerful or as readily expandable as the System 80. There is also the matter of software, and here the System 80 really scores, with hundreds of compatible programs available for the TRS-80 as well as those specially written for the System 80."*
Peter Vernon, Electronics Australia June '82

## Read what EA have to say!

# That's the new SYSTEM 80 BLUE LABEL

with features like:
- 16K memory (expandable to 48K with X-4020 Expansion Unit)
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AND LOTS MORE! Cat X-4005

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A BRAND NEW MODEL! - now with extra value!
The first row of 16K RAM is fitted as standard in this unit, with provision for an extra 16K (making the possibility of a HUGE 48K total memory!). It provides as standard a floppy disk controller capable of controlling up to 4 single density disk drives. Significant changes internally include removal of the S-100 motherboard (now available as an option - see below). The Centronics port is still standard, the RS-232C interface and connector are now only available as options (see below). Cat X-4020.

$399

**16K Expansion Pack**
Don't be misled into paying extra for no better quality: ours are the premium quality 200ns type 4116 dynamic RAMS used by most microcomputers. Why not upgrade your computer? Pack of 8 4116 RAMS. Cat X-1186. **$29.95**

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With this card you can open the way to many applications available via the S100 bus system. Cat X-4024. **$129.00**

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As an option with the expansion unit, the RS232C interface makes your computer capable of communicating with modems, or driving teleprinters or other serial printers. Cat X-4022. **$99.00**

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ALMOST HALF PRICE!

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ORIGINALLY ~~$1495~~
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ONLY
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**Already configured for the two drives most users need: drive 0 (Cat X-4060) and drive 1 (Cat X-4061).**

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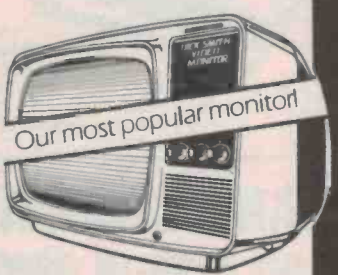


If you're seriously into computers then this is the monitor for you. Provides a sharper, brighter image, and you avoid eye fatigue! Suited more for the professional rather than the hobbyist! Cat X-1198.

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$199

## DOT MATRIX PRINTER

SAVE $170!

ONLY $799
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We've sold more of these superb printers than any other type. The Itoh 8300P offers so many advantages over its competitors ... not the least being the price! It features high speed, bi-directional printing (125 ch. per second) with a full upper and lower case character set. It accepts standard fan-form sprocketed paper, up to 240mm size (minimum 115mm) and so much more!
Each printer is supplied with a technical manual, a maintenance manual and is fitted with the standard 57N-36 input connector. Cat X-3255

# AND YOU COULD WIN A DATSUN STANZA — BUT ONLY FROM DICK SMITH ELECTRONICS!

DSE/A313.2/PAI

# VIC 20 COLOUR COMPUTER

**Ideal for the first time user, this remarkable computer can be used immediately with plug in cartridges. The fantastic range of game cartridges can be used with any colour or B & W TV set, to look just like the arcade games. Or it can be expanded to form the heart of a complex computer system. The system is programmed in BASIC and** ".....provides good value for money.....". **(EA, July 82 Pp 114)**

**Also available:**
**Colour monitor to suit VIC 20, Cat X-1195 ..... $379.00**
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**ONLY $399**
**Cat X-2000**

## GENUINE VIC 20 PERIPHERALS

***Store your programs***
**DATASETTE**

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This remarkable computer comes equipped with a tape cassette interface which lets you connect the Commodore tape unit directly into the computer. With this ability you can load, store or retrieve data on standard cassette tape. By a simple command the machine will automatically 'save' a full program for you. It's a handy and economical way of storing and retrieving data, plus you can buy existing software or create your own programs and store them. Cat X-2005.

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For two player games such as 'Tennis'. Small and compact they allow movement left or right and are easy to fire with. Cat X-2022 **$39.50 pr**

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Can you capture the aliens before they zap you?
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Race through a maze. Challenging game of action, requiring quick thinking.
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Jelly Monsters abound in a maze, racing at you, following your every move. Look out!
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Contains all of the above cassette programs in a six pack. Cat X-2037.
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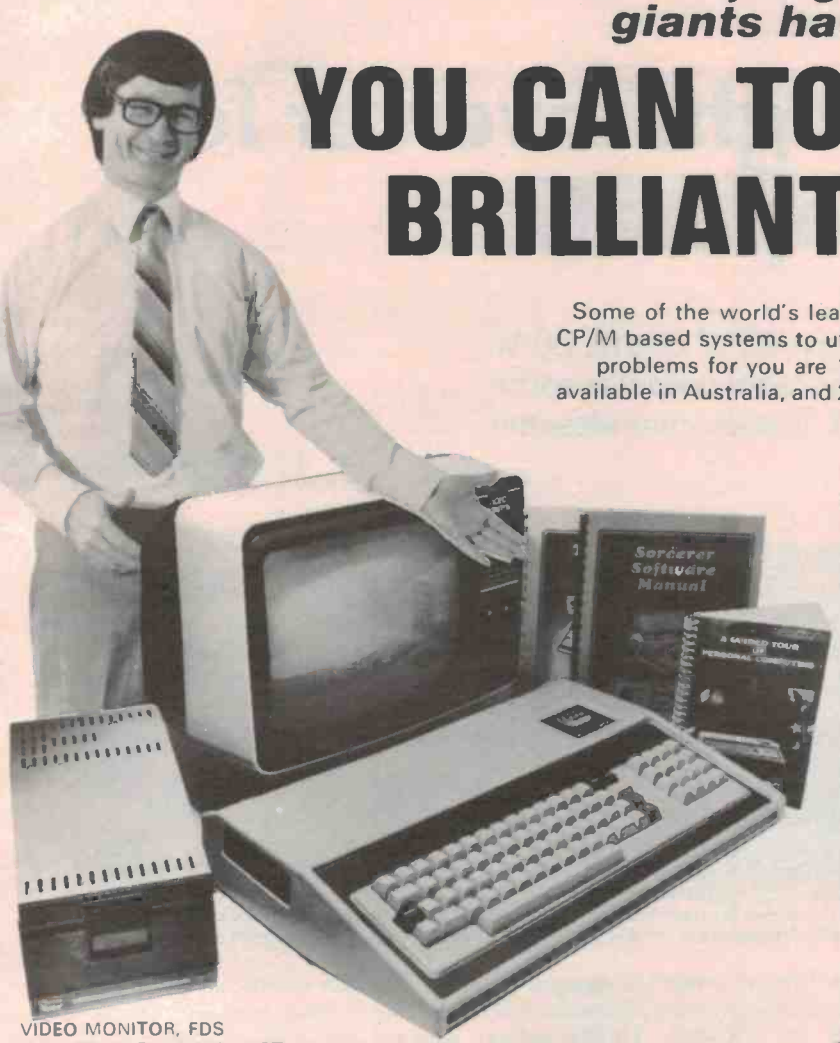
## AND YOU COULD WIN A DATSUN STANZA – BUT ONLY FROM DICK SMITH ELECTRONICS!

DSE/A313.3/PAI

***I.B.M., Digital and other industry giants have gone the CP/M way!***

# YOU CAN TOO WITH THE BRILLIANT SORCERER!

Some of the world's leading computer manufacturers are now producing CP/M based systems to utilise the vast range of existing software. The only problems for you are 1): Some of the CP/M-based systems are not yet available in Australia, and 2): Some of them may cost up to, and over, $5,000! So why not check out ...




VIDEO MONITOR, FDS & SOFTWARE MANUAL NOT INCLUDED IN PRICE OF COMPUTER

## The Incredible Sorcerer

For the serious personal computer user, it offers a truly outstanding performance - plus the ability to run the industry-standard CP/M operating system at lower cost than any other computer. The Exidy Sorcerer MkII — the most powerful, flexible and businesslike machine in its class.

## Look at the features

- Built in serial and parallel ports
- 2 cassette control ports
- Powerful graphics capabilities
- Expandable to 48K on board
- Uniquely versatile ROMPACS™ — instant change to dedicated processor, and back again!
- Built-in 4K ROM resident monitor
- Economic disk storage now available (optional) with Exidy's FDS — floppy disk subsystem (does not need expansion interface)
- 8K Microsoft BASIC Cat X-3002

**was ~~$1398~~**

NOW ONLY **$1195!**

**OUR BETTER BUYING POSITION MEANS WE CAN PASS ON THE SAVINGS TO YOU!!**

SAVE NEARLY $200

### SAVE $100's FDS Disk Drive doesn't need an expansion unit!

The FDS Disk Drive comes with CP/M as standard. It has a storage capacity of 308K Bytes and has its own controller system and logic to run itself and up to two other drives! Add it to your Sorcerer and you have the lowest cost CP/M system available in Australia.
Cat X-3220

**and it's only**

**$1290**

### GREAT NEW SOFTWARE ON TAPE

**ZAP 80**
'Secret Code Disassembler' - It will display all those unknown instructions Zilog never talk about!
Cat X-3625 ..... **$22.95**

**FORTH**
Forth is a new language for your Sorcerer using postfix notation (RPN).
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**DUMB TERMINAL vs. 3**
Enables your Sorcerer to be used as a low cost, user configured communications terminal.
Cat X-3637 ..... **$7.95**

**COPYFILE**
A disk to file transfer program essential for the single drive CP/M user. Automatically loads itself onto your disk.
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**& MANY MORE**

### UTILITIES ON DISK

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Adds disk operating commands and many enhancements to ROMPAC™ BASIC. Requires X-3205 Disk System.
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**EXTENDED BASIC FOR FDS**
Features include double precision variables, constants, maths, full line editing and all normal disk facilities and commands.
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**DSKCITOH/PRINT (FDS)**
Soft sectored disk driver and proportional print driver to be used with the FDS and the word processor ROM PAC
Cat X-3726 ..... **$155.00**

**ASK FOR OUR FREE SORCERER BROCHURE**

# DICK SMITH ELECTRONICS

SEE PAGE 144 FOR STORE ADDRESS DETAILS.

DSE/A236M/PAI

# Fluorescent light inverter for 12 V battery operation

This inverter will drive two 20 W, one 40 W or one 20 W fluorescent tube from a 12 V battery. Light output is some three times that of an equivalent power incandescent globe and efficiency is very high.

**David Tilbrook**

WE FIRST published a fluorescent inverter in the November 1972 issue of ETI. It was a self-oscillating circuit, running at around 2 kHz, and was intended for use with a 20 W fluorescent tube and a 12 V battery. The circuit worked well, and countless numbers have been built over the years. The only disadvantage is the 2 kHz running frequency, which generates an audible tone that can be difficult to silence. Having decided to publish a new design, the main priority was to develop a circuit that would run above 20 kHz, making the inverter totally silent. However, this proved to be a much more difficult task than was first expected, and most of the initial prototypes failed miserably.

The main problems associated with running above 20 kHz are caused by losses in the cores and switching transistors, causing excessive heating and inefficiency. The circuit finally developed overcame these problems with the help of some cores from Philips that exhibit very low loss above 20 kHz. The problem with the switching loss was reduced by using BDY91 transistors, which have very low saturation voltages but fast switching speeds.

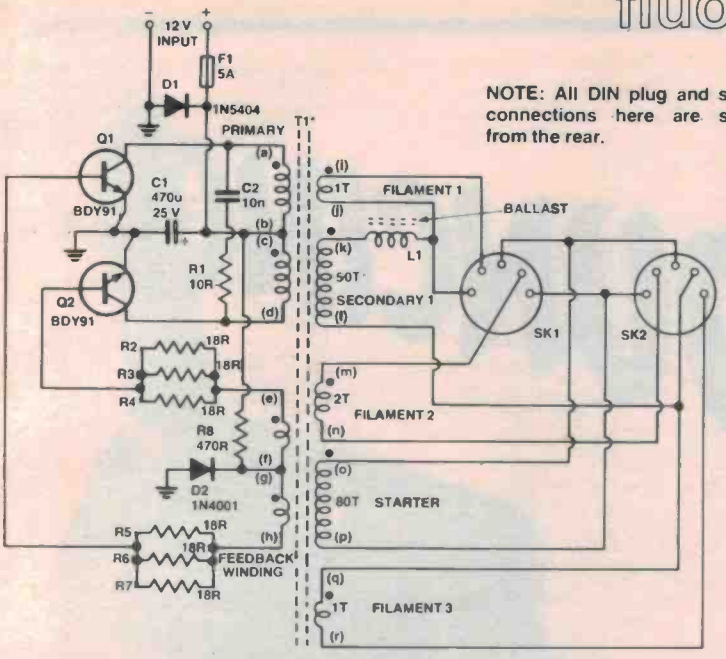
The circuit is a self-oscillating, saturating, push-pull inverter, similar in concept to the earlier design. The frequency of operation of these circuits depends on the number of turns on the primary of the transformer and on the properties of the core material. In general, if the primary turns are decreased the oscillation frequency is increased, since the magnetic field intensity necessary to cause core saturation occurs sooner, and core saturation causes the circuit to toggle to the opposite state. (A more detailed description of this is included in the How It Works section.)


Our final prototype. We used two 20 W tubes housed in 'Safe-T-Lite' enclosures. Put protective plastic caps over the transistors to prevent shorts. One 'starter' wire (see circuit) can be seen wound around the top tube.

In the initial prototype designs we tried to use common potcores such as the FX2242 or FX2243. Unfortunately these have relatively large core loss above 20 kHz, and operation of the inverter for only 15 minutes caused core temperatures of well above 150°C. Furthermore, although it was possible to make the circuit oscillate above 20 kHz, this was achieved only by allowing the transistor to saturate in order to cause switching of the circuit. This was done by limiting the amount of base drive to the transistors so that when sufficient current flowed through the transistors a voltage drop would start to appear across them, causing switching. It was impossible to make the cores saturate before the transistors with a reasonable number of turns on the primary. The problem with this technique is that the increased voltage drop across the transistors causes an increase in the power dissipation in these devices, further decreasing the efficiency of the circuit.

The solution, as mentioned above, was to use a core capable of working above 20 kHz with negligible loss. We chose Philips EC52/24/14 cores as we had previously used them in the ETI-142 power supply (Feb. '79). They are commonly used in switch-mode applications and have been available for some years. See the 'Shoparound' page this issue for suppliers. The design uses four of these cores (they come in core halves), two for the main inverter transformer and two for the ballast inductor core.

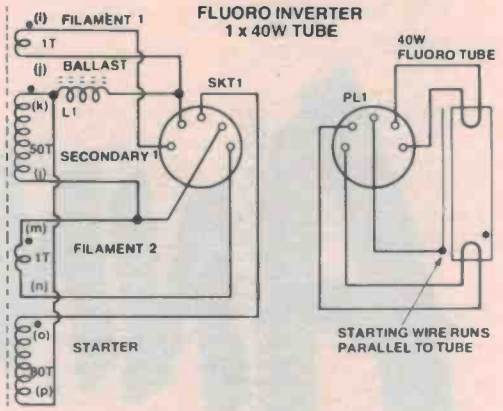
Fluorescent tubes, like most gas discharges, have a negative resistance and will pull extremely large currents if allowed to. To overcome this it is necessary to place an appropriate amount of impedance in series with the tube, limiting the current to a realistic value. A resistor of course cannot be used, since power dissipation would be enormous. Instead the ballast inductor is used, which has another advantage not immediately obvious. If the supply voltage to the inverter is decreased, by a slowly flattening battery for example, the frequency of oscillation and the output voltage will decrease. However, since the impedance of the ballast decreases at lower frequencies, the effect of decreased voltage is offset somewhat, and light output does not drop as much as expected. Similarly, if the voltage applied to the inverter is too



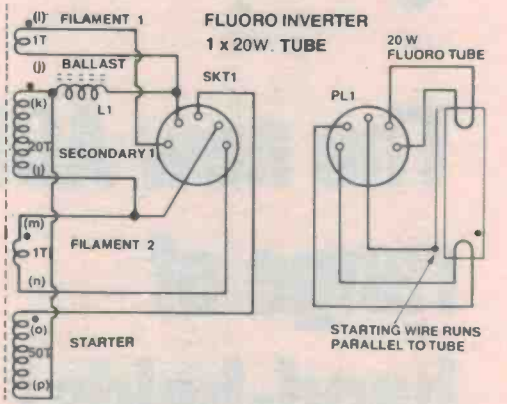

NOTE: All DIN plug and socket connections here are shown from the rear.

ABOVE: General circuit of the inverter, configured to drive two 20 W tubes, as in our final prototype.

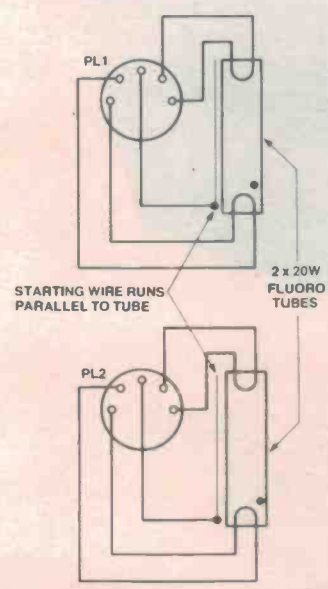
BELOW: Tube wiring details. Note that they are connected in 'series'. The 'starter' wire brings about initial ionisation of the tube. It may be laid parallel to the tube or wound around it once or twice.

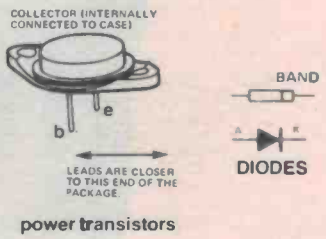



Arrangement for driving a single 40 W tube.




Arrangement for driving a single 20 W tube.




power transistors

high, the oscillation frequency tends to increase, the impedance of the ballast increases, and once again the tube current is maintained closer to the optimum, ensuring good tube life.

This inverter can be configured to drive one 40 W tube, two 20 W tubes or one 20 W tube. However, the latter option is not recommended as actual power dissipation goes up! Battens for two 20 W tubes and for a single 40 W tube are readily obtainable from lighting suppliers and it is possible to build the inverter into these. We elected to have a pair of 'portable' 20 W tubes driven from the one inverter, constructed in a convenient aluminium box. ▶

## HOW IT WORKS — ETI-1505

The circuit is a push-pull, self-oscillating inverter. The moment the supply voltage is connected, current flows through the 470 ohm resistor, R8, through the feedback winding and current limiting resistors to the bases of Q1 and Q2. One of these two transistors will turn on, as both devices are not exactly matched in characteristics, and force the other transistor to turn off. If, for example, Q1 turns on, current will flow through a-b of the primary winding. This causes a magnetic field to build up in the transformer core creating a positive voltage on d, h, j, l, n, p and r (i.e: the finish of each winding), the 'starts' being indicated by a ●). So, the base of Q2 is driven negative, forcing the transistor hard off. The base of Q1 is driven positive, driving the transistor hard on.

Since the primary of T1 acts as an inductor, the current flowing increases linearly for as long as the voltage is applied until finally the magnetic field intensity reaches a maximum, where the transformer core saturates. At this moment, the impedance of the core drops since the saturated core cannot maintain the relatively high inductance of the primary. The decreased impedance causes an increase in current flowing in the primary, driving the core even further into saturation until most of the coupling between coils on the transformer is lost. This causes the drive voltage to the transistor bases to disappear. Current stops flowing in the transformer and the magnetic field starts to collapse. This causes the voltage sense of each winding to reverse and the start (●) of each changes from negative to positive. This removes charge from the base of Q1, which turns off, and drives the base of Q2 hard on. The whole sequence of events then repeats itself, only Q2 is now hard on and Q1 is hard off.

In this way, the circuit oscillates at a frequency determined by the core material, the number of primary turns and the applied voltage.

Resistor R1 and capacitor C2 serve simply as a 'snubber' to remove flyback voltage spikes from the collectors of the transistors, preventing destruction of the devices by over-voltage. Diode D2 is incorporated to enable starting of the circuit but is 'transparent' during operation.

The transformer secondaries are wound to provide the necessary voltages for either 20 W or 40 W fluorescent tubes maintaining voltage and filament voltage. The 'starter' winding is necessary to ionise the gas in the tube to induce the tube to light. This could be done by increasing the secondary voltage but this causes an unnecessary current consumption in the primary. A separate starter winding is by far the better approach and the one we have used.

The ballast inductor L1 serves to limit the current flowing through the tube(s) which have a negative resistance characteristic and can draw very high currents once lit, if allowed.

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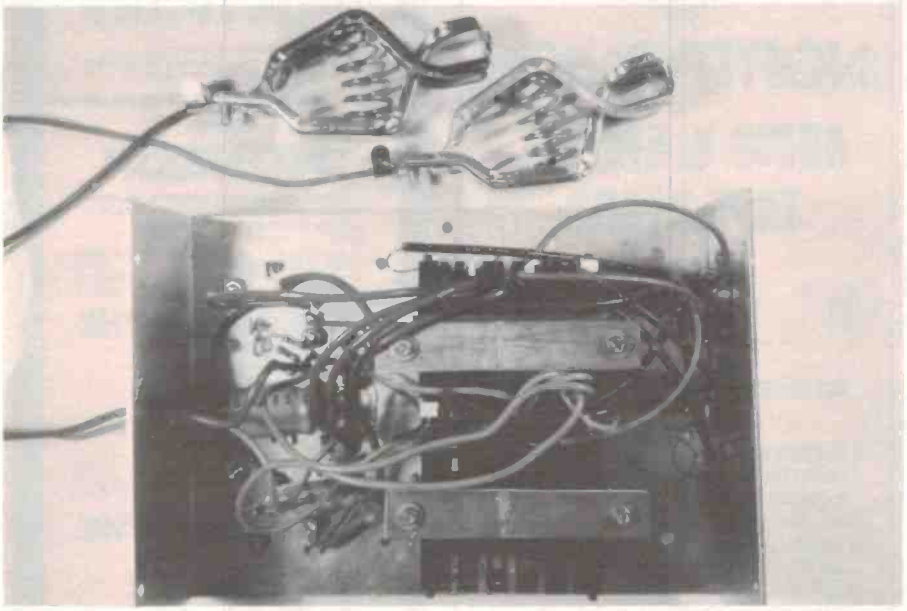


Internal view of our final prototype inverter, showing general layout. The inverter transformer, T1, is at upper right, the ballast, L1, below it.

## Construction

Best place to commence is with the hardware. We housed the unit in an aluminium case we had to hand that measured 170 mm long by 125 mm wide by 55 mm deep. This allowed plenty of room to mount everything. Any housing of a suitable size could be used, or the circuitry could be built into the base of a fluorescent light batten.

You'll need to drill TO-3 mounting hole patterns for the two power transistors (Q1 and Q2). Use an insulating washer as a template. The two transistors can be mounted adjacent to one another. We mounted ours 50 mm apart (between centre lines), toward one end of the box. The 7-lug tagstrip was mounted between them, toward the middle of the box, allowing plenty of room to mount the transformer and ballast in the area left. The two DIN sockets were mounted on the end panel, at the end of the box opposite the transistors. You'll need to drill suitable holes for the transformer mounting clamps. While the transformer assemblies are generally supplied with special mounting clamps, these may sometimes be unavailable. We didn't have any so fashioned some out of some 55 mm long bolts and a scrap of pc board for a top clamp (either remove the copper or cut it so that the bolts, chassis and clamp don't make a shorted turn around the core). When you're mounting transformer T1 later, its core should be separated from the chassis a little by a strip of cardboard or pc board. This reduces eddy current losses in the chassis and core and reduces chassis and core heating during operation.

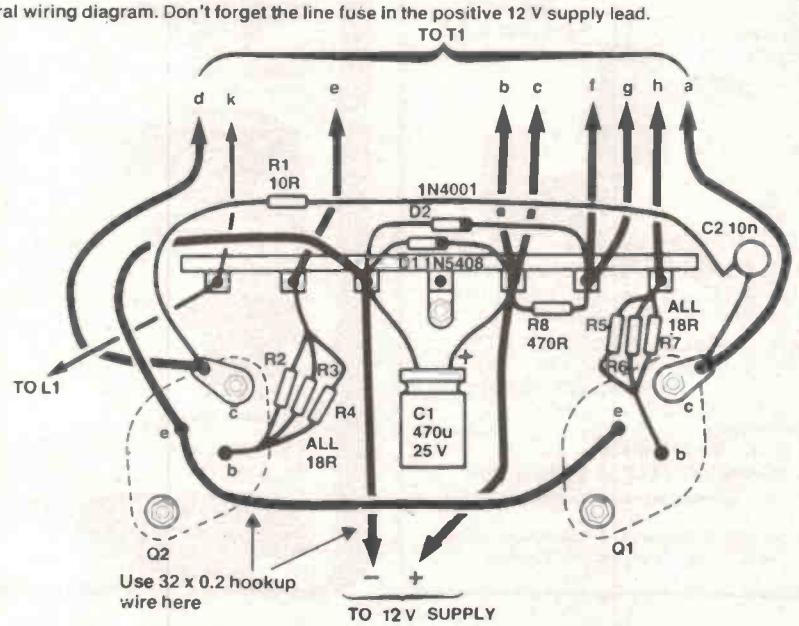
We leave the exact details to you as individual construction will likely vary considerably.

With the chassis drilled, mount the transistors first, using insulating washers, thermal compound and bushes for the mounting bolts. Put a solder lug under one mounting nut on each transistor (inside the chassis) for collector connections.

Next mount the tagstrip and solder in the resistors, capacitors, diodes and transistors, so far as possible. Refer to the wiring diagram.

Wind T1 and L1 next. Details are given in the accompanying panel. Having completed T1 and L1, assemble and mount T1 first. Sleeve all enamelled copper wire flying leads with spaghetti insulation. Make sure you can identify each lead. Wire up T1 according to the circuit and wiring diagram. Take particular care wiring up the DIN socket or sockets — depending on whether

General wiring diagram. Don't forget the line fuse in the positive 12 V supply lead.




### PARTS LIST — ETI-1505

**Resistors** ..... all ½W, 5%
- R1 ..... 10R
- R2, 3, 4, 5, 6, 7 .... 18R
- R8 ..... 470R

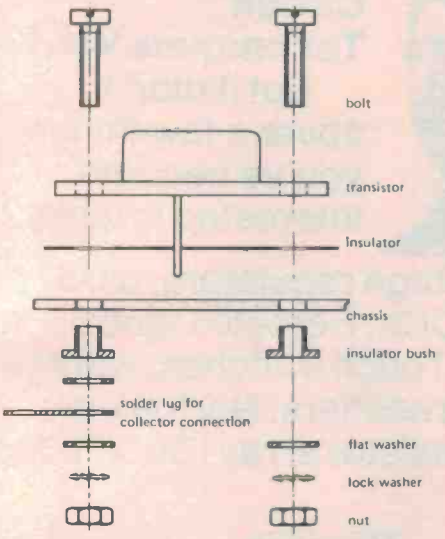
**Capacitors**
- C1 ..... 470u/25 V RB electro.
- C2 ..... 10n ceramic

**Semiconductors**
- D1 ..... 1N5404 or similar
- D2 ..... 1N4001 or similar
- Q1, Q2 ..... BDY91 or BDY92

**Miscellaneous**
- F1 ..... 5 A fuse and in-line fuseholder
- PL1, PL2 ..... 5-pin DIN plugs
- SK1, SK2 ..... 5-pin DIN sockets (chassis-mount)
- L1 ..... Philips EC-core assembly (windings — see text) 2 x EC52/24/14 cores (4322-020-52520) 1 x former, no tags (4322-021-33020) clamp assembly: 1 x 52PLATE, 1 x 55UBOLT, 2 x 632NC2A.
- T1 ..... as per L1

One 20 W or one 40 W or two 20 W fluorescent tubes; housing(s) to suit tube(s); case for electronics; one 7-way tag strip; battery cable (pair of 32 x 0.2); battery connectors; nuts, bolts, wire etc.

**Price estimate $35 — $40**
**not including fluoro tubes and tube housing(s)**




Mounting Q1 and Q2

you're using one 20 W, one 40 W or two 20 W fluorescent tubes.

Mount the ballast inductor, L1, but don't secure it in place too permanently yet as you'll need to set up the inverter by 'gapping' the core. Put spaghetti on the flying leads of L1 also.

Now the tube or tubes can be wired up. We used two 20 W tubes mounted in 'Safe-T-Lite' plastic tubes with rubber ends which we obtained from Warburton Franki. Some kit suppliers may be able to supply these along with kits. Wiring to the fluorescent tubes may be done with ordinary hookup wire — the filament pins may be soldered to directly. The 'starting' wire is attached to the tube with glue or tape. We used hookup wire run the length of each tube. It is not connected to any part of the tube. For the lead from the tubes to the DIN plugs, we used five-core double-insulated cable, which should not be too difficult to obtain.

## Setting-up procedure

Before powering up, make sure the ballast inductor core halves are in good contact with one another. Now, plug in your fluoro tube or tubes, connect the inverter to a 12 V battery or power supply (it should be capable of 4-5 A), and switch on. The tube should light smoothly and you should be able to hear the inverter oscillating at around 12-15 kHz (if your ears are OK). If the tube doesn't light or the inverter doesn't oscillate, switch off and check your wiring. If all seems OK, reverse connections 'e' and 'h' on the feedback winding and power up again. This time the inverter should spring to life — if not, you still have a problem. Sort it out before continuing.

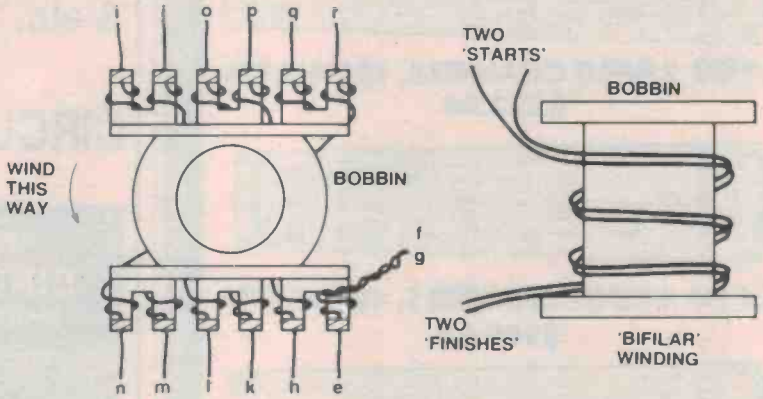
Assuming your inverter now works, you can proceed with adjusting the ballast inductor.

For correct operation, the inductance of L1 needs to be set by 'gapping' the core, limiting the maximum current through the fluorescent tube or tubes. To do this, insert an ammeter in series with one 12 Vdc supply lead, set to read 5 A (max.) if you have a 40 W load (one 40 W tube or two 20 W tubes), or 3 A (max.) if you have a 20 W tube.

We found the best gap was obtained by taking a small piece of paper, cut from a page of ETI, and inserting it between the faces of one 'leg' of the core halves! Clamp the assembly firmly. Then, apply power and measure the supply current. It should be within 100 mA of 4.5 A for correct operation on a 40 W load with a supply of between 12 and 14 volts. For a 20 W load, the current should be around 2.5 A.

That's it! May your little light shine brightly. ●

### WINDING T1 AND L1




**Components required:**
Two Philips EC core assemblies, each consisting of:-
2 x EC52/24/14 cores — 4322-020-52520
1 x former, no tags — 4322-021-33020
1 x clamp assembly as follows;
1 x 52PLATE, 1 x 55UBOLT, 2 x 63NC2A

**Wire required:**
About 4 m of 0.4 mm dia. enamelled copper wire.
About 1 m of insulated hookup wire (10 x 0.2 mm).
About 1 m of heavy duty insulated hookup wire (32 x 0.2 mm).

**L1:** Wind 40 turns of 0.4 mm enamelled copper wire (about 1 m) on one bobbin, tieing off the ends to convenient posts on the bobbin end cheek. Spread the winding over the bobbin. Leave about 100 mm or so of lead length.

**T1:** Commence with the **'starter' winding** (o/p). For this you'll need about 120 cm of 0.4 mm enamelled copper wire. Referring to the accompanying drawing, tie off the start (o), leaving about 100 mm or so of lead. Wind on **80 turns**, spreading the winding over the bobbin. Tie off the end (p) adjacent to the start, as shown in the diagram, leaving another 100 mm or so of lead.

Do **secondary 1** next. This requires 0.4 mm enamelled copper wire. The number of turns required depends on which tube or tubes you intend to run. Consult the 'windings' table. As for the first winding, commence by tieing off the start (k) then wind on the required number of turns, spreading the wire over the former. Again, start and finish leads should be 100 mm or more.

Now wind the three filament windings. **Filament 1** and **filament 3** are each **one turn** of enamelled copper wire. **Filament 2** is **two turns.**

The **feedback winding** comes next. This is wound *bifilar* using the lighter duty insulated hookup wire (10 x 0.2 mm). Take a pair of wires, laid side by side, and wind one turn on the bobbin, tieing off the ends leaving long flying leads. Twist together one start and one finish for the centre tap (f & g).

An illustration of bifilar winding (showing three turns) is given in the accompanying diagram.

The **primary** winding comes last. This too is wound *bifilar*, using the heavy duty hookup wire (32 x 0.2 mm). Wind on **three turns**, tieing off the leads, leaving long flying leads as for the feedback winding. Twist together one start and one finish for the centre tap (b & c).

Windings
L1 40 turns, 0.4 mm enam. copper wire.
T1 **primary** (a-b, c-d)
3 turns, bifilar, 32 x 0.2 mm insul. hookup wire.
**feedback** (e-f, g-h)
1 turn, bifilar, 10 x 0.2 mm insul. hookup wire.
**filament 1** (i-j)
1 turn, 0.4 mm enam. copper wire.
**secondary 1** (k-l)
single 20 W tube: 20 turns, 0.4 mm enam. copper wire.
two 20 W tubes: 50 turns, 0.4 mm enam. copper wire.
one 40 W tube: 50 turns, 0.4 mm enam. copper wire.
**filament 2** (m-n)
2 turns, 0.4 mm enam. copper wire.
**starter** (o-p)
80 turns, 0.4 mm enam. copper wire.
50 turns for 1 x 20 W tube
**filament 3** (q-r)
1 turn, 0.4 mm enam. copper wire.

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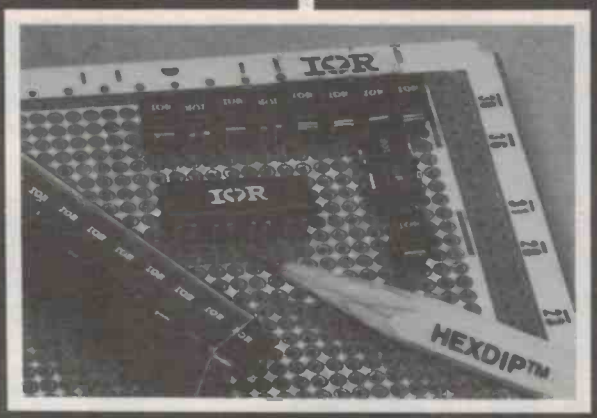


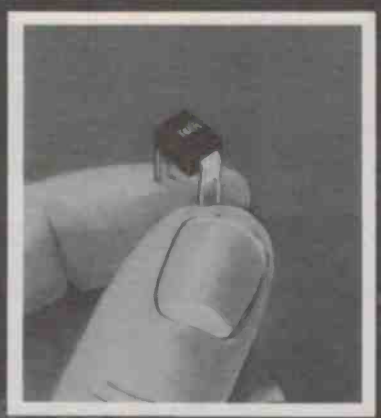

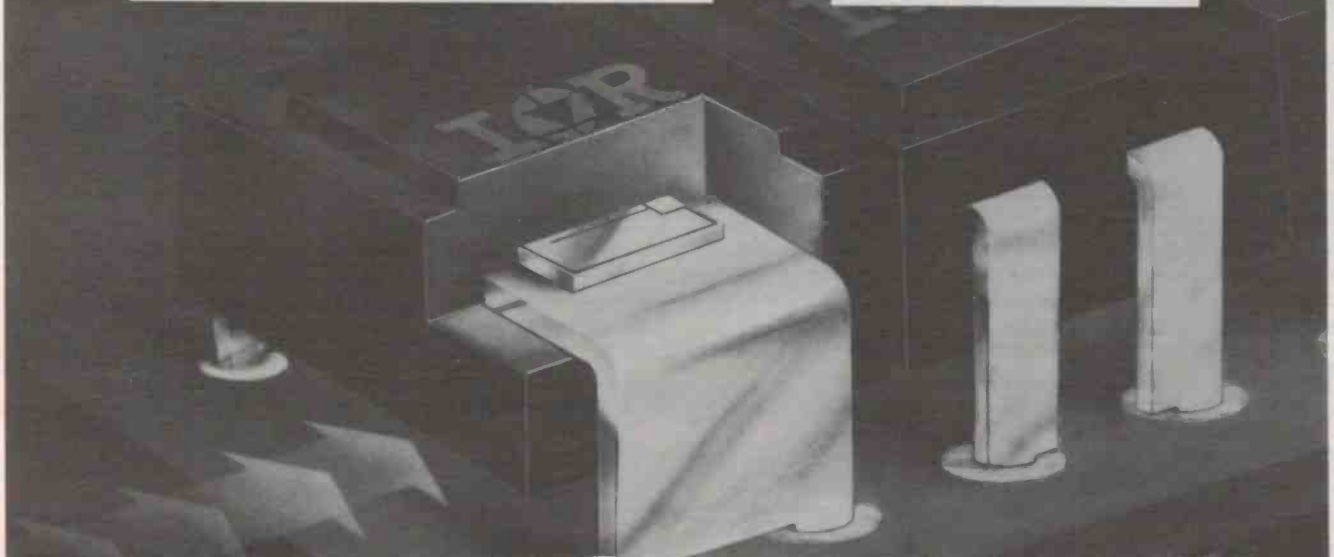


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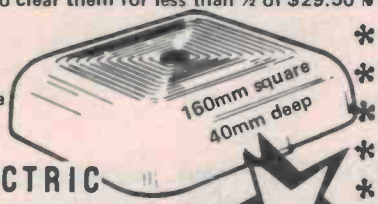


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# Lab Notes

# Using BiFET and BiMOS op-amps

The availability of BiFET and BiMOS op-amps has revolutionised circuit design since they appeared on the scene five or so years ago. While we've used devices like the CA3140 op-amp in projects we've not got around to describing practical applications circuitry. This 'Lab Notes' fills that gap.

**Brian Dance**

THE AVAILABILITY of BiFET and BiMOS devices in various packages with one to four operational amplifiers per package has revolutionised the operational amplifier market. Apart from the relatively expensive hybrid FET input devices, other FET input operational amplifiers had been available for some considerable time, so why should BiFET and BiMOS devices be so important?

The first point to note is that amplifiers with FET input stages can offer far higher input impedances than devices with ordinary bipolar transistors in their input stages. For example, the well-known 741 has an input impedance of the order of 1M and a maximum input bias current of 500 nA. The use of bipolar transistors to obtain a high input impedance has been pushed to the limit in devices such as the LM108, using supergain input devices to provide a typical input impedance of 70M and an input bias current of just under 1 nA. These values may be compared with those of some of the economical BiFET and BiMOS devices, where typical input impedances are of the order of 1 Terraohm (one million Megohms!) and input currents are some tens of picoamps (pA) at room temperature.

Thus if one connects the input of one of these BiFET or BiMOS amplifiers to almost any circuit, it will impose a very small load on that circuit. This can be a vital consideration when one is designing such high-impedance circuits as those used in pH meters or in ionisation chamber smoke detector circuits, whose output current is inadequate to drive devices such as the 741.

If one considers the very early types of monolithic FET input operational amplifiers (such as the Fairchild $\mu$A740), they do have the desired high input impedance, but their disadvantage is that their input offset voltage and its temperature coefficient are so high that they do not approach the high standard of performance required by the modern

## INTRODUCTION TO THE BIMOS AND BIFET OP-AMP

The first BiFET products were announced by National Semiconductor in 1975 (the LF155, LF156 and LF157 series, where LF signifies Linear FET device). The main advantages of these products is that the junction FET devices used in their input stages are fabricated on the same silicon chip as the remainder of the operational amplifier. Although hybrid operational amplifiers with FET input stages had been available for some considerable time previously, all of these hybrid devices contained the junction FET devices fabricated on a separate silicon chip from the remainder of the operational amplifier. Such hybrid devices can be made to have a very good performance if adequate trouble is taken in their design, but the extra labour costs involved in the testing of the separate chips for appropriate matching characteristics and in connecting the two chips in a single hybrid package inevitably resulted in a price tag far above that of modern BiFET devices. The general type of construction of a BiFET device is shown in Figure 1, the channel between the source and the drain electrodes of the FET input devices being fabricated by ion implantation.

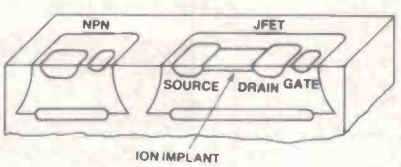



*Figure 1.* **Construction of a BiFET device.**

Although National Semiconductor produced the first BiFET products, it was not long before other manufacturers entered the BiFET market, and such products are now available from Advanced Micro Devices, Analog Devices, Fairchild, Harris Semiconductor, Motorola, Intersil, Precision Monolithics, Raytheon and Texas Instruments, although National Semiconductor still offer the widest range of BiFET products, details of which can be found in their Linear Databook.

Very soon after National Semiconductor had announced the first BiFET products, RCA introduced their first BiMOS product, the economical CA3130 operational amplifier. This has some similarities to the BiFET amplifiers, but employs MOSFET transistors in the input stage rather than junction FET devices. RCA soon introduced further BiMOS devices, one of the best known type being the CA3140, which can be used as a pin-for-pin replacement for the 741 when a higher performance is required. More recently the CA080 series has been introduced as pin-for-pin replacements for the Texas Instruments series of TLO80 BiFET types.

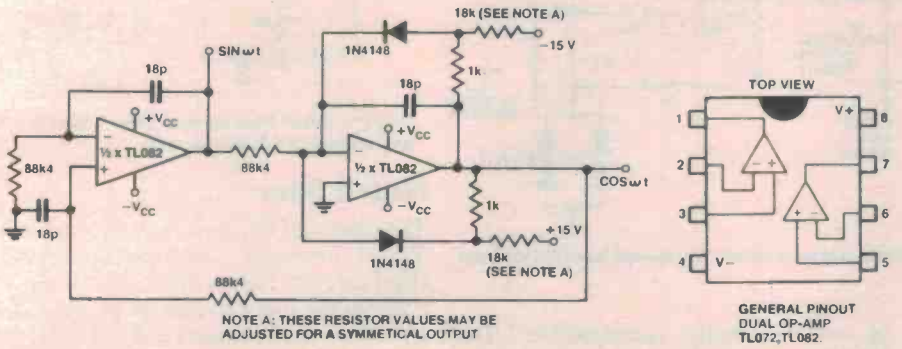



*Figure 3.* Quadrature oscillator producing two outputs 90° out of phase, using a TL082 dual op-amp — pinout at right.

professional engineer. Modern BiFET and BiMOS devices provide a very high input impedance with relatively good stability and temperature performance — although the input impedance of any of these devices at 25°C is much greater than over the full temperature range.

In general BiFET and BiMOS economical devices offer a comparable performance. If anything, BiMOS devices tend to offer the lower input bias currents and BiFET products the lower noise levels. However, premium devices of both types are available with performances far above the average for the type of device concerned.

## Half-Hertz oscillator

Figure 2 shows the use of the economical TL081 device in a simple 0.5 Hz square wave oscillator. The TL081 is a single operational amplifier in a dual-in-line package with the connections shown in Figure 2; the pin connections are the same as those of the well-known 741 devices, internal frequency compensation being employed so that no external compensating capacitor is required. External offset adjustment can be made when required by means of an external variable resistor. The TL071 is a similar low-noise device with the same connections, and is quite suitable for use in this circuit, but its low-noise characteristics are not needed. The TL061 is a low-power device with the same connections.

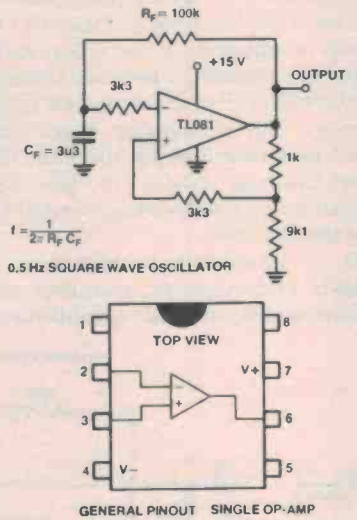


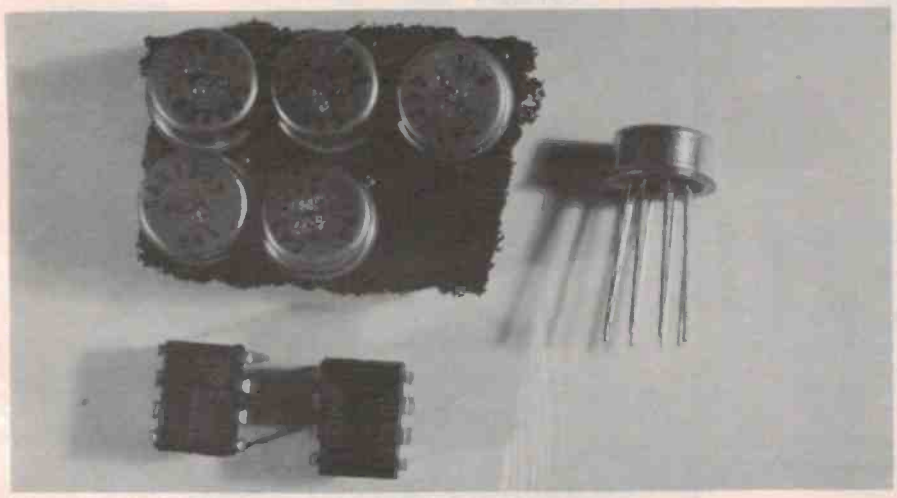

*Figure 2.* Half-Hertz oscillator using a TL081 — pinout below.

The frequency of oscillation of the Figure 2 circuit is given by $f = 1/(2\pi R_F C_F)$, or about 0.5 Hz with the values shown. The high input impedance of the circuit enables a relatively high value of feedback resistor, $R_F$, to be employed, so the value of $C_F$ can be reasonably small for a given frequency of operation. About nine-tenths of the output voltage is fed back to the non-inverting input to provide positive feedback to maintain oscillation. The capacitor $C_F$ charges and discharges through $R_F$ according to whether the state of the output voltage is 'high' or 'low' at the time concerned.

The circuit of Figure 2 generates square waves which are approximately symmetrical. However, if a circuit which generates waves with an unequal mark-to-space ratio is required, it is only necessary to connect a resistor of perhaps 10k to 50k in series with a diode across $R_F$. The direction in which the diode is connected determines whether the output spends the greater part of its time in the 'high' or in the 'low' state.

## 100 kHz oscillator

Figure 3 shows the circuit of a 100 kHz oscillator providing two outputs which are 90° out of phase with each other. Although the TL081 is perfectly satisfactory for use in this circuit, it is more convenient to use the dual TL082 device so that this one device is all that is needed. The connections of the 8-pin dual-in-line TL082 device are shown in Figure 3; it employs internal frequency compensation, but has no external offset adjustment facilities. ▶



Modern BiMOS and BiFET op-amps come in both can and DIL packages.

# Lab Notes

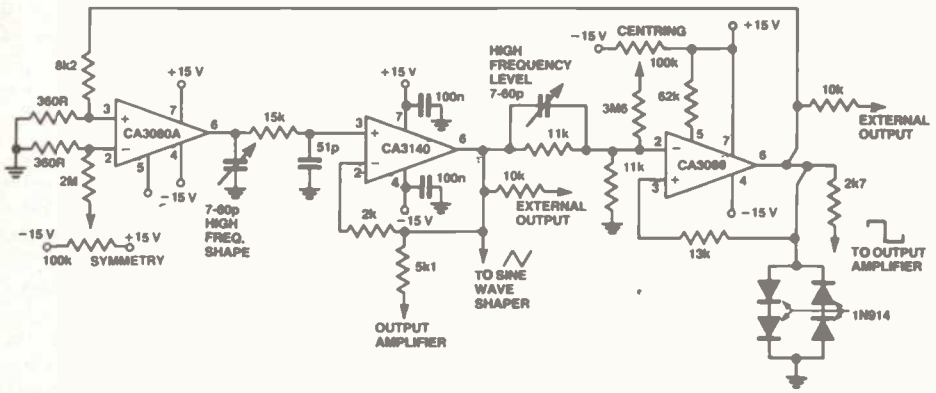



*Figure 4.* **Function generator circuit. Sourcing or sinking current from pin 5 of the left hand CA3080 will vary the frequency.**

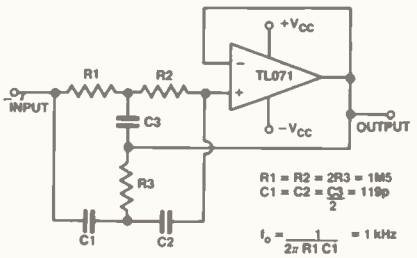



*Figure 5.* **Notch filter using a 'Twin-T' filter section on the input of a TL071 op-amp.**

## BiMOS generator

A function generator which produces square and triangular waveforms is shown in Figure 4. It employs a CA3140 BiMOS device together with a CA3080A and CA3080. A particular feature of this circuit is that a frequency range of one million to one can be obtained by the use of a single variable resistor, or alternatively by the use of an auxiliary sweeping signal.

A CA3130 device may be employed instead of the CA3140 shown, but in this case a frequency compensating capacitor (about 56p) must be connected between pins 1 and 8, since the CA3130 is not internally compensated. The CA3160, which does not require any external frequency compensation, is also suitable for use in this circuit.

The high frequency linearity of the ramp is adjusted by the 7-60p variable capacitor connected between the output of the CA3140 and the output CA3080 device. The triangular wave output level is determined by the four 1N914 level-limiting diodes in the output circuit and the network connected to pin 2 of the CA3080.

It is important to minimise lead length and parasitic coupling capacitance in this circuit by careful layout.

## Notch filter

The circuit of Figure 5 shows the use of a TL071 low-noise amplifier in a notch filter circuit. This is the normal 'twin-T' filter in the input circuit, in which one of the 'T' sections consists of R1, R2 and C3 and the other part of C1, C2 and R3. It is designed to reject signals of one particular frequency (the notch frequency), whilst passing signals of any other frequency virtually unattenuated.

For optimum performance, when a sharp notch in the frequency response is required, the components should have matched values (to within 1% or 2%). When the values shown are employed, the notch frequency occurs at approximately 1 kHz. An advantage of using a high input impedance device such as the TL071 is that relatively large values may be employed for R1, R2 and R3 and,

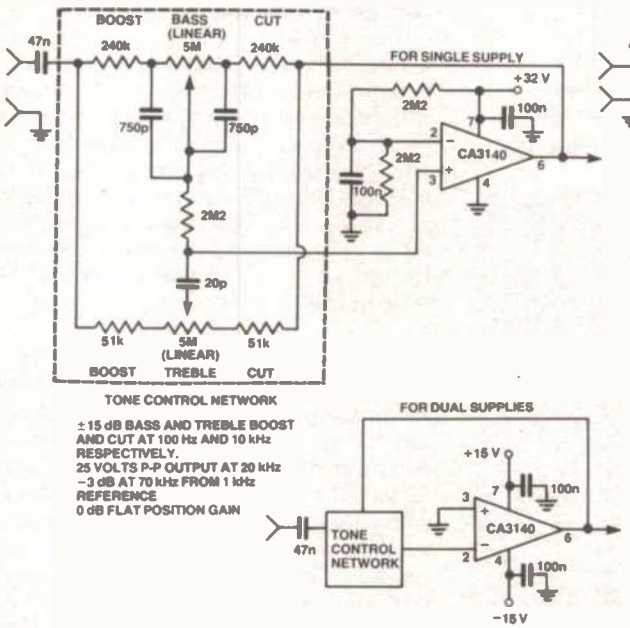



*Figure 6.* **Baxandall type tone control circuitry, with unity gain (flat position).**

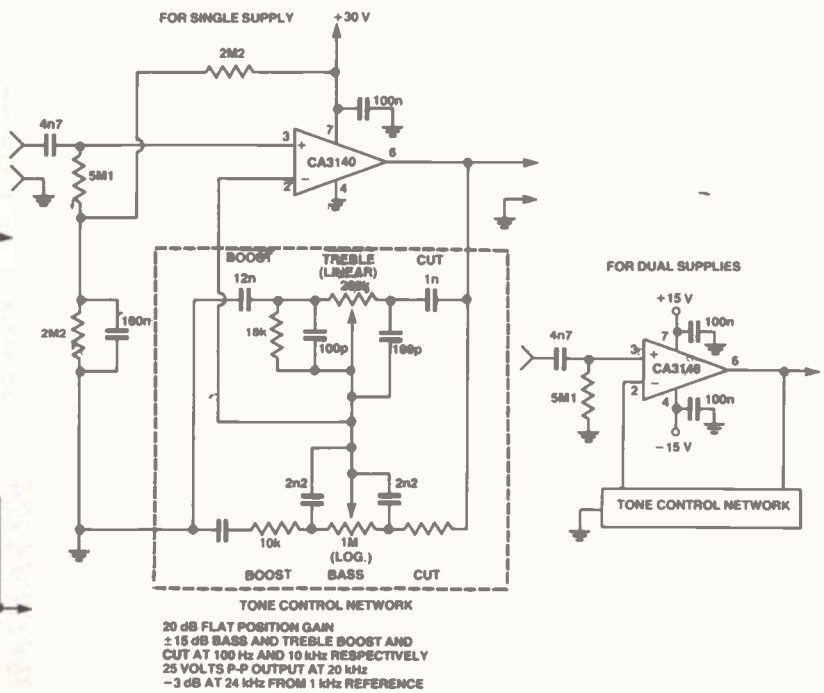



*Figure 7.* **Tone control circuit with 20 dB of gain, flat position.**

therefore, for any given frequency, C1, C2 and C3 can have a relatively low value. Large value, close tolerance capacitors are expensive, so the ability to employ devices of low value is important.

## Tone controls

Two tone control circuits using the CA3140 are shown in Figures 6 and 7. Figure 6 is of the Baxandall type, which provides a gain of unity at the mid-frequencies and uses standard linear potentiometers. The high input impedance of the CA3140 enables low-value (and therefore cheap) capacitors to be employed in a circuit which has an impedance great enough to avoid excessive loading of the stage feeding this circuit.

Bass/treble boost or cut are about ±15 dB at 100 Hz and 10 kHz respectively. Full peak-to-peak audio output is available up to at least 20 kHz, since the CA3140 has a relatively high slew rate (about 7 V/us). The gain falls by about 3 dB at a frequency of around 70 kHz.

The circuit of Figure 7 provides similar boost and cut facilities, but the gain of this circuit is about eleven. The input impedance is basically equal to the resistor from pin 3 to ground.

off between bandwidth and power consumption which is required). Figure 9 shows the response of the Figure 8 circuit.

## Mic preamp

A moving-coil microphone preamplifier with tone control is shown in Figure 10. A TL061 low-power device which is internally compensated is employed in this circuit.

## Distribution amp

The Texas Instruments series of BiFET devices is also available with four separate amplifiers in a single 14-pin dual-in-line package. Figure 11 shows the connections of the TL064 low-power BiFET quad amplifier, together with a

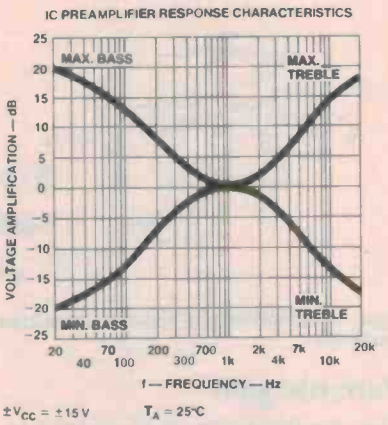



*Figure 9.* Response characteristics of the Figure 8 circuit.

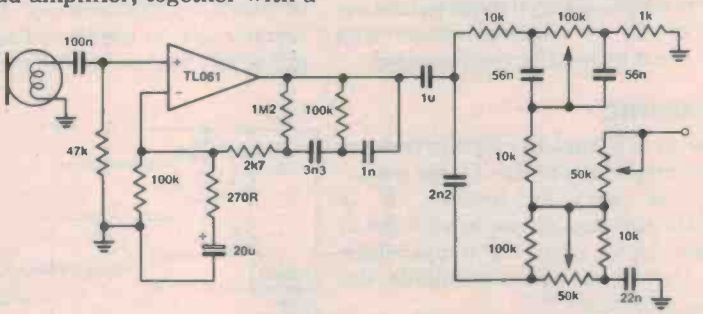



*Figure 10.* Moving-coil mic preamp with tone controls, using an internally compensated TL061 device (same pinout as TL071).

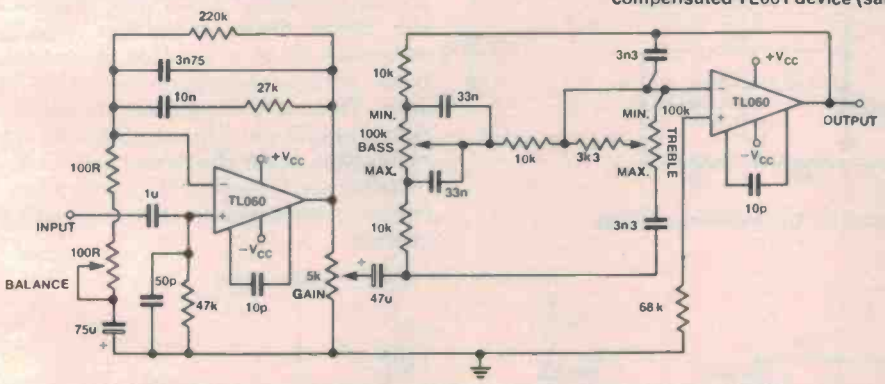



*Figure 8.* A two-stage tone control circuit using TL060 devices. (Same pinout as TL070).

A tone control circuit using the TL060 low-noise BiFET devices is shown in Figure 8. The TL060 is not internally compensated and therefore requires the 10p external frequency compensation capacitor shown connected in the circuit of each device. Similar circuits can, of course, be made using the TL080 devices at the expense of a higher power level. A further alternative is the use of TL066 programmable BiFET device without any compensating capacitors, but with a suitable value of the programming resistor between pin 8 and the negative line (about 1k, depending on the trade-

circuit for an audio distribution amplifier using one of these quad devices. The input stage acts as an input buffer and the other three stages act as output buffers, so that no signal from output A finds its way into any of the other outputs.

The TL084 and the low-noise TL074 have the same pin connections (which are the same as those of the LM324 type of device), whereas the TL085 and the low-noise TL075 devices are quad types with connections similar to the RC4136. There is no TL065 at present. ▶

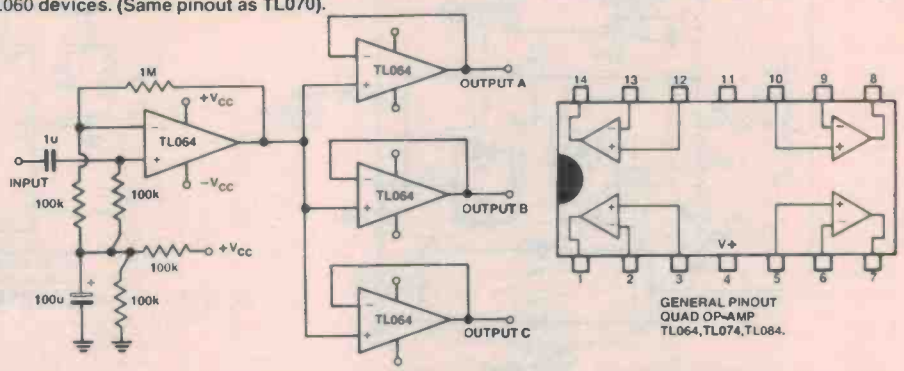



*Figure 11.* An audio 'distribution' amplifier for 'slaving' several pieces of equipment from a single source. Pinout for the quad op-amp is shown at right.

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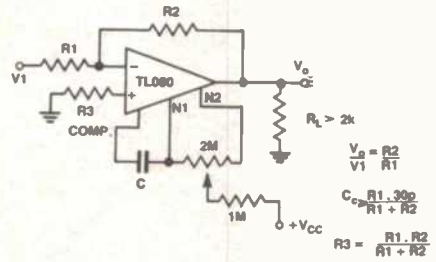


*Figure 12.* **Simple voltage-variable gain amp using the TL080.**

## Variable gain

The simple circuit of Figure 12 is an amplifier which provides a variable gain set by the potentiometer. A TL080 device is employed, so the compensating capacitor $C_c$ is required, since this device is not internally compensated.

## Ice warning

The circuit of Figure 13 employs three of the four amplifiers of the TL084 device in an ice warning detector. It is especially suitable for use in vehicles to warn the driver when the temperature of the thermistor (placed outside the vehicle) falls below 0°C.

When the temperature of the thermistor falls, its resistance rises and the current flowing through the thermistor decreases. Thus the inverting input of the TL084 connected to this thermistor receives less current from the positive supply line and its output voltage tends to rise. This output voltage is fed to the TL084 output amplifier and produces a voltage across the LED, which lights, providing the required warning.

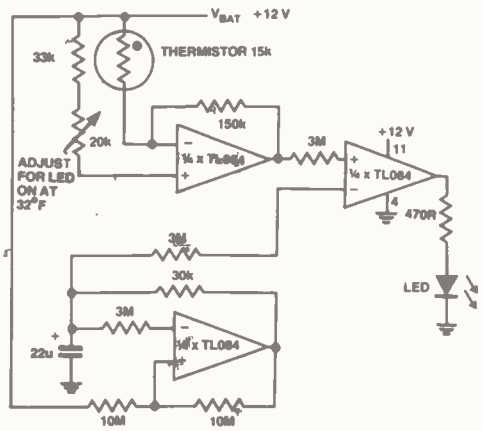


*Figure 13.* **An ice warning indicator.**

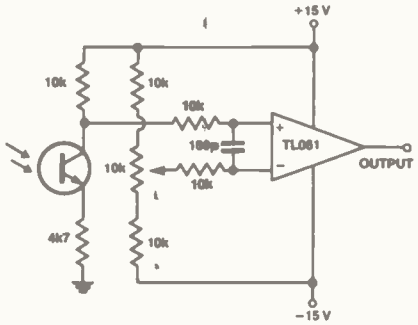


*Figure 14.* **Low-level light detector using FPT100 or similar phototransistor.**

## Light detector

The circuit of Figure 14 is a low-level light detector preamplifier using the low-power TL061 device with a TIL601 or similar phototransistor. The variable resistor can be used to balance the output at any particular value of light level.

## Sine shaper

The circuit shown in Figure 15 uses a CA3140 as a voltage follower device in combination with diodes from the CA3019 array to convert the triangular signal from a function generator into a sinewave output, which has typically less than 2% harmonic distortion.

The circuit is best adjusted using a distortion analyser, but a fairly good adjustment can be made by comparing its output signal on an oscilloscope with that from a good sinewave signal generator. The initial slope is adjustd by R1, followed by an adjustment of R2. The final slope is established by adjusting R3, thereby adding additional segments that are contributed by these diodes. Repetition of the adjustments may be necessary, since there is some interaction between the adjusting potentiometers.

## Wien bridge

A CA3140 BiMOS amplifier is used in the circuit of Figure 16, together with a CA3019 diode array, to form a Wien bridge oscillator. The zener diode shunts the 75k feedback resistor and, as the output signal amplitude increases, the zener diode impedance rapidly decreases so as to produce more feedback, with a consequent reduction in gain. This action stabilises the output signal amplitude. This combination of a monolithic zener diode and the bridge rectifier tends to provide a zero temperature coefficient for this regulating system.

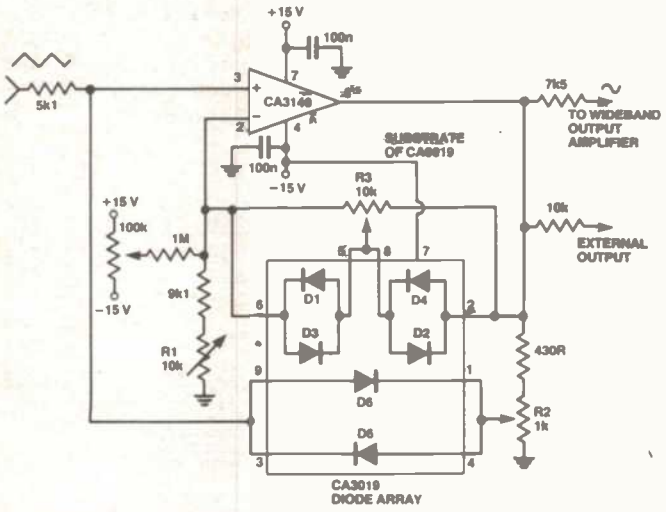


*Figure 15.* **A triangle-to-sine waveshaping circuit employing a CA3140 op-amp and a CA3019 diode array.**

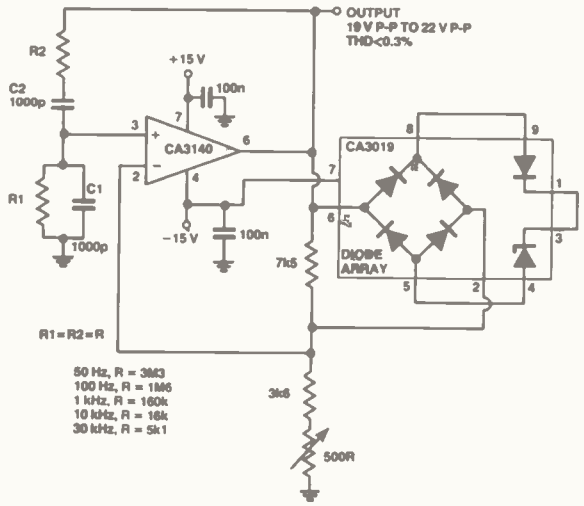


*Figure 16.* **A Wien bridge oscillator featuring amplitude stabilisation via the zener action from the CA3019 diode array.**

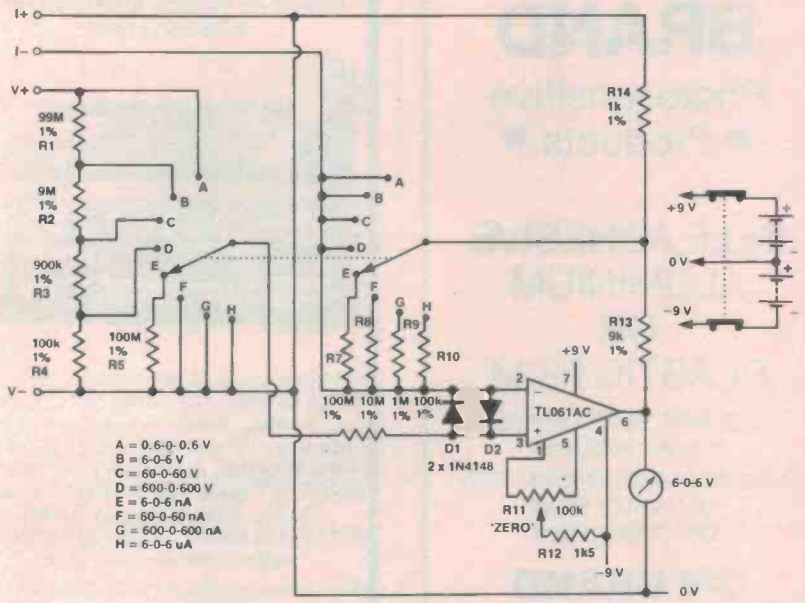


*Figure 17.* A multi-range voltmeter with high impedance input plus multi-range low-current meter.

As the output circuit contains no RC time constant, there is no lower frequency limit for operation. If C1 = C2 = 1u (polycarbonate) and R1 = R2 = 22M, the operating frequency can be about 0.007 Hz. At high frequencies, as the frequency is increased the amplitude of the signal must be reduced to prevent slew rate limiting from taking place. An output frequency of about 180 kHz will reach a slew rate of about 9 V/us when the output voltage amplitude is about 16 V peak-to-peak.

## Meter

The high input impedance of BiFET and BiMOS devices has led to their use in many voltmeters of high input resistance and also in meters to measure very small currents.

The circuit of Figure 17 was designed by Texas Instruments for the measurement of voltages in the range ±0.6 V to ±600 V, where the source resistance may be quite high, and to measure currents from 6 nA to 6 uA. The instrument was required to accept inputs of either polarity and be inexpensive, robust and reliable. It also had to have a long battery life, so a TL061 low-power operational amplifier device was selected. An inexpensive centre zero meter is considerably cheaper than a liquid crystal display and would provide adequate accuracy for the purpose.

When the switch is in one of the positions A to D inclusive, the instrument is set for the measurement of voltages. The amplifier has a non-inverting gain of 10 and range selection is achieved by a simple potential divider network with a fixed input impedance of 1000 megohm. A panel-mounted 'centre zero' control is included in the circuit to facilitate corrections for the mechanical movement of the meter zero and for the change in the operational amplifier input voltage offset (for example, with temperature).

In the current measuring mode of switch positions E to H inclusive, the amplifier operates as a current-to-voltage converter. For the most sensitive range of 6 nA, a transimpedance of 1 Gigaohm is required to produce a full-scale deflection of the meter. Rather than use a resistor of such a high value, a resistance multiplier arrangement was devised with a 100M feedback resistor for the most sensitive range.

The two diodes across the input of the operational amplifier in conjunction with R6 provide protection against any gross overloading of the instrument. A suitable arrangement incorporating a fullwave rectifier into this circuit would allow alternating input signals to be measured, but arrangements would have to be made to allow for frequency roll-off of the response at high frequencies.

## 3 pA meter

A CA3160 and a CA3140 are used in the circuit of Figure 18 to construct a pico-ammeter with ±3 pA full scale deflection (one picoamp = $10^{-12}$ amps). Pins 2 and 4 of the CA3160 are connected to ground, so the input pin 3 between them is effectively 'guarded'. If slight leakage resistance is present between terminals 3 and 2 or 3 and 4, there would be zero voltage across this leakage resistance and this would reduce the leakage current by a large factor.

It is preferable to operate the CA3160 with its output pin 6 near the ground potential, so as to reduce the dissipation by reducing the device supply current. The CA3140 serves as a x100 gain stage to provide the required plus and minus output voltage swing for the meter and feedback network. A 100:1 voltage divider network consisting of a 9k9 resistor in series with a 100 ohm resistor sets the voltage at the 10 kMohm resistor to ±30 mV full-scale deflection. This 30 mV signal results from ±3 V appearing at the top of the voltage divider network, which also drives the meter circuitry.

It is possible to switch the 9k9 and 100 ohm network in the output circuit so that current ranges from 3 pA to 1 nA can be handled using the single 10kM resistor.

The writer has seen circuits using BiMOS devices published for use in measuring currents down to 100 femtoamps (0.1 pA), but obviously extreme care is required to ensure the insulation is adequate when such small currents are being measured. ▶

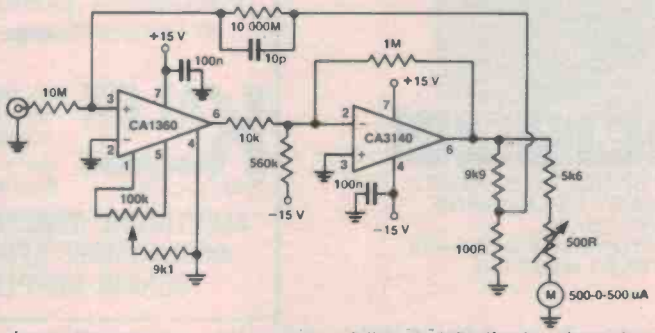


*Figure 18.* This circuit will measure *very* low currents — full-scale deflection is ± three picoamps!

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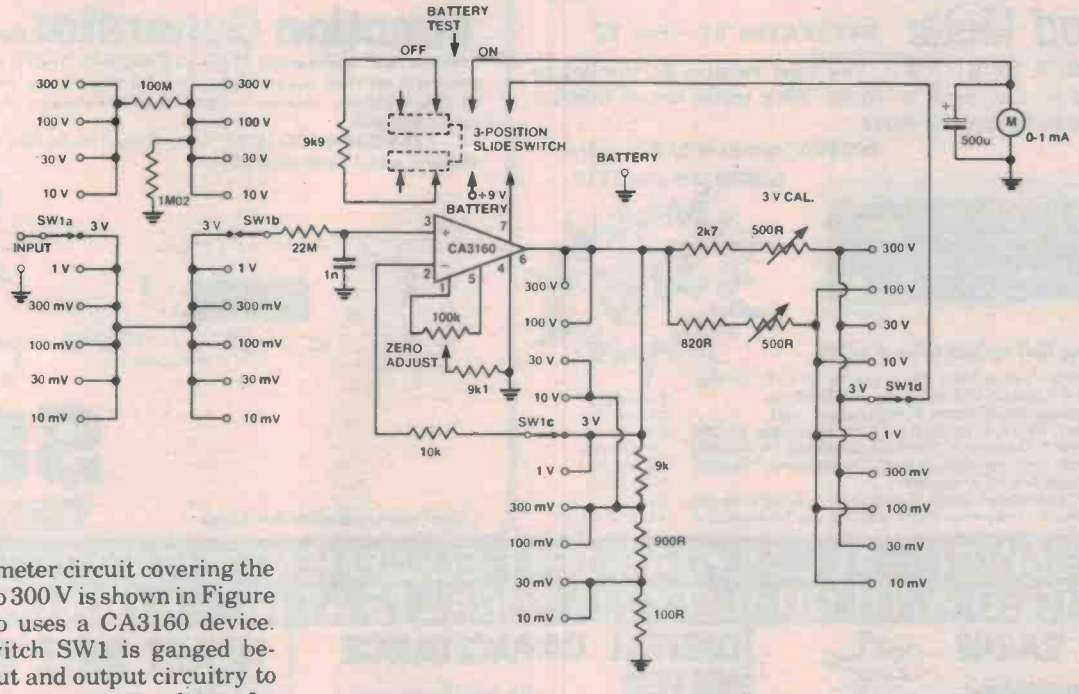


*Figure 19.* Example of a multi-range voltmeter measuring from 10 mV to 300 V.

## Voltmeter

A further voltmeter circuit covering the range 10 mV to 300 V is shown in Figure 19, which also uses a CA3160 device. The range switch SW1 is ganged between the input and output circuitry to enable the proper output voltage for feedback to terminal 2 through the 10k resistor to be selected.

This circuit is powered by a single 8.4 V mercury battery, the power supply current being somewhat less than 500 uA plus the meter current required to indicate a given voltage. Thus the supply current rises to about 1.5 mA at full-scale deflection.

Any readers who experience problems in obtaining a CA3160 may use a CA3130 with a frequency compensation capacitor of about 56p between pins 1 and 8.

The aim of this article has not been to introduce readers to all the latest BiFET and BiMOS devices (of which there are large numbers), but rather to give an indication of the wide selection of circuits that can be made with just a few of the standard types of device which are readily available. ●

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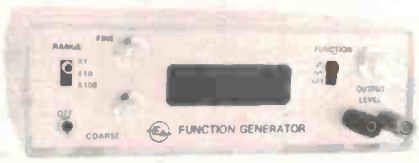


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1% resistors used NOT 2%.
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YOU PAY NO MORE FOR A QUALITY JAYCAR KIT!!

## 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!!!

$110

- Can display very slow waveforms
- One shot triggering
- Inbuilt graticle shows on TV screen
- Crystal locked timebase
- DC-100kHz bandwidth
- capable of storage operation
Staggering value at $110.

## NEW!!! LCD TACHO KIT!

ref: EA May 1982


**$49.50**

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

## ETI 480 AMP-COMPLETE -closeout price

You benefit from our new low price for this legendary 100W Guitar/P.A.

- 100W RMS into 4 ohms 60W/85 ohms.
- Completely self contained.
- Includes power supply and rugged 16 gauge aluminium case.
- Line input drives to full power.
- Can accommodate 480 preamp.

(2 input mic/guitar, Bass Treble, separate level controls, master level control) in the same case. (Preamp only $30 extra). We only have a few left so grab one now at only $99.

**$99** was $130

## 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

SAVE $89!!!

~~$489~~ $399

Send SAE for full spec. sheet.

# QUALITY FOR NO MORE

## 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!!!

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?

7¼ OCTAVE (88 NOTE) VERSIONS $589 * Stand $75 extra

## EPROM PROGRAMMER

only **$59**

Ref: EA Jan 1982
This versatile kit enables you to program the popular EPROMS, WITHOUT a computer!!! Includes 24 pin socket. Zero insertion force socket to suit, ONLY $12.50

## 1/3 OCTAVE GRAPHIC EQUALISER

NEW!!! ALL I.C. SOCKETS AT NO EXTRA CHARGE!

**ONLY $198**

The 2801 is a single channel graphic equaliser that divides the audio spectrum into twenty eight one third octave bands. Each frequency segment is controlled by a slider that provides up to — 10dB of adjustment in standard ISO steps. The 2801 was designed primarily to compensate for any deficiencies in the linearity of speaker systems, acoustic peculiarities of the hall or listening room, and inadequacies of program source quality.
In P.A. application the equaliser may be used to improve sound quality and increase intelligibility by attenuating problem frequencies that cause ringing, boominess or other disruptive resonances that occur in acoustically difficult rooms. The 2801 allows sound systems to be "tuned" according to the special acoustics of a room, to maximize output and minimize feedback.
As a creative tool in sound recording or re-recording the 2801 allows complete freedom in contouring response over the complete audio spectrum from 31.5Hz to 16KHz.

### SPECIFICATIONS

| | | | |
|---|---|---|---|
| DISTORTION (@ 2 volts out) | Less than .04% 20Hz—20kHz | Range of controls | ±10dB |
| FREQUENCY RESPONSE | | Individual Filters Level | ±15dB |
| —EQ. OUT | Flat | CONTROLS | 28 Vertical potentiometers continuously variable |
| —EQ. IN | 20Hz—20kHz±½dB | EQUALISATION | ±10dB |
| SIGNAL TO NOISE RATIO | Greater than 85dB | | Rotary potentiometer variable ±15dB |
| (@ 2 volts out, controls flat) | | LEVEL | Toggle switch |
| OUTPUT IMPEDANCE | 50k to 100k depending on the input configuration | EQ. BYPASS | Toggle switch |
| MAXIMUM INPUT VOLTAGE | 10 volts | POWER | Rear panel RCA sockets and 6.5mm sockets for input and output |
| EQ centre frequencies | 31.5, 40, 50, 63, 80, 100, 120, 160, 200, 250, 315 400, 500, 630, 800, 1K, 1.25K, 1.6K, 2K, 2.5K, 3.15K, 4K, 5K, 6.3K, 8K, 10K, 12.5K, 16K, Hz | Terminations | |
| | | PHYSICAL | |
| | | Size | 19" x 3½" x 8" (standard rack mount size) |
| | | Weight | 4kg |
| | | Finish | Front panel brushed and anodised black with lettering, black Marviplate cover. |

### TOTALLY REFURBISHED MODEL—2801 MKII A

This model is distinct from the 2801, 2801 MK II. It features quality I.C. sockets for all I.C.'s as well as several component changes. ie: We are using 4136 op amps again because they draw less current than the TLO75/85. This results in less hum radiation from the transformer. We are also using higher value slide pots, and a 5534 op amp for the line driver. Using the 5534 renders the output short circuit proof-handy whenon the road.
You get all these great new features at no extra cost!

## 2010 MK II

**ONLY $129**

The 2010 is a two channel graphic equaliser featuring ten adjustable controls on octave centre frequencies (independent for each channel). Each control provides up to ± 14dB of adjustment. Each channel is also equipped with a level match control giving an overall gain of adjustment of ± 14dB. The functional versatility of the 2010 equaliser is unsurpassed. Eight modes of operation are available from the push button switches on the front panel. Included amoungst these are the ability to equalise both recording and playback when dubbing tapes. The 2010 has been designed to be compatible with all commercially available equipment and is ideal for use in a HI FI system or PA system

### SPECIFICATIONS

| | |
|---|---|
| ELECTRICAL (EACH CHANNEL) | |
| FREQUENCY RESPONSE | ±0.5dB 10Hz to 20kHz, Controls flat |
| F.G. LINE OR TAPE | Flat |
| EQ BYPASS | |
| SIGNAL TO NOISE RATIO | Greater than 87dB |
| 3 VOLTS OUT CONTROLS FLAT | |
| TOTAL HARMONIC DISTORTION | Less than .04 % 20Hz to 20kHz |
| 1 VOLTS OUT CONTROLS FLAT | 100ohms |
| OUTPUT IMPEDANCE | 2 Volts RMS into 10K load |
| RATED OUTPUT | 10 volts RMS |
| OUTPUT AT CLIPPING | 50K nominal |
| INPUT IMPEDANCE | 10 volts RMS |
| MAXIMUM INPUT VOLTAGE | 31, 63, 125, 500, 1K, 2K, 4K, 8K, Hz ±10% |
| EQ CENTRE FREQUENCIES | |
| RANGE OF CONTROLS | ±12 dB at Centre Frequency |
| INDIVIDUAL FILTERS | ±10dB |
| LEVEL MATCH | |
| CONTROLS | 10 Vertical Slide Controls for each channel |
| EQUALISATION | Vertical Slide Control each Channel |
| LEVEL | Pushbutton Switch |
| EQ BYPASS | Pushbutton Switch |
| EQ LINE | Pushbutton Switch |
| EQ TAPE | Pushbutton Switch |
| MONITOR TAPE | Pushbutton Switch with LED Indicator |
| POWER | Rear panel RCA sockets for both input and output connections |
| TERMINATIONS | |
| PHYSICAL DIMENSIONS | 483mm x 89mm x 152mm (19"x 3½"x 8") |
| WEIGHT | 4kg |
| FINISH | Front panel brushed and anodised Aluminium silk screened lettering. Black Marviplate covers. |

## 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 $32.50

THIS MONTH ONLY!! SAVE $4.00

## Jaycar

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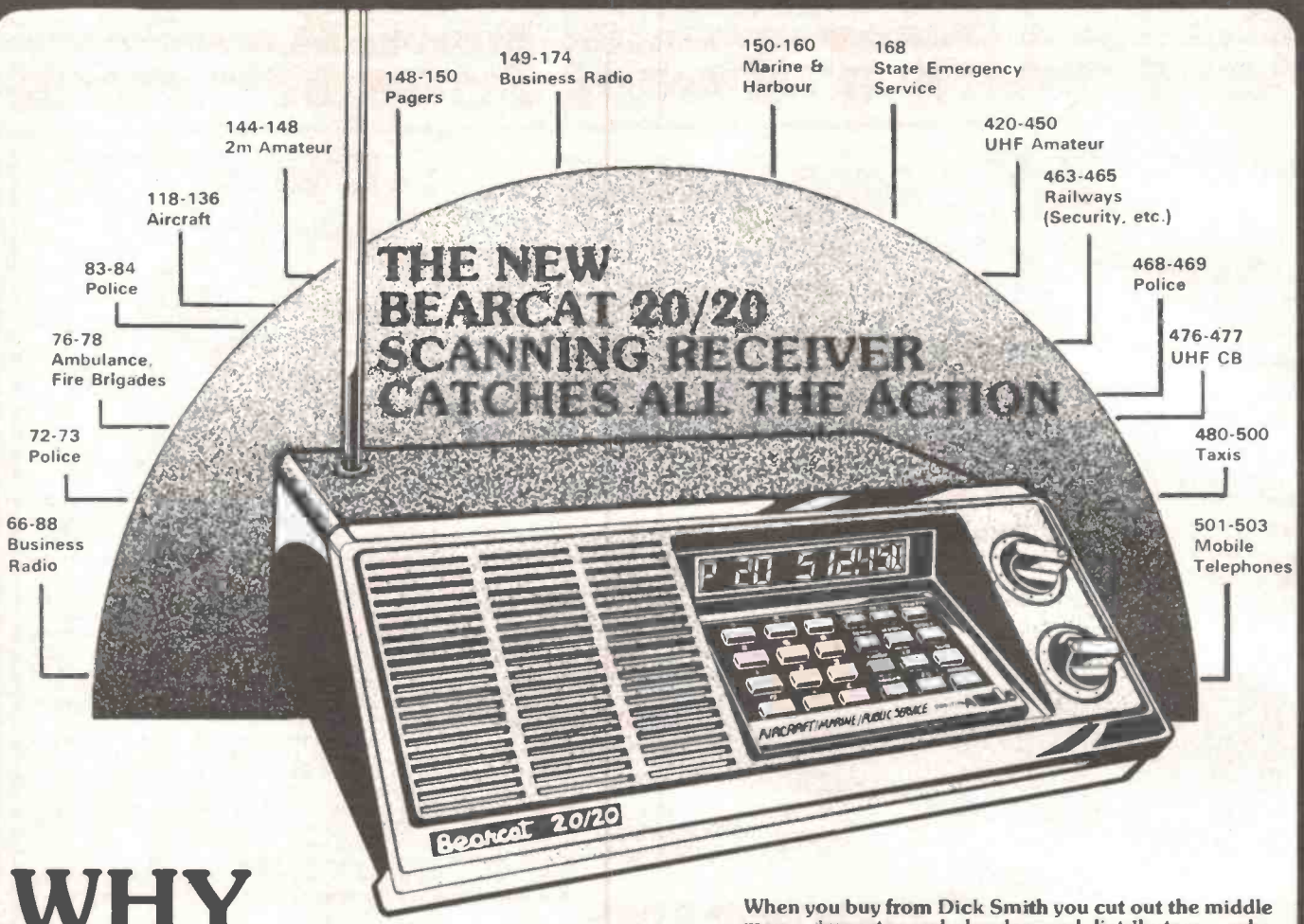
Ph. 2646688 Telex 72293
Mail Orders To:
Box K-39 Haymarket 2000
Post and Packing charges
$5-$9.99 ($1.20) $10-$24.99 ($2.40)
$25-$49.99 ($3.50) $50-$99.99 ($4.60)
$100 up ($6.20)

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

OPENING NEXT MONTH AT CARLINGFORD. RIGHT AT CARLINGFORD COURT, NEXT TO KENTUCKY FRIED CHICKEN.

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**When you buy from Dick Smith you cut out the middle man — importers, wholesalers and distributors — who add their margin and inflate the price you pay. Dick imports direct from the manufacturer to you and passes on the savings.**

**Introducing** - a brand new communications hobby - the latest craze in the U.S.A. and now sweeping Australia.

It's called 'Scanning' - and you can catch **ALL** the action with the latest in microprocessor controlled scanning receivers - **The Bearcat 20/20** - exclusive to Dick Smith Electronics.

This incredible receiver covers most of the VHF and UHF bands - where all the exciting action is these days.

Want to listen in to a few specific stations (up to 40!)? Simply punch a few buttons and let the **Bearcat's** computer search through them for you.

If you don't know where they are, no problems: **The Bearcat 20/20** will search for them for you.

The Rolls-Royce of scanners can now be yours - catch up on all the action with **The Bearcat 20/20** scanner, only from Dick Smith Electronics.

**NOTE:** Owning and operating a scanning receiver is now completely legal. You're allowed to listen in to any station you desire.

**SPECIFICATIONS:**

**Frequency range:**
66-88MHz
118-136MHz
144-174MHz
421-512MHz

**Sensitivity:**
Most bands 0.4uV

**Selectivity:**
-55dB @ ±25kHz

**Power Source:**
240V AC or 12V DC

**Scanning speed:**
Selectable, 5 or 15 channels/second

**Antenna:**
Inbuilt whip, provision for external beam

**No. of programmable channels: 40**

**ONLY**

# $475.00

**Cat D-2810**

# EXCLUSIVE TO DICK SMITH ELECTRONICS

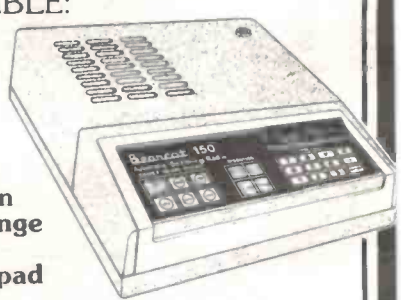
A309/FI

SEE PAGE 144 FOR STORE ADDRESS DETAILS.

ALSO AVAILABLE:

**Economy BEARCAT 150FB**

**With up to 10 Channels, base station operation only. Similar range to above (up to 490MHz), touch-pad controls.**




**Cat D-2800**

**Incredibly low price - only $275.00**

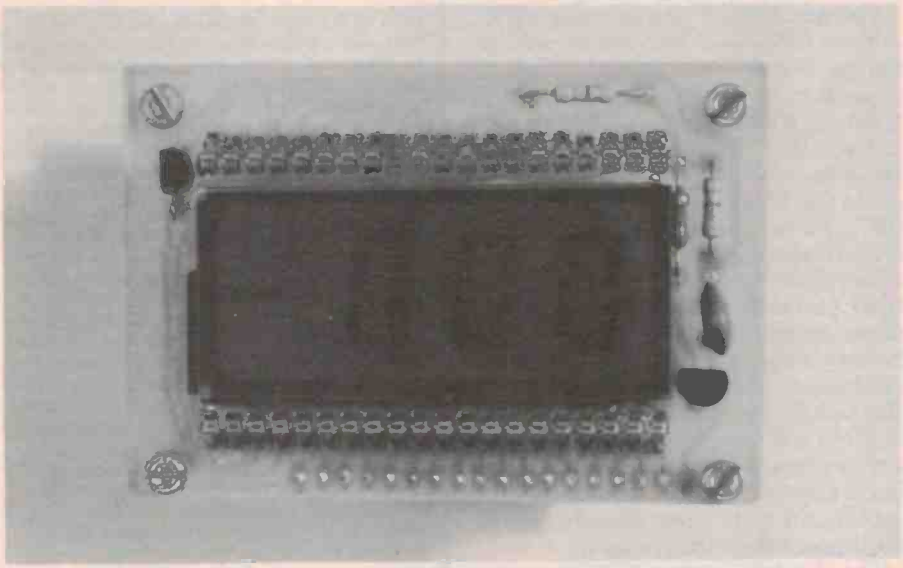
# Versatile digital panel meter with liquid crystal display

David Tilbrook

This simple, versatile project can be used as the basis of many test instruments or as a stand-alone meter to measure voltage (as low as 200 mV) or current.

THERE ARE many applications that require a digital readout of dc voltage. To fulfil this requirement we published a digital voltmeter, the ETI-135 digital panel meter in October 1977. It was based around the Intersil ICL7106 digital voltmeter IC, which was at that time available in the form of an evaluation kit. Although the individual ICs are widely distributed now the evaluation kits are becoming scarce. For this reason we have decided to republish the design in a form suitable for commonly available components. The kit was supplied with small rectangular capacitors enabling them to be laid on their side to reduce height and allow the display to be mounted as closely as possible to the front panel. Unfortunately these capacitors are not commonly available. Greencaps work well in this application but their physical size requires a new pc board layout.

We overcame these problems by designing a pc board suitable to be cut in half. The display, the 7106 IC and a few other components mount on one of the pc boards, while all other components, including the battery if required, mount on the other pc board. This enables almost any sized components to be used and by mounting one of the pc boards behind the other, ensures the display occupies as little front panel space as possible. ▶



## SPECIFICATIONS

| | |
|---|---|
| **Full scale readout** | depends on setup. Full scale sensitivity is 199.9 mV |
| **Resolution** | 100 uV |
| **Accuracy** | ‹ 1 digit when correctly calibrated |
| **Display** | 3½-digit LCD |
| **Input impedance** | › $10^{12}$ ohms |
| **Input bias current** | approx. 2 pA |
| **Polarity indication** | automatic |
| **Conversion method** | dual slope |
| **Reference** | internally generated ±100 ppm |
| **Power supply** | 9 V @ approx. 1 mA |

## Construction

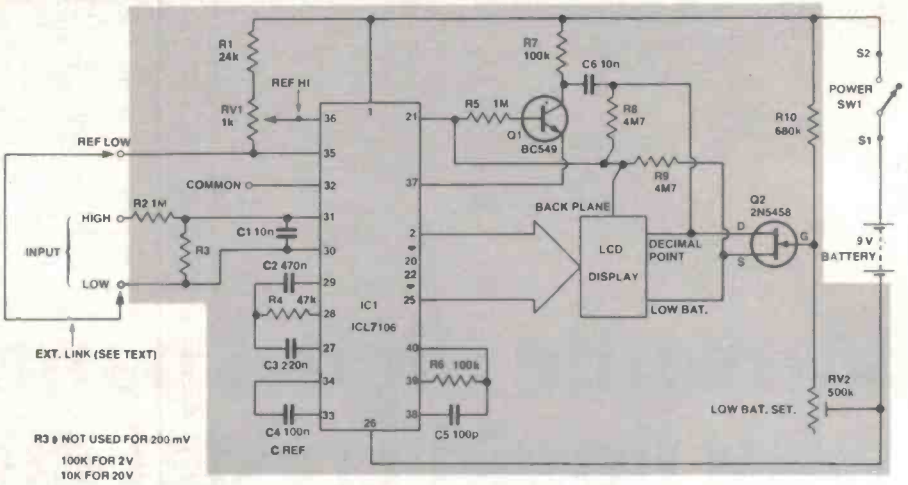
The project can be constructed in two forms, either on a single pc board, or as mentioned above, by cutting the pc board in half and mounting one half behind the other. If your application requires that the pc board be cut, do so before mounting any of the components.

Start construction by deciding on the sensitivity that best suits your requirements. This decides the value of resistor R3. If a 200 mV (199.9 mV) maximum sensitivity is required R3 is omitted. For a 2 V (1.999 V) meter, the required value of R3 is 100k while for a 20 V (19.99 V) meter, use 10k.

If the meter is setup for 200 mV operation it is advisable to solder an additional 1M resistor in parallel with the input, i.e: directly from the low input terminal to the high input terminal. This reduces the input impedance of the meter to 1M and reduces the sensitivity of the instrument to stray static voltages. Without this resistor the display has an input impedance of more than $10^{12}$ ohms. So the input capacitance can easily become charged by static, prohibiting the meter from zeroing correctly. On the other ranges, a parallel resistor is automatically present so the additional 1M resistor is not necessary.

Having decided on the value of R3, solder all resistors and capacitors onto the pc boards, with the exception of capacitor C6. Next, solder the 10-turn trimpot, RV1, and the 'low batt.' set trimpot, RV2. The latter is best mounted lying down. If the project is constructed using the single pc board approach all the capacitors should also be mounted lying down so that the display can be as close as possible to the front panel. If the twin pc board approach is used only those components mounted under the battery need be mounted lying down. The battery is mounted on a 9 V battery clip using 6 mm long spacers as shown in the accompanying photos. If the project is constructed using the single pc board approach, mount the battery clip, once again with 6 mm spacers, but on the copper side of the pc board.

The main IC and the liquid crystal display can now be mounted. The 7106 is mounted under the LCD display, so if a socket is required ensure that it is a low height type. Otherwise, solder the IC directly to the pc board making sure that the device has been inserted the right way around. Check this against the construction overlay before soldering. The LCD display should be mounted using Molex pins. This spaces the display off the pc board and ensures that the transistors and capacitors around the display are not higher than the display itself. It is probably easier to plug in the display before soldering the remaining components. There are no convenient orientation marks on the display so it is necessary to hold it at a slight angle and look for the outline of the digits. The display should be mounted with the decimal points at the bottom and the 'LOW BAT' indicator in the top left hand corner of the display.




PRINTED CIRCUIT ARTWORK for this project can be obtained by sending a stamped, self-addressed envelope to: ETI-161 ARTWORK, ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011.

Finally, solder the remaining transistors and capacitor C3, being careful to orientate the transistors correctly and not to scratch the front glass of the display.

If the single pc board approach has been adopted, construction is complete at this stage. If the twin pc board approach has been used however, it is necessary to solder the 18 wire links

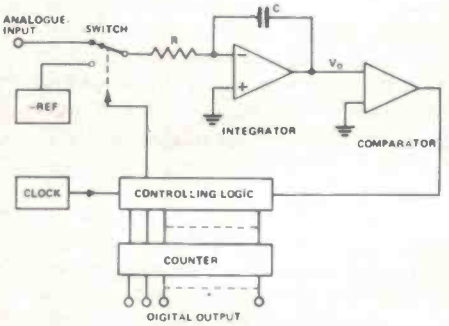
### HOW IT WORKS — ETI-161

Most of the work is done by the ICL7106 IC. This uses the dual-slope integration technique to ensure good long-term accuracy and reliable operation. The analogue input is first converted to a time period which is then converted to a binary number by a digital counting system. This conversion system is illustrated in the block diagram. When the switch connects the analogue signal input to the input of the integrator, the output from the integrator ramps up at a rate determined by the input voltage. At the same time, the counter is started at zero and begins to count clock pulses. When a predetermined number of pulses has been counted the input is switched to the reference by the control logic. At this time, the integrator capacitor, C, has been charged linearly to some voltage determined by the ramp rate and therefore by the input voltage. As the switch changes to the reference, the counter is reset to zero and commences counting again. The reference is of appropriate polarity to that of the input signal and so causes the integrator to ramp down with a fixed slope. When the output reaches zero, the counter is stopped and its contents displayed on the digital readout. The count displayed is the ratio of the counts during the downward ramp to the counts during the upward ramp.

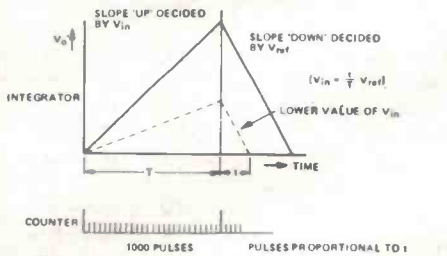
The value of the integrator capacitor and clock frequency are of little significance, provided they are stable for the duration of the conversion period.

This is a true dual polarity system so the integration direction depends on the polarity of the input voltage. Provided ac ripple on the input averages to zero over the count time it will be rejected. If 50 Hz ripple is to be rejected, for example, a 50 kHz clock rate could be used, giving an 80 ms sampling time (four cycles of 50 Hz). The clock can be adjusted by varying the value of R6. We experienced no problem with 50 Hz ripple. Capacitor C1 in conjunction with resistor R2 function as a low pass filter with a −3 dB rolloff point well below 50 Hz.

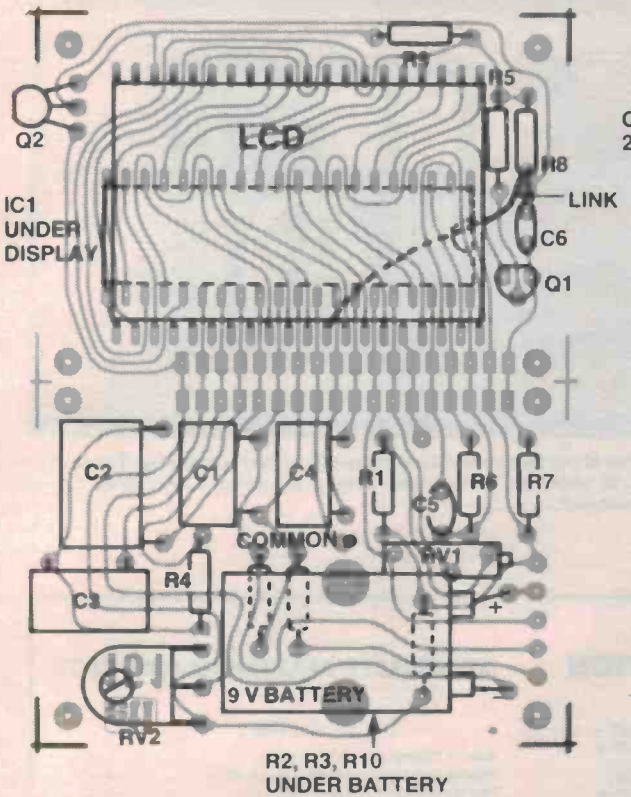
The 2N5458 JFET (Q2) is used simply as a voltage sensor to monitor the battery voltage and drive the LOW BAT indicator if the voltage falls below that determined during set up.



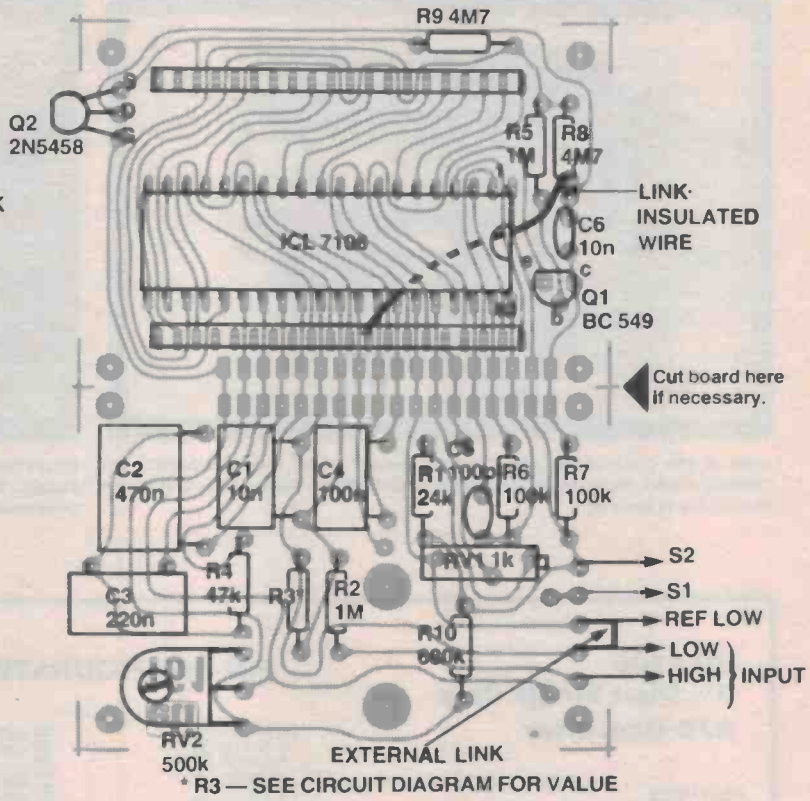

Block diagram of the dual-slope integration technique




Timing diagram of the dual-slope A/D conversion technique.




COMPONENT OVERLAY SHOWING POSITION OF LCD AND BATTERY




COMPONENT OVERLAY WITHOUT LCD OR BATTERY SHOWING POSITION OF IC, R2, R3 AND R10

between the two boards. Before doing this however, solder a lead from the point on the pc board marked 'COM.' It is necessary to connect this point to one of the two input terminals. The usual method is to connect COM to the low input. Also, connect REF LOW to the low input. This configures the meter to a normal absolute reading voltmeter that will display the voltage between the low and high input terminals with normal polarity indication. The module is also capable of ratiometric measurement. For information about this application consult the data sheet included for the ICL7106.

Mount the pc boards, spacing them approximately 20 mm apart, either using spacers or simply an entire set of nuts on the four mounting bolts. Use tinned copper wire to make the links between the pc boards, soldering each one at both ends before proceeding to the next. A fine-tipped soldering iron and fine solder (22g) should be used for this project and is especially important at this stage.

## Calibration

Before powering up, ensure that all components have been soldered correctly and have been inserted with the correct orientation. If all is well plug in the battery and connect the points S1 and S2 to each other. The display should immediately stabilise with all digits reading zero. Use a power supply to generate a test voltage and adjust RV1 so that the panel meter agrees with another voltmeter. Preferably use a digital voltmeter for this, although a good analogue instrument can also be used with decreased accuracy. RV2 is used to adjust the low battery indication on the display. The best way to do this is to run the unit from an adjustable power supply, checking operation against a known voltmeter while decreasing the supply voltage. Set the LOW BAT indicator to come on at a supply voltage just above where the panel meter fails to read accurately. Do not exceed 9 V on the supply leads when doing this test.

Once calibrated correctly this project is capable of very accurate measurement. The 7106 is used in many commercial digital multimeters and the high input impedance enables the module to be used in many applications.

We intend publishing several projects using the display, but even as a general purpose dc voltmeter the module has proved very useful. A 1R shunt resistor can be soldered directly across the input to convert the module into a dc current meter reading in milliamps (i.e: 199.9 mA). Use an OR1 shunt to read dc amps (i.e: 1.999 A). Add an 'absolute value' generator to enable ac voltage or current to be measured. ▶

### PARTS LIST — ETI-161

**Resistors** ..... all ¼W, 5%
- R1 ..... 24k
- R2, R5 ..... 1M
- R3 ..... see note
- R4 ..... 47k
- R6, R7 ..... 100k
- R8, R9 ..... 4M7
- R10 ..... 680k
- RV1 ..... 1k 10-turn trimpot
- RV2 ..... 500k horizontal trimpot

**Capacitors**
- C1 ..... 10n mylar, 50 V
- C2 ..... 470n mylar, 50 V
- C3 ..... 220n mylar, 50 V
- C4 ..... 100n mylar, 50 V
- C5 ..... 100p NPO ceramic
- C6 ..... 10n ceramic

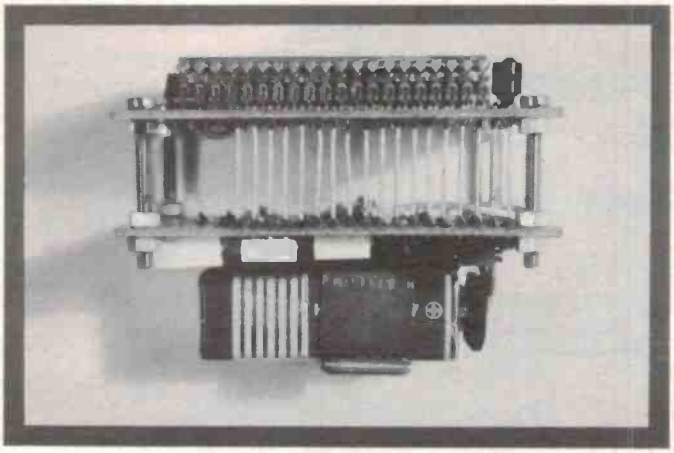
**Semiconductors**
- IC1 ..... ICL7106
- Q1 ..... BC549, BC109
- Q2 ..... 2N5458, MPF106

**Miscellaneous**

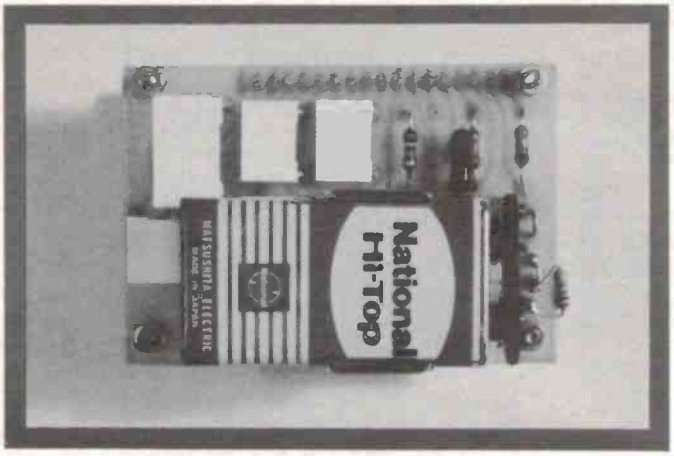
ETI-161 pc board; LAD204 liquid crystal display (from Intersil evaluation kit) or similar; battery holder clip for No. 216 battery (if required); SW1 — SPST switch (if required); two 6 mm long spacers; four 20 mm spacers (if required); nuts and bolts to suit assembly; No. 216 9 V battery (if required).

**Price estimate** **$30 — $35**

NOTE: many of these components are available in the Intersil Evaluation kit, particularly the 7106, the display and the capacitors.



View of the panel meter with the 'electronics' board mounted behind the 'display' board, showing the connections run between the two boards and how the battery is mounted.



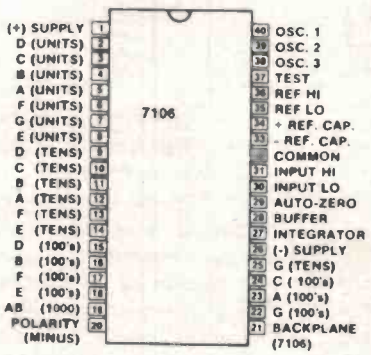

Rear view of the 'electronics' board showing battery positioning. If an external supply is used the battery and battery mounting components can be dispensed with.

## ICL7106
## 3½ Digit Single Chip A/D Converter

**FEATURES**

- Guaranteed zero reading for 0 volts input on all scales.
- True polarity at zero for precise null detection.
- 1 pA input current typical.
- True differential input and reference.
- Direct display drive - no external components required. — LCD ICL7106
  — LED ICL7107
- Low noise - less than 15μV pk-pk.
- On-chip clock and reference.
- Low power dissipation - typically less than 10mW.

## PIN CONFIGURATION



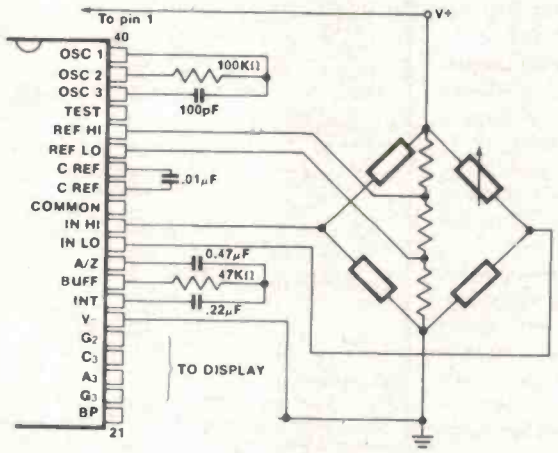

## ABSOLUTE MAXIMUM RATINGS

**ICL 7106**

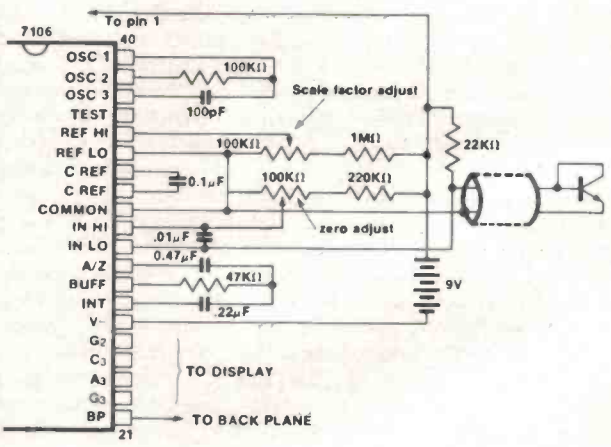
| | |
|---|---|
| Supply Voltage (V+ to V−) | 15V |
| Analog Input Voltage (either input) (Note 1) | V+ to V− |
| Reference Input Voltage (either input) | V+ to V− |
| Clock Input | Test to V+ |
| Power Dissipation (Note 2) | |
| Ceramic Package | 1000 mW |
| Plastic Package | 800 mW |
| Operating Temperature | 0°C to +70°C |
| Storage Temperature | −65°C to +160°C |
| Lead Temperature (Soldering, 60 sec) | 300°C |

Note 1: Input voltages may exceed the supply voltages provided the input current is limited to ±100μA.

Note 2: Dissipation rating assumes device is mounted with all leads soldered to printed circuit board.



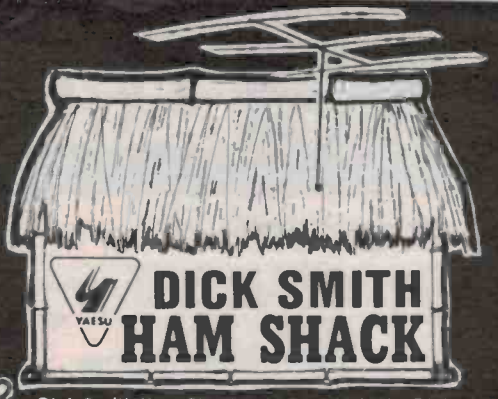

7106 measuring ratiometric values of Quad Load Cell. The resistor values within the bridge are determined by the desired sensitivity.




7106 used as a digital centigrade thermometer. A silicon diode-connected transistor has a temperature coefficient of about −2mV/°C. Calibration is achieved by placing the sensing transistor in ice water and adjusting the zeroing potentiometer for a 000.0 reading. The sensor should then be placed in boiling water and the scale-factor potentiometer adjusted for 100.0 reading.

# DON'T MISS OUT!

## Check out the Yaesu bargains in my new Ham Shacks




*Dick Smith Ham Shacks are located in the Dick Smith stores listed below. You'll find a licensed amateur at each shack — someone who can talk your language and give you any help you need. (Amateur items also available at other Dick Smith stores.)*

### FT-ONE — The ultimate

Top of the line - it's got everything: SSB AM - RTTY - CW - FM* - 100W PEP - Built in power supply Cat D-2852

**ONLY $1975**

(*Option) General Coverage 150kHz - 30MHz

### FT 720 RVH 2m

FM — 25 watt — it goes remote scanning & memories. Cat D-2890

**$369.95**

SPECIAL - AUGUST ONLY
Remote cable only $10
Hurry while stocks last!

### TH 3JR HF Antenna

Triband (10-15-20 mtrs) beam, 12' boom, 600W PEP. Approx. 8db gain, 25db F/B. Cat D-4304.

**ONLY $275**

### 150 FB VHF-UHF SCANNER

Hear it all! Touch control — fully synthesised. Cat D-2800

**ONLY $275**

**WHY PAY MORE?**

### FT 480R

Big gun — all mode. It's got it all in such a small package. 1 & 10 watt output plus scanning plus memory plus NB plus tone burst plus priority ch. plus 2 VFO's plus satellite operation. Cat D-2887

**only $514**




### FT 208R 2m

FM - hand held, 800 chan. loaded with features: LCD, 10 memories, scanning, hi/lo power, touch tone, memory backup, and comes complete with charger and battery. Cat D-2889.

~~WAS $360~~ **only $325**

**NEW**

### FT 102

Big power — 3 x 6146B — built in power supply — all WARC bands — super dynamic range — best ever! Cat D-2880.

**and it's only $1195**

### V5JR HF Antenna

5 band (80-40-20-15-10 mtrs) vertical. 1 kw PEP, 6.7m high, very good for limited space applications. Cat D-4305.

**ONLY $99**

### 5/8 WAVE 2 mtr Whip

Fits our standard ¾ base (D-4056). 1.3m long — fibreglass construction. Cat D-4205.

**ONLY $14.95**

### FT 101Z (FM)

Old reliable — the famous 101 with FM and all the WARC bands too. Cat D-2872.

**ONLY $885**


### FT 707 HF MOBILE

Car/boat/plane or even home. This is the hot little giant, all solid state 100W PEP, all WARC bands too! Cat D-2869

**only $765** ~~WAS $795~~

### FT 230R 2m ONLY $359

Super compact FM 3/25 watt synthesised — LCD — 2 VFO's — 10 memory plus scanning. It's out of sight 2m radio!! Cat D-2893

### FT 107m/dms


Solid state — built in power supply — all WARC bands and digital memory. Cat D-2871.

~~WAS $1325~~

**ONLY $1225**

**NEW**

### VHF — UHF Whip with base

68-600 MHz comes with cutting chart. 110cm long stainless steel super for UHF CB & 2m amateur & 70 cm amateur & our new scanners. Cat D-4023

**ONLY $9.95**

### ANTENNA ROTATOR

WIND LOAD 8.6 sq. ft.

with control box. Rotation torque: 500kgcm Braking torque: 1500 kgcm. For VHF/UHF and small HF beams - perfect for TH 3JR (above). Cat D-5000

**$139**

### FT 290 R 2m


All mode — scanning, portable plus LCD plus 2 VFO's plus 10 memories plus hi/lo power plus built in antenna plus NB plus memory backup. Cat D-2885

**and it's only $349** ~~WAS $395~~

### FRG 7700 HF RECEIVER

150KHz - 30MHz

Go anywhere — all mode — short wave listeners dream come true! Cat D-2840

**ONLY $525**

SAVE OVER $10!

~~WAS $539~~

### FL 2050 2m linear

Cat D-2547

70 watts output for 10 watts input. Great for mobile 13.8V operation. Perfect with our FT 480R and hand helds.

**only $239**

### FL 2100Z HF Linear

Big power — 1.2kW. All WARC bands. Cat D-2548.

SAVE $12! ~~WAS $580~~ **$568**

**THAT'S LESS THAN 48¢ PER WATT!**

### FT 902D


Built - in power supply, 180W PEP in all WARC bands — memory option Cat D-2853

**ONLY $1195**

The stores at right stock this complete list of Dick Smith Amateur Radio equipment. All other Dick Smith stores stock some amateur equipment but may not be able to give you the service of "Ham Shack" stores listed.


Sydney — 125 York St 290 3377
Gore Hill — 162 Pacific Hwy 439 5311
North Ryde — 396 Lane Cove Rd 888 3200
Parramatta — 30 Grose St 683 1133
Adelaide — 60 Wright St 212 1962
Springvale — Dandenong Rd 547 0522
Richmond — 656 Bridge Rd 428 1614
Perth — 414 William St 328 6944
Buranda — 166 Logan Rd 391 6233
Chermside — 842 Gympie Rd 59 6255
Melbourne — 399 Lonsdale St 67 9834

DSE/A307/PAI

# More **BABANI BOOKS** to you by post

**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 dltto.
**196** 75¢

**PRACTICAL TRANSISTORISED NOVELTIES FOR HI-FI**
Circuits for audlo power meter, stereo phone adaptor, multi-channel mlxers, gain control, contour network etc. etc.
**201** **$1.30**

**HI-FI LOUDSPEAKER ENCLOSURES**
Data for building corner reflex, bass reflex, exponentlal horn, folded horn, tuned port, Klipschorn labyrinth, tuned column, loaded port and multi speaker panoramics. Clear dlmensioned dlagrams included.
**205** **$3.50**

**DIODE CHARACTERISTICS, EQUIVALENTS & SUBSTITUTES**
Includes signal, zener, rectlfier 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** **$4.60**

**AUDIO ENTHUSIASTS' HANDBOOK**
Dlscusses audlo and hi-fi topics including record/playback curves, stylus compliance, disc recordings — then and now, evaluating loudness, equipment compatibility, acoustic feedback, equipment performance figures and standards etc. etc.
**214** **$4.05**

**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, ITL pulse detector, hi-impedence Vm, square-wave osc/pulse gen, logic probe, lo-range ohmmeter, bridge, signal tracer etc.
**218** **$3.10**

**SOLID STATE NOVELTY PROJECTS**
A number of novelty projects usIng modern ICs and transistors. Includes 'Optomin' — a musical instrument played by reflecting a light beam with your hand, water warbler for pot plants, music tone generator, LEDs and ladders game, touch switch, electronic roulette wheel etc.
**219** **$3.10**

**BUILD YOUR OWN HI-FI & AUDIO ACCESSORIES**
Essential for keen hi-fi and audio enthusiasts. Projects include stereo decoder, three-channel mixer, FET preamp for ceramic pick-ups, mic preamp with adj. bass, stereo dynamic noise llmlter, loudspeaker protector, voice-operated relay, etc.
**220** **$3.10**

**28 TESTED TRANSISTOR PROJECTS**
Some circuits are new, others are familiar designs. Projects can be split and/or combined for specialised needs.
**221** **$4.60**

**SOLID STATE SHORT WAVE RECEIVERS FOR BEGINNERS**
Design and construction of several solid-state short-wave receivers giving high level of performance yet utilising relatlvely few inexpensive components. See also 226.
**222** **$4.60**

**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** **$4.60**

**50 CMOS PROJECTS**
Many interesting and useful projects — multivibrators, amplifiers and oscillators; trigger devices; special devices.
**224** **$4.60**

**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** **$4.60**

**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** **$4.60**

**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** **$4.60**

**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**

**FIRST BOOK OF PRACTICAL ELECTRONIC PROJECTS**
Full constructional data, circuits, components lists for many practical projects including audio distortion meter, super FET receiver, guitar amp, metronome, etc.
**BP23** **$2.55**

**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** **$2.20**

**50 FET PROJECTS**
Projects include amplifiers and converters, test equipment, tuners, receivers and receiver aids, mixers and tone controls etc etc. The FET used is not critical. This book is of interest and value to SW listeners, radio amateurs, hi-fi enthusiasts and general experimenters.
**BP39** **$6.10**

**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** **$6.45**

**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** **$4.60**

**ELECTRONIC PROJECTS FOR BEGINNERS**
This book gives the newcomer to electronics a wide range of easily built projects. Actual components and wiring layouts aid the beginner. Some of the projects may be built without using soldering techniques.
**BP48** **$4.60**

**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** **$4.95**

**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** **$6.60**

**PRACTICAL ELECTRONIC CALCULATIONS & FORMULAE**
For the practical person's workbench. Bridges gap between technical theory and cut-and-dried methods which work but leave the experimenter unfulfilled. There's a strong practical bias. Tedious and higher maths avoided where possible. Many tables included. This one's a beauty!
**BP53** **$8.25**

**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** **$5.50**

**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** **$5.10**

**BEGINNER'S GUIDE TO DIGITAL ELECTRONICS**
Covers all essential areas including number systems, codes, constructional and sequential logic, analog/digital/analog conversion.
**BP61** **$3.50**

**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** **$8.25 (each)**
**Book 4** **$10.80**
**Book 5** **$9.95**

**SINGLE IC PROJECTS**
Simple to build projects based on a single IC. A few projects use one or two transistors as well. A strip board layout is given for each project plus special constructional and setting up info. Contents include low level audio circuits, audio power amps, timers, op-amps and miscellaneous circuits.
**BP65** **$5.10**

**BEGINNER'S GUIDE TO MICROPROCESSORS & COMPUTING**
Introduction to basic theory and concepts of binary arithmetic, microprocessor operation and machine language programming. Only prior knowledge assumed is very basic arithmetic and an understanding of indices.
**BP66** **$6.40**

**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, efc.
**BP67** **$6.40**

### 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** **$3.50**

### 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** **$4.95**

### ELECTRONIC SECURITY DEVICES

Besides including both simple and more sophisticated burglar alarm circuits using light, infrared and ultrasonics, this book also gives circuits for gas and smoke detectors, flood alarms, fire alarms, doorphones, baby alarms, etc.

**BP56** **$5.35**

### 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** **$5.30**

### CHOOSING AND USING YOUR HI-FI

Provides fundamental info invaluable when buying hi-fi. Explains tech. specs, advice on minimum acceptable standards and specs for adequate sound. Also invaluable advice on how to buy and install and maximise your equipment's potential. Includes glossary of terms.

**BP68** **$6.10**

### 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** **$6.40**

### ELECTRONIC HOUSEHOLD PROJECTS

Most useful and popular projects for use around the home. Includes two-tone buzzer, intercom, smoke and gas detectors, baby alarm, freezer alarm etc. etc.

**BP71** **$6.10**

### A MICROPROCESSOR PRIMER

This small book takes the mystery out of microprocessors. It starts with a design for a simple computer described in language easy to learn and follow. The shortcomings of this basic machine are then discussed and the reader is shown how these are overcome by changes to the instruction set. Relative addressing, index registers follow as logical progressions. An interesting and unusual approach.

**BP72** **$6.40**

### 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** **$7.15**

### 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** **$6.40**

### 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** **$6.40**

### 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** **$1.85**

### ELECTRONIC CALCULATOR USERS' HANDBOOK

Presents formulae, data, methods of calculation, conversion factors, etc, for use with the simplest or most sophisticated calculators. Includes the way to calculate using only a simple four-function calculator: trigonometric functions (sin, cos, tan); hyperbolic functions (sinh, cosh, tanh); logarithms, square roots and powers.

**BP33** **$4.60**

### 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** **$10.00**

### 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** **$4.60**

### PRACTICAL COMPUTER EXPERIMENTS

How to build typical computer 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** **$6.50**

### 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** **$6.40**

### POPULAR ELECTRONIC CIRCUITS — BOOK 1

Yet more circuits from Mr Penfold! Includes audio, radio, test gear, music projects, household projects and many more. An extremely useful book for all hobbyists, offering remarkable value for the designs it contains.

**BP80** **$7.15**

### 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 enthuslast to understand and build up what appears to be a quite complex instrument.

**BP81** **$6.45**

### ELECTRONIC PROJECTS USING SOLAR CELLS

Well-known author Owen Bishop has designed a number of projects that benefit from solar power and obviate the problems encountered with batteries, such as weight and bulk, frequency of replacement, and failure when batteries are exhausted.

**BP82** **$7.15**

### VMOS PROJECTS

A book to suit the dyed-in-the-wool experimenter. Though primarily concerned with VMOS power FETs and their applications, power MOSFETs are dealt with, too, in a chapter on audio circuits. A number of varied and interesting projects is covered under the headings: Audio Circuits, Sound Generator Circuits, DC Control Circuits and Signal Circuits. Learn while you build.

**BP83** **$7.20**

### 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** **$7.20**

### 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** **$10.85**

### AN INTRO TO BASIC PROGRAMMING TECHNIQUES

Ideal for beginners seeking to understand and program in BASIC. Book includes program library for biorhythms, graphing Y against X, standard deviations, regressions, generating musical note sequences, and a card game.

**BP86** **$6.60**

### 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** **$5.05**

### 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)** **$6.60**

# ORDER FORM

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| 223 | | BP48 | | BP66 | | BP56 | | BP95 (was 213) | |
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# SAVE A FORTUNE: BUILD IT YOURSELF FROM A DICK SMITH KIT!

Why pay for commercial equipment when, with just a few hours of your time, you can build it yourself with the aid of a Dick Smith kit. Because you supply the labour, you can save $$$! AND what's more, it's great fun. So have a go and do it yourself. Your friends will never believe you built it!

## Building a Dick Smith Kit is as easy as A B C!

A

Everything you need is supplied — parts, solder, even nuts and bolts. AND most kits include detailed instruction manuals, making construction a breeze!

B

It goes together so easily; you don't have to be an expert to build a kit, just follow the instructions.

C

And it's finished! Sit back and enjoy your project: because you did it yourself!

**And it looks so good your friends won't believe you built it!**

SAVE $$$

### DUAL TRACE CRO SWITCH

SAVE MONEY and convert your single trace CRO to a dual trace with this superb kit. Dual trace CRO's have uses in almost every application. Whenever you need to compare two waveforms, the dual trace CRO is the best bet. Cat K-3065. SEE EA FEB 81

only $49.00
WAS ~~$55.00!~~

### TV CRO ADAPTOR

Want to save a heap of money? If your electronic enthusiasm is hindered by financial burdens, this could be the kit for you. The TV CRO converts any standard TV set into a large screen oscilloscope with a frequency response from 10Hz to 300kHz with a sensitivity of 100 mV RMS for full screen deflection. Cat K-3060. SEE EA MAY 80.

only $29.95

### UNIVERSAL TIME/ STOPWATCH


This terrific all-purpose counter can be used as a stopwatch, countdown timer or event timer. Large LED display, and timing rates are switch selectable between 0.01 secs to 1 sec. Great for sporting events, darkrooms - in fact anywhere you need to keep track of the time. Cat K-3435. SEE EA SEPT. 81

only $39.50

SPECIAL

### 240V CONTROL TIMER

Switch an appliance on for a preset period any time of night or day. Large lighted LCD clock and tough die cast case combine to give rugged reliability. Far more accurate than time switches enables time on period to be switched to 16, 32, 64 & 128 minutes. Cat K-3085. SEE EA APRIL 80

only $42.50 WAS ~~$49.00~~

SPECIAL

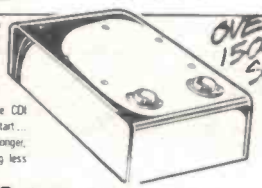
### TRANSISTOR ASSISTED IGNITION

This kit incorporates circuitry with dwell extension which results in a hotter spark at high engine speeds and is compatible with modern electronic tachometers. All components and casing are supplied. Cat K-3300. SEE EA NOVEMBER 79

only $29.00
was ~~$34.00~~

### CAPACITOR DISCHARGE IGNITION

OVER 15000 SOLD!



This has got to be the best valve CDI available. Your car will be easier to start... when cold or hot, your plugs will last longer, keeping your car in tune and using less petrol. Cat K-3280.

only ~~$33.50~~ $29.50 SEE EA JULY 75

SPECIAL

### INFRARED LIGHT BEAM RELAY

Protect your property and equipment with this ideal burglar alarm. A light beam trigger that uses an invisible beam of light! It has a range of 5m and there are no lenses to adjust. Battery power gives the unit about 50 hours continuous use. Cat K-3380. SEE ETI MAY 81

only $59.00
was ~~$65.95~~

SAVE $$$

### INFRARED 2-CHANNEL REMOTE CONTROL

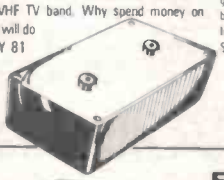
Control 2 appliances simultaneously, independent of each other. Use it to control your alarms, stereo, radio, in fact just about anything you can think of. Cat K-3375. SEE EA APRIL 81

only $29.50
WAS ~~$39.50~~

SAVE $$$

### UHF/VHF DOWN CONVERTER

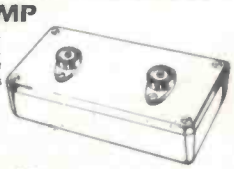
SINGLE CHANNEL ONLY. This project will convert TV station transmissions in the UHF band down to unoccupied channels in the VHF TV band. Why spend money on expensive TV sets fitted with UHF when this kit will do the job just as well. Cat K-3235. SEE EA MAY 81



$29.50
WAS ~~$33.50~~

### TV MASTHEAD AMP

Improve your TV reception with this easy to build kit. Can cut out "snow" effect, reduce "ghosting" effect, good for picking up distant stations and can be used for boosting FM signal as well, plus lots more! Works from 240v supply included. Cat K-3232. SEE EA AUGUST 79



only $33.50

SAVE $$$

### DIGITAL FREQUENCY COUNTER

Now a completely new frequency and period counter using the latest IC technology. Low component count makes it very easy to build and very reliable. It rivals the performance of commercial units costing many times the price. Cat K-3439. SEE EA DEC 81

The case shown here is an option

only $99.50

### FUNCTION GENERATOR

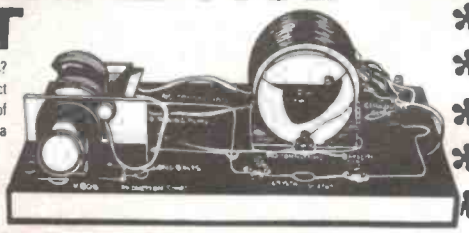
This kit produces sine/triangle and square waves over a frequency range from below 20Hz to over 160KHz! It has four digit LED readout enabling accurate frequency settings. The kit makes an ideal companion to our Frequency Counter Kit (Cat K-3439). The case shown here is an option (Cat H-2505 $19.95) Cat K-3520.

only $52.50
WAS ~~$59.50~~

SEE EA APRIL 82

## DICK'S ORIGINAL 1952 CRYSTAL SET

Want a radio that works during blackouts and doesn't need batteries? Then this is just for you! Dick's own crystal set kit. A satisfying project that will give you lots of fun. It can pull in a surprising number of broadcast stations and produce good sound even when connected to a stereo system. All necessary parts are supplied. Cat K-2650. SEE EA APRIL 82



only $6.90

# NEW KITS ... STOP PRESS ... NEW KITS ... STO

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## 12V FLUORO INVERTER

Handy project which should have appeal, with our impending power strikes. 12V operated inverter circuit in our CDI metal case! Also the power to drive 2 x 20watt or 1 x 40watt fluorescent tube (tube or container not supplied). Efficient circuit gives low current drain.

Cat K-3275

ONLY $65.00


## PROTOTYPER

Invaluable for Designers Experimenters, Hobbyists, useful for school projects, great as a teaching aid - Includes: Oscillator, led drivers, switches, debounce circuit all on-board. This safe unit has a seperate power supply. The power supply can be varied or fixed. 5V and 1.25V to 10V. It has easy connector strip - every workshop should have one.

Cat.K-3465

ONLY $79.00


## POWER SUPPLY

This very useful Power Supply Kit is designed for use with high powered transceivers or where several small C.B.'s have to run from the one supply. Output voltage is 13.8 volts (fully regulated) at 7.5 amps continuous or 10 amps peaks. The supply is housed in a sturdy case, overload protector being provided by a Darlington Pair (current limiting) with led overload condition indication.

Cat K-3452

ONLY $119

## 150watt PA AMPLIFIER

This fabulous little PA kit allows you to let more people hear you at your Rallys or if you're in to bigger things like Fete's we would all agree that this kit would save you heaps. It features:2 mic inputs, 1 aux input, also Pre-amp out and insert fascilities - when used with OP590 output transformer the applications are limitless. e.g. 2ohm, 4ohm, 8ohm, 16ohm, 50ohm (70v), or 100ohm (100v). Cat.K-3525. Transformer to suit MO153.

Short form no case supplied.

## LCD DIGITAL PANEL METER

ONLY $29.50

A versatile highly accurate panel meter using a large liquid crystal display for low power consumption. The PC board design allows for maximum flexibility to cater for varied mounting arrangements. The low cost makes it ideally suited as a readout device on many projects, at both amateur and professional level. It may be considered as a viable replacement to conventional existing analogue equipment.

Cat. K-3450

Short form no case supplied.

# PRICE SLASH PLUS A BONUS

Due to overordering we now have an excess of PCB's! So why not buy now while we're offering them at these ridiculously low prices. You reap the benefit! PLUS All boards bought after the 1st of August will include a copy of the EA or ETI article relating to that particular PCB.

| Cat No. | Kit | Price | Cat No. | Kit | Price |
|---|---|---|---|---|---|
| H-8330 | Radar alarm | 99¢ | H-8404 | Electrotune | $6.75 |
| H-8340 | Morse key | $1.20 | H-8420 | Voice canceller | $1.80 |
| H-8366 | Metal locator | $1.10 | H-8421 | Voice operated relay | $1.50 |
| H-8377 | Power chopper | $1.00 | | | |
| H-8384 | Selectalot | $1.50 | H-8613 | Car alarm | $1.30 |
| H-8387 | Cylon voice | $1.20 | H-8638 | Uni relay driver | $1.40 |
| H-8395 | Infra red TR/REC | $1.90 | H-8634 | Neg. ion generator | $3.50 |
| H-8397 | Infra red control | $2.90 | | | |

**SPECIAL PARTS:**

Ultrasonic transducers as used in the EA Electronic Rule kit. Cat No's L-7050 & L-7052 ... ONLY $4.95

Panel meter moving iron as used in EA Mains Watt Meter Kit. Cat No. Q-2090 ..... ONLY $7.95

## Parts for New Kits

***Special parts for kits which are not in our current catalogue (or may be hard to find!)***

**CORE BALANCE RELAY – SEE ETI APRIL 81 (CAT K-3315)**

PL24/5VA Transformer ..... Cat M-3590 ... $8.95

**SUPER 80 COMPUTER -SEE EA AUG 81 (Cat K-3600)**

20k 10 turn trimpot ..... Cat R-1970 ... $2.60
Mini 5 volt relay ..... Cat S-7105 ... $2.60
12MHz crystal ..... Cat K-6035 ... $3.50
2716 EPROM ..... Cat Z9207 ... $12.50
S-100 Edge Connector ..... Cat P-2670 ... $9.75

**DIGITAL FREQUENCY COUNTER - See EA Dec 81 (Cat K-3493)**

Deluxe instrument case ..... Cat H-2505 ... $19.95
(above case is also used in function generator & new car computer)
10MHz crystal ..... Cat K-6032 ... $4.95

**FUNCTION GENERATOR - See EA April 82 (Cat K-3520)**

FND500 LED displays ..... Cat Z-4150 ... $1.35
XR2206 IC ..... Cat Z-6820 ... $6.95
Slide Switch – 3 pole 3 position .... Cat S-2070 ... 95c
Slide Switch – 2 pole 3 position .... Cat S-2030 ... 80c
Slide Switch – 2 pole 2 position .... Cat S-2040 ... 65c

**150W MOSFET AMPLIFIER - See ETI May 82 (Cat K-3525)**

2SK134 FET ..... Cat Z1815 ... $7.90
2SJ49 FET ..... Cat Z-1816 ... $7.90
PCB ..... Cat H-8644 ... $6.50
(PCB for mosfet amp preamplifier) ... Cat H-8646 ... $6.50
NE5534 IC ..... Cat Z6090 ... $4.50

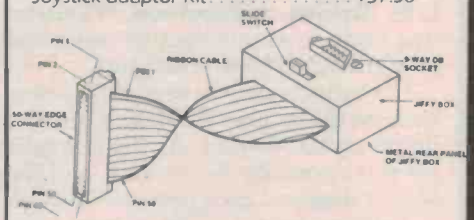
## SYSTEM-80 JOYSTICK ADAPTER KIT

Ever wish you could hook up a joystick to your System-80, so you could play games faster and with greater realism? Well, your wish has been answered. This little adapter won't strain your piggy bank and can be assembled very easily. It plugs in, and away you go!

NOTE: Compatible with most U.S. games software designed to work with the "Alpha" joystick.

Cat. K-3455

Joystick adaptor Kit ..... $37.50




## MATCHING JOYSTICK

This is the joystick to go with the above adapter. Standard Atari-type joystick, with sensors for four primary directions of motion and separate "fire" button. Complete with cable and DB-09 connector. (Also suit VIC-20 computer).

Cat. X-2020 ..... $19.90

# DICK SMITH ELECTRONICS

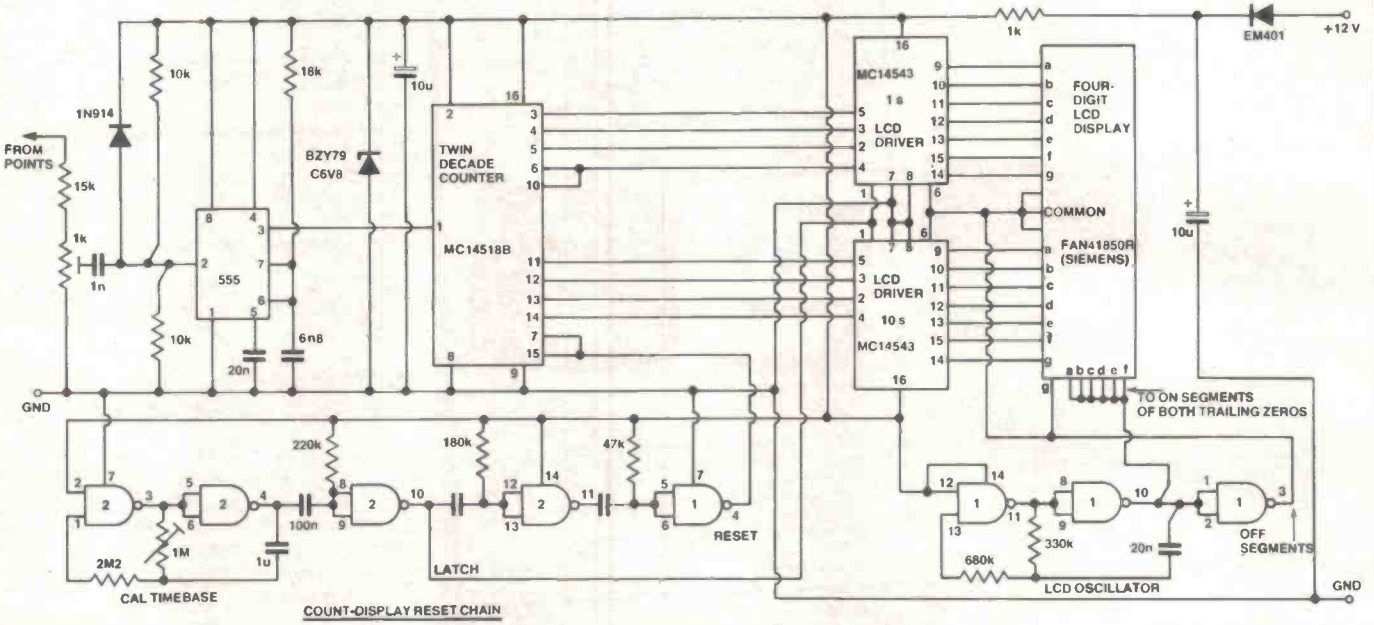
SEE PAGE 144 FOR ADDRESSDETAILS

**ASK FOR YOUR FREE COPY OF OUR ALL NEW KIT CATALOGUE!**


DSE/A306/PAI.Fi.

# 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.**




## LCD tacho

This rev counter circuit, sent to us by **L.W. Brown of Burwood, Victoria,** was built as an automotive tacho and has functioned for several years.

The tacho consumes very little power because of the use of CMOS ICs and a liquid crystal display. At night a dash lamp is necessary for viewing, and the type of display I used does not function in extreme heat, nor did it work completely on frosty mornings, so it may be preferred to use a display with a wider temperature specification.

I used a display featuring a single edge connector, and the pc board was built the same size as this display-plus-edge connector. A very compact module of approximately 77 x 44 x 24 mm was constructed by mounting the pc board behind the display.

The circuit uses a conventional 555-type tacho stage, driving two decade counters. Each decade counter drives a latch decoder driver and then the display. A 60 Hz square wave oscillator supplies the ac drive to the LCD and to the drivers. As this is a four-digit display reading directly in rpm, the two trailing digits are fixed at zero. These 'on' segments of the display are driven with an out-of-phase signal, while the 'off' segments are driven with the same signal as the common terminal.

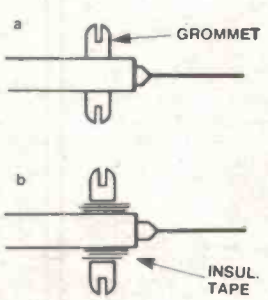
The timebase provides the necessary gating for counting by generating the display latch followed by the counter reset signal. The gate times required for a four-stroke engine are:

0.3 s for four cylinders
0.2 s for six cylinders
0.15 s for eight cylinders.

For a single cylinder two stroke engine the gate time is 0.6 s.

If a dc supply is not available, try connecting a 10k resistor from the points to the 12 V input. I have not tried this 'self power' modification, however.

## Probe finger guards




ETI's gripe about multimeter probes lacking finger guards in the Univolt multimeters review in the May issue (page 22) brought a swift response from **K.L. Blaze of the School of Botany, University of Melbourne, Victoria.** Here's how he solved the problem:

I use rubber grommets (e.g: from Clark Rubber stores, which stock a variety of sizes). These are slid onto the probe stems and, if necessary, glued in place — as shown in diagram (a). If the probe is too slim for the grommet, a few turns of insulating tape should suffice to enlarge the diameter — as in (b).

# SUB-WOOFER SYSTEM

## MASSIVE PRICE BREAKTHROUGH!!!

A Sub-Woofer System makes a lot of sense. Apart from getting down to a genuine 30Hz you could actually save money over all.
For years we have been persevering with huge 12" 3 or 4 way systems in up to 120 litre cabinets to try to get down to— at best 45Hz. We have even duplicated our effort by having a stereo pair for this frequency!!!
Big 12" systems don't come cheap. With a Sub-Woofer you can forget about what happens below the non-stereo <100Hz region. Once that's done you are free to use a very compact (and generally far cheaper) system for stereo. Concert hall sounds in your lounge room without needing an auditorium to house your speakers.!!!
The profit you make from selling your 12" system could pay (or even exceed) the cost of the Sub-Woofer system. — AND you can get down to 30Hz!!!

1812 LIKE NEVER BEFORE. So too those big pipe organ records. This system is a must for the direct or digital disk enthusiast.
Now that "ELECTRONICS AUSTRALIA" have designed *a Mosfet Sub-Woofer filter/amplifier and speaker system you have no excuse.

JAYCARS' BULK BUYING PASSES SAVINGS ONTO YOU. TRULY A PRICE BREAKTHROUGH FOR SUB-WOOFER SYSTEMS.

*(With due respect to Thiele, Small, Snyder and others!)

## THE SUB-WOOFER

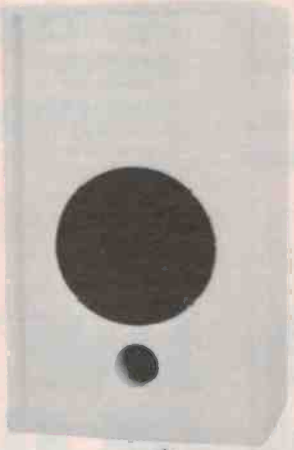
This unit has been extremely popular with audio enthusiasts right across Australia! EA have designed a special crossover/booster amp just for this unit. Now you have no excuse to build a subwoofer system to enjoy those thrilling low notes from pipe organs, synthesisers, 1812 cannons etc!!

SPECS:
Diameter 10" (250mm) Cast frame. QT= 0.39 VAS= 63l
Power handing = 100WRMS.
Free-Air Resonance-32Hz=1Hz
Voice Coil=2" (51mm) DIA.
Magnet Assy: 3kg(6.6 lbs)

A FREE SUB-WOOFER CABINET DESIGN IS PROVIDED WITH EACH UNIT!

**ONLY $79.50**
MODEL SW 250

## THE ENCLOSURE * * * *



This compact 63 litre vented enclosure was specifically designed around the parameters of the SW 250 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 photograph shows the prototype which was finished in white. The production units are only available in black.

**ONLY $79.50**

**FREIGHT ANYWHERE $10**

## AMPLIFIER/FILTER UNIT

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 preamp out or power-amp out.
Power supply on board.
(Transformer needed. ONLY $39.50)

**ONLY $79**

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.

## LAST CHANCE-PERHAPS?

### PLESSEY—FOSTER

Over the last few months we have sold hundreds of famous Plessey-Foster Speakers at great prices. Whilst we admit we had plenty of stock to sell (of some models) we are just about at the end. Genuine Bargains!!!

We still have a small quantity left of the stock shown below:

P.A. SPEAKERS
12" 50W RMS C300K05 — NORMALLY $69.50, NOW $39.50, SAVE $30.00

10 pcs OR MORE $29.50 - UNBELIEVABLE!!!

HI FI/GENERAL
12" 20W RMS C300L05 — NORMALLY $29.95, NOW $19.95, SAVE $10.00

JAYCAR— OPENING NEXT MONTH AT CARLINGFORD, RIGHT AT CARLINGFORD COURT, NEXT TO KENTUCKY FRIED CHICKEN.

MOTOROLA

### PIEZO HORN TWEETERS

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|---|---|
| KSN1005A 50W RMS PA HORN | $16.00 |
| KSN1025A 100W RMS PA HORN | $26.00 |
| KSN1038A 50W RMS PA/HI FI HORN | $16.00 |
| KSN1039A 50W RMS HIFI/CAR RADIO DOME | $12.00 |

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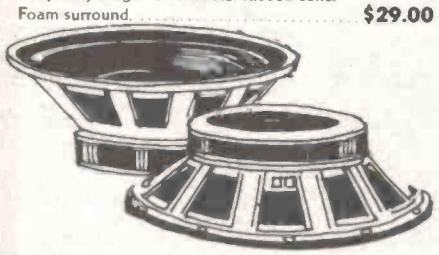
**Model 605.** HiFi Midrange speaker 100-8,000Hz frequency range. 6" cone. 120W RMS power handling in the range 500-5,000Hz ..... **$28.00**

## 10" HiFi Models

**Model 108.** HiFi Woofer. 50WRMS power handling. Frequency range 30-4,000Hz. Ribbed cone. Foam surround. ..... **$29.00**



**Model 118.** HiFi woofer. 80WRMS power handling. 30-4,000Hz response. ..... **$38.00**

**Model 145.** Ultra high power (120WRMS) woofer with high efficiency. Ideal for disco and other sound systems where power handling and efficiency are crucial. 25-4,000Hz response. ..... **$70.00**

## 12" HiFi Models

**Model 618.** HiFi Woofer. 60WRMS power handling. 30-4,000Hz response. Ribbed cone. foam surround. ..... **$32.00**

**Model 518.** Higher powered version. 30-4,000Hz response. Ribbed cone, foam surround. 100WRMS power handling. ..... **$44.00**

**Model 235.** Ultra high power HiFi woofer. 120WRMS power handling. 30-5,000Hz response. Curvilinear ribbed cone with cloth surround. ..... **$62.00**

## 12" PA Models

**Model 511.** General purpose speaker for Guitar, Bass, general PA and speech reproduction. Power handling 40WRMS. 50-8,000Hz response. ..... **$36.00**

**Model 516.** Twin cone version of Model 511. Power handling 40WRMS. Frequency response 50-14,000Hz. ..... **$46.00**

**Model 231.** Similar to the 511 but higher power handling (60WRMS). Response 50-8,000Hz. Ideal for PA, Disco, musical instrument use. ..... **$52.00**

**Model 241.** General purpose high powered PA speaker. 80WRMS power handling. 50-8,000Hz response. ..... **$73.00**

**Model 246.** Twin cone wide range version of Model 241. 80WRMS power handling. 50-15,000Hz response. ..... **$77.00**

## 15" PA Driver

**Model 451.** High powered (100WRMS) high efficiency driver for electric bass, organ, bass end of PA etc. 40-6,000Hz response. ..... **$123.00**

# Hear Ye! Hear Ye!! Lowest prices in Australia. Hear Ye!

## Only at Sheridans the Component Kings

KSN1025

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KSN1016

**KSN1016.** 50x125mm rectangular horn gives ultra wide dispersion. Distortion is under 1%. The ideal unit for hi-fi use. Response is 3-30kHz. Maximum input 25V RMS(100 Watts). Don't pay $17.50. Our price is only **$15.00**

**KSN1038** Superhorn ideal for long throw PA applications. 3.8kHz to 28kHz response. 25V RMS (100 Watt input). Our price is is a super low **$13.50**

**KSN1039.** Brand new 3.75" direct radiating tweeter with domed screen. Ideal for home and auto sound system. Only ¾" depth. Superb transient response. Ultra low distortion (0.75%). **$8.50**

## MOTOROLA PIEZO TWEETERS.

KSN1038

These fantastic speakers carry a high 25VRMS(100watt rating). They don't need a crossover and have incredibly high efficiency (40-50%). Now you can buy them at the best price in town.

**KSN1025.** 50x150mm rectangular horn. Gives wide 2-25kHz response. 25V RMS input. Others are asking $24.00 but at Shendans you only pay **$21.00**

## CASSETTE BARGAINS

We've made a scoop purchase of superb Australian made 'G TAPE'. This low noise/high output tape is housed in a high quality screw package. Fully guaranteed.

**C90 5 for $5.69 save $2.80**
**C60 5 for $3.99 save $2.00**

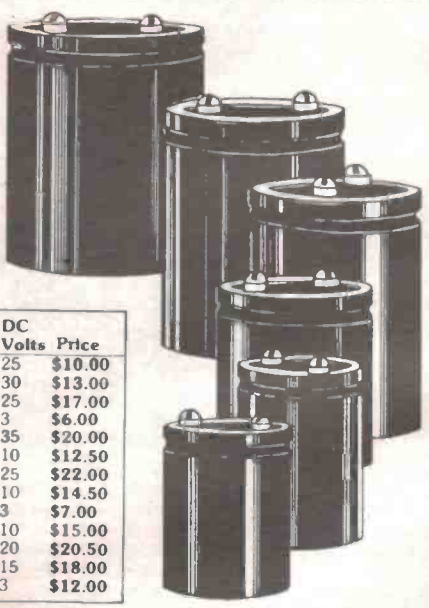

## WIRE BARGAIN

Save on heavy duty twin speaker cable with tracer. Heavy duty 14/.014 cable. Ideal for speaker and alarm installations. Various colours: Brown, black, white and clear.

**100 metres normally $12.00 Save $5.00** **$7.00**

# SAVE 50% ON ELECTROS

**We've made a huge purchase of top quality Sprague and Sangamo computer grade electros and we're passing on the savings to you. Write for details of other values.**



| Value MFD | DC Volts | Price | Value MFD | DC Volts | Price | Value MFD | DC Volts | Price |
|---|---|---|---|---|---|---|---|---|
| 500 | 250 | $5.00 | 9100 | 60 | $10.00 | 39000 | 25 | $10.00 |
| 880 | 350 | $6.50 | 10000 | 25 | $6.00 | 39000 | 30 | $13.00 |
| 1800 | 50 | $3.50 | 10000 | 40 | $6.50 | 47000 | 25 | $17.00 |
| 2400 | 50 | $4.00 | 13000 | 60 | $10.00 | 55000 | 3 | $6.00 |
| 3000 | 75 | $5.00 | 14000 | 25 | $5.50 | 65000 | 35 | $20.00 |
| 3300 | 75 | $5.50 | 14000 | 40 | $9.00 | 67000 | 10 | $12.50 |
| 3600 | 25 | $3.25 | 15000 | 3 | $3.50 | 76000 | 25 | $22.00 |
| 3700 | 30 | $3.50 | 20000 | 25 | $8.75 | 88000 | 10 | $14.50 |
| 4300 | 25 | $3.75 | 22000 | 10 | $6.00 | 100000 | 3 | $7.00 |
| 5400 | 35 | $4.25 | 22000 | 75 | $19.00 | 110000 | 10 | $15.00 |
| 7000 | 35 | $5.00 | 26000 | 10 | $6.50 | 110000 | 20 | $20.50 |
| 8000 | 35 | $6.00 | 33000 | 16 | $12.00 | 120000 | 15 | $18.00 |
| 8700 | 40 | $7.50 | 36000 | 20 | $7.75 | 200000 | 3 | $12.00 |

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# Ideas for Experimenters

IDEA OF THE MONTH

Gary Brunkhorst
McDowall, Qld.

## Symmetrical divide-by-three

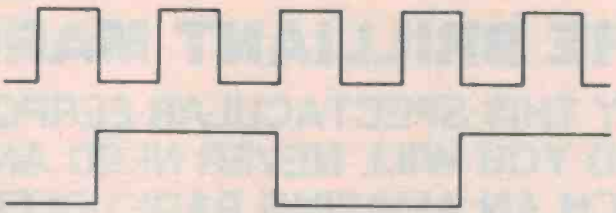


Figure 1

This circuit takes an input (symmetrical) square wave at CMOS levels and divides it by a factor of three, producing a symmetrical output. Figure 1 shows input and output waveforms.

At first glance, this may seem a simple task, but note that the output waveform first changes state on a negative-going transition of the input waveform, then on a positive-going transition, etc. The circuit of Figure 2 neatly overcomes the problem of non-symmetrical divided output by inverting the input waveform periodically, using an exclusive-OR gate.

The waveforms involved are shown in Figure 3. The prototype circuit used a 74C73 for flipflop 1 and 2, but almost any type of edge-triggered flipflop could be used. The same method could be used to obtain a divide-by-5, 7 or 9.

(Ed. note: this circuit may not work at high speeds owing to gate delays in flipflops 1 and 2, but is nonetheless a good idea, despite the limitations.)

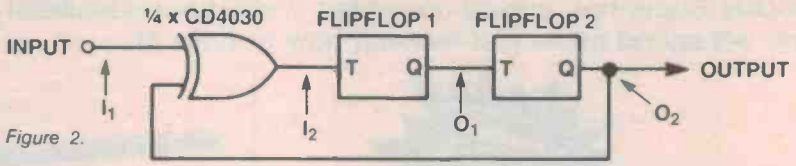



Figure 2.

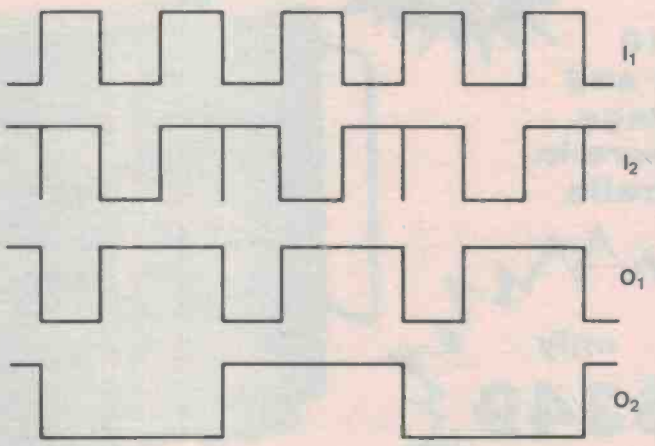



Figure 3.

# ★ 'IDEA OF THE MONTH' CONTEST ★

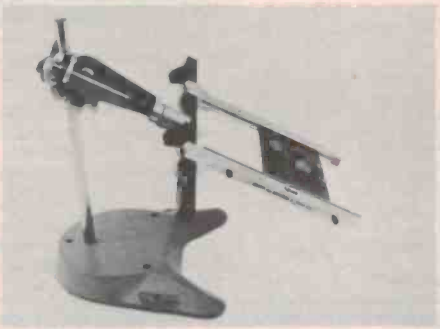
Scope Laboratories, who manufacture and distribute soldering irons and accessory tools, have offered to sponsor a contest with a prize to be given away every month for the best item submitted for publication in the 'Ideas for Experimenters' column — one of the most consistently popular features in ETI. 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.

# RADIO — FOR LIFE

## THE BRILLIANT MARC NR 82 FI

### BUY THIS SPECTACULAR PERFORMANCE 12 BAND RECEIVER AND YOU WILL NEVER NEED ANOTHER. NEVER BEFORE HAS SUCH AN AMAZING RADIO BEEN OFFERED FOR THE PRICE.

**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!

SEE REVIEW PAGES 22, 23 'ELECTRONICS AUSTRALIA' AUGUST

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**Digital Tuning**

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**4 Inbuilt Antennae**

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**STRICTLY LIMITED STOCKS**

**SPECIFICATIONS:**

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

**Frequency range:**

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

**Output power:** 5.0W (Max.)

**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)

**Quantities strictly limited:** Grab one now for only $349. 7 Day money-back guarantee

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***All these scopes are dual trace and incorporate the latest features such as high brightness rectangular CRTs.***

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- 7.7nS risetime
- Single sweep
- Trigger delay
- TV sync
- X-Y, dual, chop, add, subtract etc.

**45MHz/1mV**

**BS625 $990.00**

## ALTERNATE AND DELAYED TIMEBASE

- 21 range timebase
- 100mS-1 uS trigger delay
- Front panel trace rotate
- X-Y, dual, chop, add, subtract etc.

**35MHz/1mV**

**BS635 $790.00**

## BUILT-IN COMPONENT TESTER

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

**20MHz/5mV**

**BS601 $550.00**

## BATTERY PORTABLE

- 2 hour operation from built-in NiCad battery
- Automatic recharging
- Auto trigger free run
- TV sync

**15MHz/2mV**

**BS301 $720.00**

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### QUICK SPEC CHECK

| MODEL | B'WIDTH | SENS | SIG DEL | TRIG DEL | SCREEN | T'BASE |
|---|---|---|---|---|---|---|
| 625 | 45MHz | 1mV | Y | Y | 150mm | 0.2uS - 0.5S/div |
| 635 | 35MHz | 1mV | N | Y | 150mm | 0.1uS - 0.5S/div |
| 601 | 20MHz | 5mV | N | N | 150mm | 0.5uS - 0.5S/div |
| 310 | 15MHz | 2mV | N | N | 95mm | 0.5uS - 0.5S/div |

### COLINE SP100 PROBE

Professional 100MHz probe offering x1, ref, x10 positions. 1.5m lead with BNC connector and selection of tips. Complete in heavy duty plastic pouch. **$25.00**

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## MAIL COUPON FOR FREE GUIDE

Please send me a copy of your shortform oscilloscope guide.

NAME _____

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TELEPHONE _____

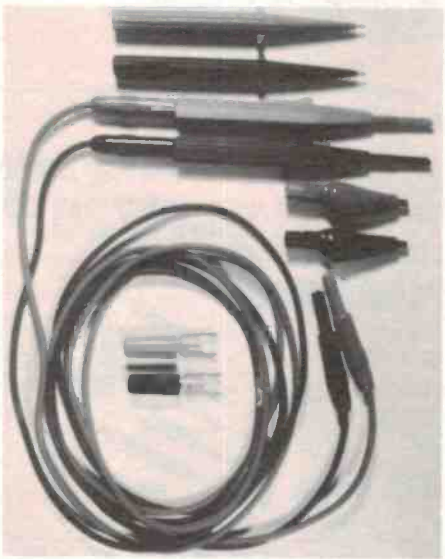
# Shoparound

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-1505 fluorescent light inverter

We had some difficulty sourcing suitable components with the characteristics required for this project, but following extensive discussions with the Philips organisation and one of their distributors, Sycom, supplies of both the EC-type ferrite cores and the BDY91 transistors should be available — albeit with a short delay in some instances.

The only retailer we could find who had current stocks of the specified Philips EC assemblies was All Electronic Components in Melbourne. They should also be able to supply BDY91 or BDY92 transistors. But, save yourself the trouble of collecting components, they have indicated they will be stocking a kit for this project.



Our gripe about multimeter leads in the May issue review of the Univolt multimeters (page 22) brought a swift response from Elmeasco. They distribute the Coline range of meter probes and accessories — said probes including *finger guards*, the lack of which was the subject of our gripe. The above photo shows the Coline set of probes that also include shrouded plugs, banana connectors and alligator clips. Clip-type and pointed probes are included; they just plug in to the leads. Cost? — just $25 plus 17½% sales tax. Enquiries to Elmeasco, P.O. Box 30, Concord NSW 2137. (02)736-2888.

Many kits and component suppliers have indicated they will be stocking kits for this, but they may not be immediately available until adequate stocks of the Philips components arrive, which should be toward the end of the month or early in September.

The 'Safe-T-Lite' housings we used for our two 20 W tubes were purchased from Warburton Franki.

## ETI-161 digital panel meter

A most handy instrument. Hands up all those readers who have an Intersil DPM Evaluation Kit (ICL7106EV) lying around in the bottom of a drawer! Here's your last chance to turn it into something useful. Most of the components in the evaluation kit can be used in this project — chief among them being the ICL7106 IC, the liquid crystal display and the capacitors. Printed circuit boards can be obtained from the list of pc board suppliers at the end of this column.

For those shopping around for parts, many suppliers carry the ICL7106 — such as Rod Irving Electronics, Dick Smith Electronics and All Electronic Components. The latter are official Intersil distributors, incidentally. The LAD204 liquid crystal display may be harder to get. However, Dick Smith Electronics carry a 4½-digit liquid crystal display, catalogue No. Z-4175, which plugs straight into our board and works — only you get a 3½-digit readout.

A number of suppliers will be carrying this project as a kit and we advise you scan the advertisements.

## ETI-652 Atari joystick interface

Add a 'pilot's control' to your System 80! Well, not quite, but this simple add-on interface allows you to use an Atari or Commodore joystick for on-screen graphics control of your System 80. The Atari-type joystick is widely available as an accessory and all the parts for this project are more or less bog standard. Dick Smith Electronics list the joystick, catalogue No. X-2020, at $19.90. However, D.S.E. indicate they will be stocking a kit for this project.

This interface allows you to use the joystick on some of the Big Five and Adventure International games software that calls for a joystick.

## PC Boards, panels etc.

Almost every pc board ever published by ETI may be obtained from the following firms:

RCS Radio
651 Forest Rd
Bexley NSW 2207

All Electronic Components
118 Lonsdale St
Melbourne Vic. 3000

In addition, many of our boards are stocked by Radio Despatch Service or, if they haven't got your requirements in stock, can have them made to order for you. Here they are:

Radio Despatch Service
869 George St
Sydney NSW 2000

The same three firms can provide front panels for our projects, too.

For the projects we've done over the past three to five years, many (if not most) pc boards and panels may be obtained through the following firms:

Mini Tech
P.O. Box 9194
Auckland N.Z.

James Phototronics
522 Grange Rd
Fulham Gardens S.A. 5024

Sunbury Printed Circuits
Lot 14, Factory 3, McDougall Rd
Sunbury Vic. 3429

Jemal Products
P.O. Box 168
Victoria Park W.A. 6100

Rod Irving Electronics
425 High St
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Electronic Agencies
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and

119 York St
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64K SINGLE BOARD COMPUTER KIT NOW ONLY $499 +TAX.

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$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 (2K x8) 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) $299 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!

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PRICE CUT!

$199 KIT
A&T $219

FULLY STATIC AT DYNAMIC PRICES

32K STATIC ALSO AVAILABLE

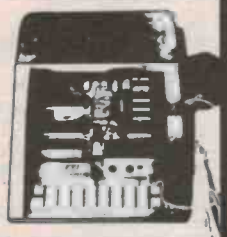
FOR SWTPC 6800 BUSS!

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

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 $13.80

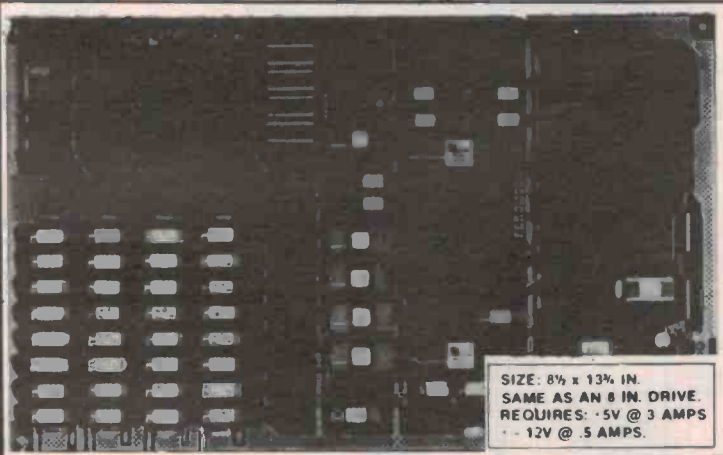
RAM Expansion (add to PCB) $16.00

### 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 $499 Including tax ($435 tax exempt)

Also available: Blank PCB's with Roms $275 + Tax.
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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.

#### Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERUPTS. Fully buffered and runs 8080 software.

#### 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.

#### 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!

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ET1/82/4

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ETI 8/82/4

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| 4002 | Dual 4 Input NOR Gate | 48 |
| 4006 | 18 Stage Static Shift Register | 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 |
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| 4032 | Triple Serial Adder | $1.95 |
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| 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 |
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| 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 | 65 |
| 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 |
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| 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 |

## 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/M'plexer | 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 |
| 74LS195 | 4-Bit Parallel Access Shift Register | $5.00 |
| 74LS221 | Dual Monostable Multivibrator | $2.25 |
| 74LS240 | Octal Tri-State Driver | $3.50 |
| 74LS241 | Octal Tri-State Driver | $3.50 |
| 74LS244 | Octal Buffer/Driver | $3.55 |
| 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 |

## MEMORIES

| | | 1-9 | 10 up |
|---|---|---|---|
| 2102 | 1K x 1 RAM | $1.95 | $1.65 |
| 2114-3 | 1K x 4 RAM 350nS | $2.45 | $2.00 |
| 2114 | 1K x 4 RAM 450nS | $1.45 | 99 |
| 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 | |

## Z-80A/6800

| | | |
|---|---|---|
| Z-80A | CPU 4MHz | $8.50 |
| Z-80A | PIO 4MHz | $8.50 |
| Z-80A | CTC 4MHz | $8.50 |
| Z-80A | S10/0 4MHz | $20.95 |
| Z-80A | S10/1 4MHz | $20.95 |
| Z-80A | S10/2 4MHz | $20.95 |
| Z-80A | DART 4MHz | $32.95 |
| Z-80A | DMA 4MHz | $20.95 |
| 6802 | CPU | $11.00 |
| 6821 | PIA | $4.95 |

## 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 |

## 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 |
| OM350 | $9.50 | LM4558 | $1.50 |
| LM361 | $3.75 | LM5534N | $1.55 |
| LM380 | $1.48 | LM5534AN | $2.00 |

## SPECIAL FUNCTION

| | |
|---|---|
| SA80600 Door Chime | $9.95 |
| AY-1-5050 | $9.50 |
| TEA-10P2 PAL Colour Encoder | $17.50 |
| TDA-1022 Bucket Brigade | $29.50 |
| EXAR 2206 Function Generator | $6.95 |
| MOC-3020 TRIAC Opto Coupler | $2.50 |
| MM 5837 Noise Generator | $3.90 |
| TA 7205P Audio Amp | $4.50 |
| 7216 IJI Audio Amp | $47.50 |
| SN 76488NF Sound Effects Generator | $5.95 |
| AY-1-0212 Top Octave Synthesiser | $19.50 |

## 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 | $1.00 |
| 78L15 | $1.00 |
| 79L15 | $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 |
| LM318H | $3.50 |
| LM337K | $9.50 |
| LM396K | $19.50 |

## LED's

| | |
|---|---|
| 5mm Red | 15 |
| 5mm Green | 26 |
| 5mm Yellow | 30 |
| 5mm Orange | 28 |
| 3mm Red | 18 |
| 3mm Green | 28 |
| 3mm Yellow | 28 |
| Rectangular Red | 40 |
| Rectangular Green | 40 |
| Rectangular Yellow | 40 |
| Flashing Red | 49 |
| Flashing Red 10+ each | 45 |

**New JAYCAR store opening next month at Carligford – right at Carlingford Court, next door to Kentucky Fried Chicken**

## 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 |
| BDV64B | $5.95 | BC559 | 18 |
| BUX80 | $9.50 | BC639 | 34 |
| 2SK134(N) | $6.50 | BC640 | 34 |
| BU105 | $12.50 | BD266AD | $1.50 |
| MPSA05 | 95 | BD139 | 53 |
| TIP31A&B | 90 | BD140 | 53 |
| TIP32A | 90 | MJ2955 | $1.50 |
| TIP2955 | $1.20 | 2N3055 | $1.50 |
| TIP3055 | $1.20 | 2N3442 | $2.50 |
| MPF102 | 95 | 2N3569 | 45 |
| MPF105/2N5459 | 85 | 2N3638 | 35 |
| MPF106/2N5485 | 78 | 2N3643 | 45 |
| MPSA55 | 95 | 2N3646 | 45 |
| MFE131 | $1.98 | 2N3773 | $5.00 |
| BF115 | 75 | 2N4258 | 35 |
| BF200 | 95 | 2N5484 | 85 |
| BF469 | $1.65 | 2N5087 | 65 |
| BF470 | $1.65 | 2N5589 | $8.50 |
| MJE340 | $1.98 | 2N5590 | $9.50 |
| MJE350 | $1.98 | 2N5591 | $12.50 |
| ZTX501 | 45 | 2N5245 | 90 |
| 8C337 | 25 | 2N6027/D13T1 | 58 |
| 8C546 | 65 | TT800 | 85 |

## IC SOCKETS – SOLDER

| | |
|---|---|
| 8 Pin | 25 |
| 14 Pin | 30 |
| 16 Pin | 35 |
| 18 Pin | 35 |
| 20 Pin | 38 |
| 22 Pin | 40 |
| 24 Pin | 50 |
| 28 Pin | 60 |
| 40 Pin | 70 |

## QUALITY WIRE WRAP IC SOCKETS

| | |
|---|---|
| 14 Pin | 85 |
| 16 Pin | $1.05 |
| 18 Pin | $1.35 |
| 20 Pin | $1.45 |
| 22 Pin | $1.40 |
| 24 Pin | $1.75 |
| 28 Pin | $2.25 |
| 40 Pin | $2.66 |

**Ideal for projects**

## DIL PLUGS AND COVERS SOLDER TYPE

| | |
|---|---|
| 14 Pin Plug | 85 |
| 14 Pin Cover | 25 |
| 16 Pin Plug | 95 |
| 16 Pin Cover | 25 |
| 24 Pin Plug Only | $2.50 |

**TOP QUALITY**

## CRYSTALS

| | |
|---|---|
| Case Style: HC-33/U | |
| 1.000MHz | $12.50 |
| 1.8432MHz | $9.50 |
| 2.000MHz | $7.50 |
| 3.000MHz | $7.50 |
| Case Style: HC-18/U | |
| 4.000MHz | $6.50 |
| 4.43MHz | $6.50 |
| 4.9152MHz | $6.50 |
| 5.000MHz | $5.50 |
| 8.867238MHz | $5.50 |
| 10.000MHz Parallel Resonant | $9.50 |
| 12.000MHz | $5.50 |
| 16.000MHz | $5.50 |
| 20.000MHz | $7.50 |

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E&OE

# "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

## 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.**

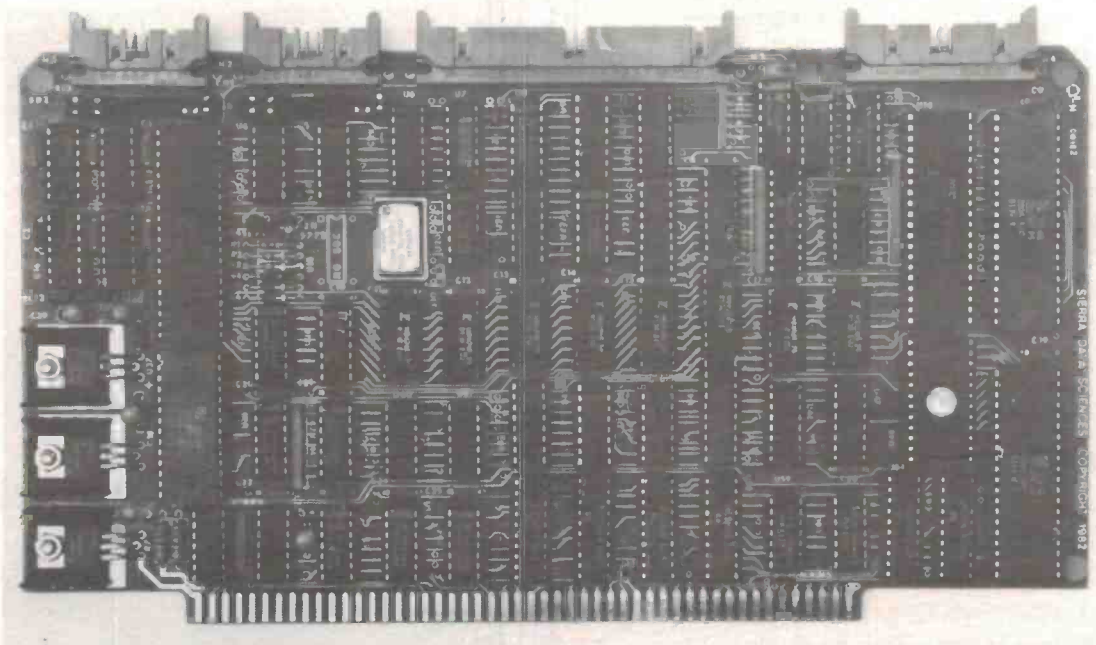
commodore COMPUTER

MLVL1460a

Introducing the first complete single board computer for the S100 bus . . .

# SBC100 MASTER PROCESSOR

Provides all resources necessary for stand-alone CP/M operation, yet allows expansion into multi-processor and hard disk systems.



## Features:

- Z-80A 4MHz
- Two serial ports (Z-80 DART—SIO optional)
- Two parallel ports (Z-80A PIO)
- NEC 765 floppy disc controller supports 4, 203 mm drives double sided, double density.
- 64K RAM (no wait states)
- 2732 4K EPROM supplied with system executive, may be switched out under software control.
- Intelligent Winchester interface (optional).
- IEEE 696 S100 standard interface.
- Software programmable baud rates.
- Time-of-day clock.
- Will operate stand-alone.
- Expandable into multi-user and hard disk systems.
- 4-layer PCB, all IC's socketted, high quality construction.

The Sierra Data Sciences SBC100 Master Processor is the first S100 single board computer that provides all resources necessary to run CP/M.

Standard features provided are an RS232 terminal port; a serial printer port; two parallel ports that may be used as a Centronics or intelligent Winchester interface; a floppy disc controller; 64K of memory; and a Z-80A running at 4MHz. A sophisticated CP/M implementation designed to make use of all the features of this board is also available.

While perfect for single user environments, this board was designed to be equally suitable for both time-sliced and multi-processor networking systems. A satellite processor card, the SBC100S, has been designed to assist in multi-processor implementations. As data transfers are via I/O ports on the S100 bus, it can be used with other host processors, even 16-bit machines. A full implementation of the powerful TURBODOS multi-user operating system is available.

We can provide individual boards, metalwork, single user systems, or complete multi-processor machines. For the state-of-the-art in microcomputing contact us now.

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**Postal: PO Box 158, Hurstbridge, 3099, Victoria, Australia.**

# Dick Smith releases approved direct-connect modem


Direct interconnection between computers via the telephone lines is common practice overseas — particularly in the US. This practice has been somewhat held back here by the Telecom-imposed necessity of either using an acoustic coupler or leasing appropriate 'approved' equipment.

**The Dick Smith organisation has just announced the release of a Telecom-approved direct-connect low-cost modem, called the 'Dataphone', that they claim will turn this whole scene around. Dick Smith explains (from his press release):**

"Until now, people have had only two choices. One was to lease a modem from Telecom, but this costs about $800 a year. This is more than the price of many personal computers! The other option was to buy an acoustic-coupling modem — but these still cost around $400 — far too expensive. It was obvious that the communications revolution wasn't ever going to get under way in Australia until people could buy a really low-cost modem. So we decided to make it happen!"

When DSE began work on the Dataphone, Telecom Australia were not yet prepared to accept privately-owned direct-connect modems of the discrete type for authorisation as a 'Permitted Attachment'. So DSE began negotiating with Telecom in parallel with the technical development, to see if official policy could be updated. This two-pronged approach paid off, because the Dataphone became the first — and currently the only — direct-connect discrete modem to be given Telecom authorisation (Permit No. C82/37/557).

Direct-connect modems are preferred because of the greater reliability compared to acoustic-coupled types.

The Dataphone is Australian-designed and manufactured. The unit just plugs in and has a standard RS-232C interface, permitting it to be used with any computer or data terminal with that interface. It is claimed to comply with Telecom regulations and CCITT recommendation V.21, and is thus compatible with other standard modems.

It operates in either answer or originate mode at 300 baud. A switch permits selection of the mode. A carrier detect signal output and indicator is included for circuit monitoring.

The Dataphone will cost $169 retail and was scheduled to be available in mid-July.


## Learn about micros with the Microprofessor

**Emona Enterprises have just released a low cost microprocessor learning aid called the 'Microprofessor'.**

The MPF-I Microprofessor features a Z80 microprocessor — the most widely used 8-bit processor, and the basic unit comes as a single board computer complete with 36-key keyboard, a 6-digit display, 2K of RAM, 2K monitor ROM, cassette interface (for storing programs on an ordinary audio cassette tape), 24 input/output lines for expansion (expansion units are available) and a speaker for sound output. It's all powered by a plug pack.

Special manuals are provided aimed at helping you teach yourself by experiment using the Microprofessor.

Amazingly, it sports a tiny BASIC interpretor in a PROM you can plug in. Commands include continue, call, for . . . next, goto, gosub, input, if . . . then, let, list, load, new, print, return, run, save, stop. You get a form of mnemonic readout on the display.

Cost of the basic MPF-I is $115 plus sales tax!

Optional expansion units include a speech synthesiser (!!), an EPROM programmer and we hear a printer is in the wind.

Accessories available for the MPF-I board include: a Z80 counter-timer chip, a Z80 parallel I/O chip, a breadboard for playing with circuits, extra 2K RAM plus 2K and 4K blank EPROMs.

Full details of this interesting new development are obtainable from Emona Enterprises, CBC Bank Building, 661 George St, Sydney 2000, (02)212-4815 or Radio Parts, 562 Spencer St, West Melbourne 3003, (03)329-7888.

Speech synthesiser

Printer

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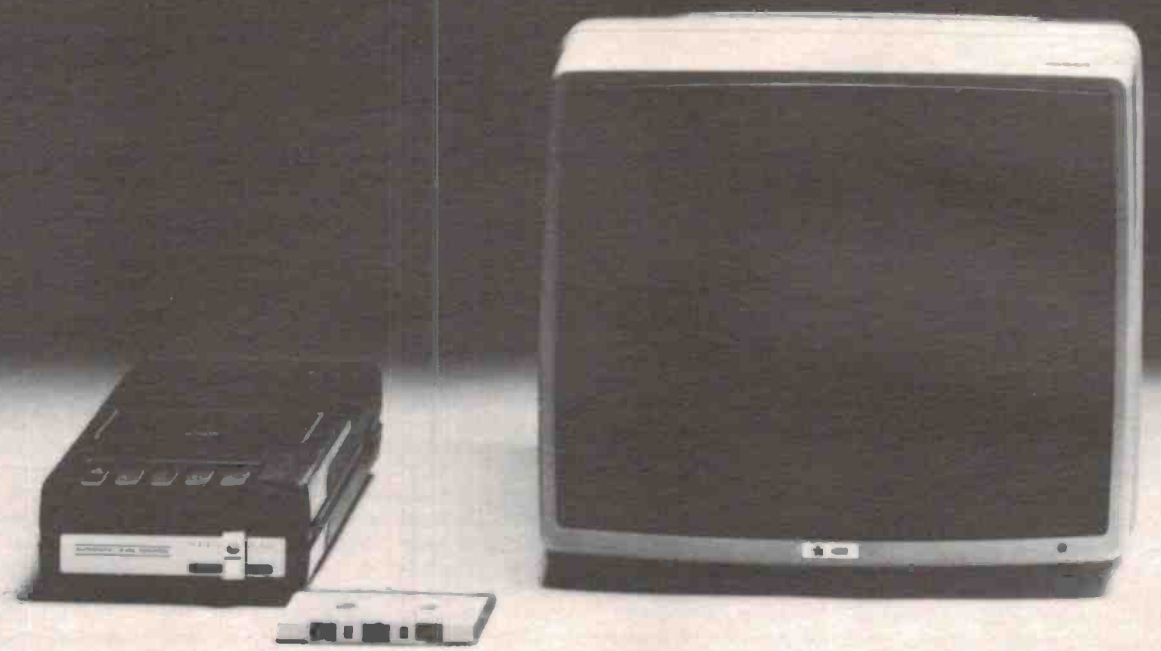

With one giant step, Australia's MicroBee brings the power of the personal computer within your reach. MicroBee is now ready built with a superb new case. Yet incredibly it costs no more. The no compromise computer you can afford. MicroBee is a complete learning package. Explore and master programming with the BASIC manuals, and inbuilt 16K ROM BASIC. Find out why the NSW Department of Education chose MicroBee.
MicroBee is powerful and "friendly". You learn to control the built in sound, graphics and write and correct programs more easily with MicroBee. Printers, modems and cassette storage plug straight in.
The optional parallel and Z80

# expansion power thought possible



port let you connect joysticks or use the world standard S100 bus. MicroBee grows with you. Inexpensively. Add disc drives, colour graphics and EPROM programmers. Write programs in Z80 code. Or upgrade to disc drives and CP/M with the new 64K memory card. MicroBee, your first class ticket into computing.

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At last!

# Don't pay $400! Unbelievable price breakthrough: $169


# Australia's first direct modem to meet new Telecom regulations!

The data communications revolution has now reached Australia. More and more personal computer users are communicating with other computers via the telephone network, to exchange data and programs with other personal computer users and to access the growing amount of valuable information in the big computer "data bases".

Until now, the only type of telephone modem available for use with personal computers has been the acoustic coupled type. These are expensive, and also depend heavily on the telephone's old-fashioned carbon microphone. As a result even the best units of this type are often not capable of really reliable, trouble-free operation.

But now, after months of development work and negotiation with Telecom Australia, Dick Smith Electronics presents the Dataphone – a telephone modem that really is suitable for personal computers. It's not an acoustic-coupled type, but a true high performance direct connect modem. And it's authorised by Telecom. Even more importantly, it will cost you less than half the price of a comparable acoustic modem!

Here are just some of Dataphone's many exciting features:

★ Simple plug-in connections.
★ Full duplex operation for speed and convenience.
★ Operates at the standard data rate of 300 baud.
★ Designed and manufactured in Australia.
★ Standard RS 232C interface – so it can be used with almost any personal computer.
★ Fully complies with both Telecom regulations and CCITT Recommendation V.21 – hence it is not only legal, but also fully compatible with other modems. (Telecom Authorisation No. C82/37/557).
★ Operates in either Answer or Originate mode, at the flick of a switch, for complete flexibility.
★ Has a phone/modem switch, for convenient operation.
★ Comes complete with approved power supply and detailed, easy to understand user manual.

And the best news of all – it costs only **$169**

**DICK SMITH Electronics**

HFC

See Page 144 for address details

DSE/A304/PAI

# Print-out

## Set your Apple singing

**Well, playing tunes anyway. The ARP Chroma is a synthesiser instrument that links to an Apple II to provide programmability and flexibility.**

The Apple II becomes part and parcel of the synthesiser. With the Chroma and the Apple, you can create a 32-channel programmable synthesiser with eight independent voices, plus you get mass storage (with composition menus!) and you can store all sorts of colourations and spectra you require.

If, as a computer hack, you're a frustrated composer, have a look at the ARP Chroma. See Hutchings Pianos and Electronic Keyboard Specialists, 5-7 Edgecliff Rd, Bondi Junction NSW 2022. (02)387-1376.

## New format in computing exhibitions

**The ninth Australian Computer Conference and Exhibition, being held in Hobart during August 23-27 1982, marks the end of the Australian Computer Society's biennial conferences. A new series of conference/exhibitions have been planned to keep up with the latest technology, beginning in 1983 on an annual basis.**

Riddell Exhibition Promotions Pty Ltd, in conjunction with the Australian Computer Society, have reached an agreement which will see the National Convention staged annually, primarily between Melbourne and Sydney. This will begin with the tenth Australian Computer Conference and Exhibition (10ACCE) to be held at the Royal Exhibition Building, Melbourne, September '83, followed by Sydney, November '84. Suppliers of the industry will not have to wade through the usual numerous exhibitions, but support only one major calendar event a year.

The Exhibition will cater for **all** areas of the computer industry from the largest mainframes to the smallest personal computers, and a full array of peripherals, media supplies and office automation, furniture, transport and software. For further information please contact Peter Petherick, Riddell Exhibition Promotions Pty Ltd, 166 Albert Road, South Melbourne Vic. 3205. (03) 699-1066.

## Applecase

**Computer Force have available a robust carrying case for Apple owners who need portability.**

Constructed of aluminium and stainless steel externally, the case is claimed to withstand a considerable amount of abuse. Internally, the case has been moulded to suit an Apple II and its accessories. You can fit the Apple, two disk drives, one box of diskettes, game paddles and a number of cables and manuals. Dimensions are 700 mm long, 500 mm wide and 220 mm deep. Price is $275.

Enquiries to Computer Force, P.O. Box 409, Artarmon NSW 2064. (02)95-5624.

## Computer Country and the Australian Beginning

**We've mentioned the Australian Beginning several times in previous issues of ETI, each time adding new details available through the system, giving information on special offers, how to join, and so on. We thought it was time we summarised for ETI readers just what the Australian Beginning is all about.**

Basically, through the Australian Beginning system microcomputer and word processor system owners, as well as owners of 'dumb' terminals, are able to access:

- a wide variety of Information sources and data banks, including news, weather, airline schedules, investment advisory services, sports, government information, etc.
- full electronic mail facilities
- many computer programs, including entertainment, educational aids, programming and diagnostic tools, a wide range of financial and business applications
- the system computer's huge storage capacity to use the large on-line applications programs, and to put their own programs on the Australian Beginning's system for disaster back-up
- a 'shopping by computer' system to help get the best price on many consumer and business items
- the telex system — Australian Beginning users can send telex messages through the system to any telex user, and receive telex messages.

As mentioned in the July issue of ETI (p. 71), the Australian Beginning and Sigma Data are offering a low-cost package including desktop terminal, acoustic coupler, Australian Beginning lifetime membership and a prepaid block of 60 hours' computer use. The system is run on Data General computers, and is available for $20 a week over five years.

Another new facility is a computer insurance package against computer breakdown or accidental damage. The premium of $135 annually also covers software, and includes the full cost of repair, or in the event of total loss complete replacement of the system. Information on the policy is available through David Hornidge Insurances Pty Ltd, 422 Collins St, Melbourne Vic. 3000. (03)67-8583.

Computer Choice, a franchisee of Computer Company, is now opening in Perth, and carries a wide range of microcomputer systems, including the Apple, Hitachi Peach, Northstar, NEC, Osborne, Atari, and others. Computer Choice will also be the prime WA dealer for the Australian Beginning system, as well as dealing with service and informational seminars on the Australian Beginning.

For further information on the Australian Beginning contact Gary Alpert, Computer Country Pty Ltd, 338 Queen St, Melbourne Vic. 3000. (03)329-7533.

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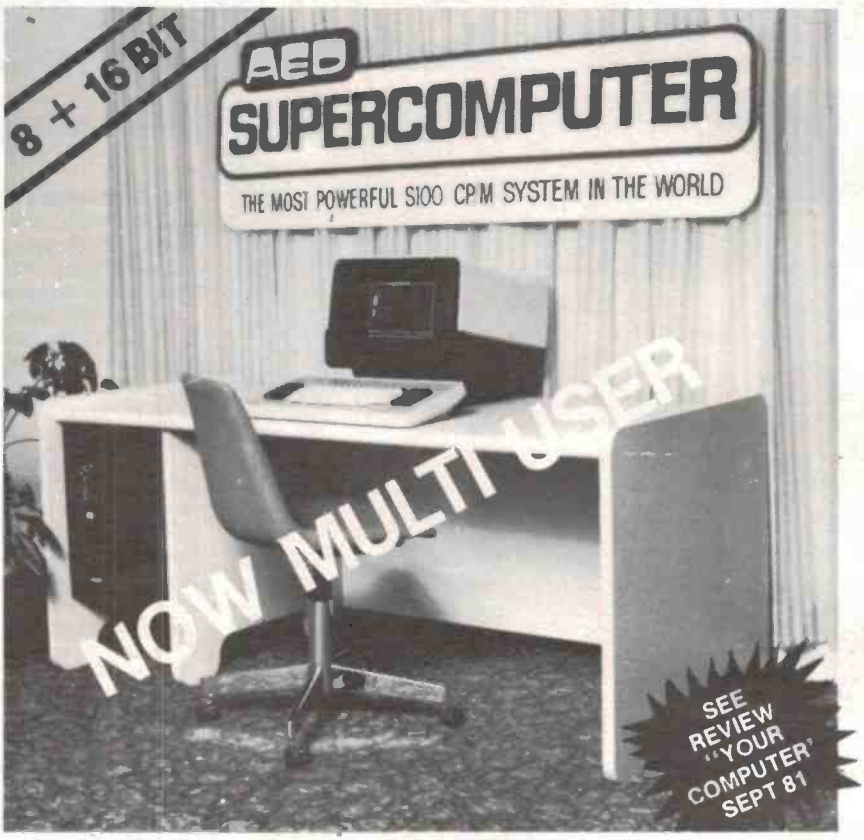


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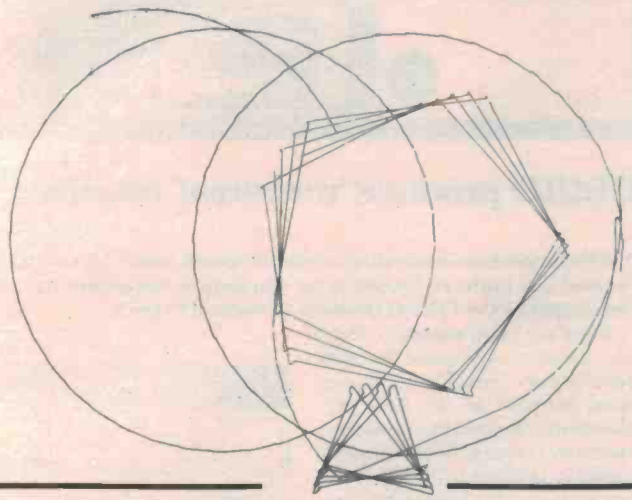
AT LAST AED HAS ENTERED THE MULTI USER ARENA. BY IMPLEMENTING MULTI USER FACILITIES ON THE "SUPERCOMPUTER".
WE HAVE AVOIDED IMPLEMENTING MULTI USER FOR THE LAST 2 YEARS BECAUSE WE BELIEVED INSUFFICIENT MULTI USER TECHNOLOGY HAD DEVELOPED FROM THE SYSTEM SOFTWARE HOUSES. THOSE MULTI USER OPERATING SYSTEMS THAT WERE WELL ENGINEERED EG. TURBODOS & OASIS WERE NOT COMPATIBLE WITH THE POPULAR CP/M AND WERE THEREFORE NOT ABLE TO OFFER VERY MUCH IN THE WAY OF END USER APPLICATION SOFTWARE SUPPORT. THE MULTI USER OPERATING SYSTEMS WHICH HAD CP/M COMPATIBILITY WERE NOT WELL ENGINEERED AND DID NOT HAVE TOTAL CP/M COMPATIBILITY EG. MP/M.
DURING THE LAST 2 YEARS WE KEPT OUR EYES OPEN FOR AN OPERATING SYSTEM WHICH SATISFIED BOTH OF THESE REQUIREMENTS. IN AUGUST 1981 "INFOSOFT" AND THEIR MULTI/OS ATTRACTED OUR ATTENTION AND SUBSEQUENT INVESTIGATION REVEALED THAT "INFOSOFT" WAS IN FACT A SLEEPING GIANT THAT WAS RESPONSIBLE FOR THE CREATION OF SUCH FAMOUS OPERATING SYSTEMS AS CREMENCO CDOS, S.D. SYSTEMS SDOS AND COSMOS AND MOSTEKS NEW MULTI USER AND NETWORK OPERATING SYSTEMS.
"INFOSOFT" HAVE RECENTLY STARTED MARKETING THEIR OWN SINGLE USER, MULTI USER AND NETWORK OPERATING SYSTEMS UNDER THEIR OWN BANNER, IN NOVEMBER 1981 WE SENT AN ENGINEER TO INFOSOFT OFFICES IN CONNETICUT TO EXAMINE THEIR MULTI USER OPERATING SYSTEM IN DETAIL, HE DETERMINED THAT MULTI/OS HAD MANY TECHNICAL ADVANTAGES OVER THE ALTERNATIVES AND THAT IT WAS ALSO TOTALLY CP/M AND CDOS COMPATIBLE. SOME OF THE OTHER ADVANTAGES ARE THAT IT LEAVES A LARGE TRANSIENT PROGRAMME AREA FOR EACH END USER, IT HAS KEYBOARD TYPE AHEAD, LARGE DISK HANDLING, SUBDIRECTORIES, DEFAULT DRIVES F R COM FILES AND BATCH FILES ETC ETC ...
WE DECIDED THAT AT LAST HERE WAS THE MULTI USER SYSTEM THAT AED AND ITS CLIENTS HAVE BEEN PATIENTLY LOOKING FOR. INFOSOFT WERE IMPRESSED BY THE SUCCESS OF OUR CP/M EXTENSION "SUPERAED" WHICH IS NOW BEING MARKETED BY SSM IN CALIFORNIA. INFOSOFT DECIDED TO INSTALL US AS THEIR SOLE REPRESENTATIVE IN AUSTRALIA, NEW ZEALAND AND NEW GUINEA.
AED IS NOW MAKING THESE OPERATING SYSTEMS AVAILABLE CONFIGURED ON THE SUPERCOMPUTER, ALSO THE CONFIGURATION PACKAGES ARE AVAILABLE TO OTHER OEM'S SO THAT THEY MAY IMPLEMENT THEM ON THEIR OWN MACHINES.
THE SUCCESS OF THE "SUPERCOMPUTER" HAS LEAD TO SALES AS FAR AWAY AS TONGA AND MEXICO.
FOR COMPLETE INFORMATION ON THE SUPERCOMPUTER AND ITS OPERATING SYSTEMS WRITE TO US OR CALL US AND ARRANGE A DEMO.

# Printout



## THE ARTICULATE TURTLE

The ETI office was recently honoured by a visit from a very articulate (as Turtles go . . .) Tasman Turtle. Yes folks, it was a walking, drawing, flashing, talking . . . *talking?* . . . Turtle.

The, er, machine was a Standard Turtle, fitted with the General Purpose Interface board and the Turtle Talk board. The latter is a digital speech synthesiser employing the National Semiconductor 'Digitalker' chip set with interfacing power supply circuitry and audio amplifier on board. Interrupt and mute circuitry is also included so you can 'pull' phonemes out of words in the vocabulary to make new words. A command facility also allows you to cut words short for building other words. These last three facilities permit very flexible word programming.

Alan Branch, who turned up at ETI with the articulate Turtle under his arm, brought a number of demonstration disks with him. In no time there was a crowd of staff gathered around the articulate Turtle watching/listening to it perform. Pity we never had time to fire it up on the ham bands for a 'digital' contact!

The Turtle Talk board is remarkably flexible, only requires simple (or no) interfacing and straightforward programming. The basic ROM set has a vocabulary of 143 words (and you can pull them apart to make your own), expandable on board to a 600 word vocabulary ROM set. You can get ROMs in other languages (French, German etc), and both European and American voices. The spoken words (and numbers) can be written on-screen, spelling determined by the programmer (i.e: colour, not color). Programming is done by simple POKE and PEEK instructions. Only a single line of programming is required for any word. Or you can program it with switches, even. Flexible Systems are currently selling the Turtle Talk board for $254 plus tax. See their advert on page 43 of last month's issue.

Having played with speech, we went on to more mundane things — like programming the Turtle in Logo. It's simple. Type FORWARD and it goes forward, BACK and it goes back & etc. But it doesn't recognise JUMP! So we tried circles. You can get it to draw circles by dropping the pen and moving forward a few paces, turning a few degrees, moving forward a few paces, etc. Eventually, it draws a circle. Using a BIC finepoint we drew a circle in this manner about 300 mm or so in diameter — and closed the loop at the finish! Not 1 mm in or 1 mm out — it *closed*. It's hard to believe until you see it. Spirals, rotating geometric figures etc, are a piece of cake after that. Yes, it can draw pieces of cake too — depending on how good a programmer you are!

I was amazed at how having a Turtle and getting it to do things under program control hones one's programming skills. It certainly forces you to think clearly.

The amazing Articulate Turtle — now all we need is one with a male voice and one with a female voice, a few attachments and . . . anything could happen!

## Ram this on your ZX81

**The Melbourne firm of Vendale has released a 32K dynamic RAM add-on for the ZX81, priced at $165.**

It simply plugs into the ZX81 expansion port and offers the full 32K. No extra power pack is required.

Details from Vendale Pty Ltd, Dept. T7, P.O. Box 456, Glen Waverley Vic. 3150. (03)232-0444.

## Decisions, decisions

**Microtrix will no doubt be proud to show you their Decision 1 computer, which utilises advanced IEEE-696 S100 boards from Morrow Designs.**

The CPU card is designed to function like an IBM 370 processor, features dynamic allocation of memory in 4K increments to 1 M, supervisor control of use, sophisticated trapping mechanism and an optional floating point processor.

The DMA floppy disk controller implements full DMA to IEEE-696 specs, using an on-board Z80A to supervise operations. Memory and I/O mapped controllers are also available, as is a DMA hard disk controller.

A multi-user, multi-tasking operating system (Micronix) is designed to operate on the Decision 1 with hard disks, and is claimed to be functionally equivalent to Bell Lab's UNIX. A CP/M emulator is provided, allowing use of all CP/M programs, it is claimed. Up to 15 users can be supported.

You can get 64K static RAM cards, I/O cards and hard disk drives of various capacities. Further details from Microtrix, 75 Grand Boulevard, Monmorency Vic. 3094. (03)439-5257.

## New single-board computer

**Table Top Systems has just released the AC-85 Single Board Computer, designed as the heart of a small business micro system.**

The AC-85 provides the expert hobbyist and the forward-looking end-user with a low-priced entry into computers, Table Top claim.

On a single 220 x 330 mm board the user will have available a 10 MHz 8085 A-Z CPU; 64K of dynamic RAM (300 ns); 2K EPROM bootstrap monitor which, after start up, is replaced by RAM; three RS232C serial channels with software selectable Baud rates; double or single density 8" floppy disk controller with DMA, capable of operations with up to four Shugart 801 or 851 D (or equivalent) disk drives; a real time clock; CP/M configured ready to run; fully assembled and tested plus full back-up service and 30-day factory warranty.

The AC-85 has been designed to allow users to take advantage of the large amounts of software written for the CP/M operating system. Table Top Systems claim they can supply all CP/M software that the user might need to fulfil his requirements.

All that is needed to turn the AC-85 into a complete system is: a power supply; disk drive(s) and associated power supply; RS232 terminal and printer.

The AC-85 costs $1495, plus tax, and is available from Table Top Systems, P.O. Box 32, Toongabbie NSW 2146.

## Club Call

**The Microcomputer Society,** P.O. Box 580, Fortitude Valley Qld. 4006, meets on the second Friday of each month at the Old Town Hall, cnr. Vulture and Graham Sts, South Brisbane. Meetings start at 7.30 pm — doors open around 7 pm, and if the main gate is closed use the back stairway! Parking is available and visitors are always welcome. Contact the Secretary at the above address, or phone (08)356-6176.

Special interest groups of the Society include:

- The **TRS80/System 80 Interest Group,** which meets on the first Sunday of each month at 21 Rodney St, Lindum, at 2 pm. Phone 396-2998 for more information.
- The **Apple II Brisbane User Group** meets on the third Sunday of each month at the Hooper Education Centre, Kuran St, Wavell Heights, starting at 8.30 am and running till 4.30 pm, with a break for lunch — bring your own food to barbeque. For more information contact Graham Hannam on 398-9405 or Peter Newland on 396-6072.

**1802 Users Group:** for those who own an ETI-660 or a COSMAC VIP, you can contact the 1802 Users Group at P.O. Box 6210, Auckland, New Zealand. Be kind and send them a return-addressed envelope and some IRCs.

# Printout

## Cromemco personal computer

**Adaptive Electronics Pty Ltd recently announced that Cromemco has released a new powerful low-priced personal computer.**

The Marketing Manager of Adaptive Electronics, Mr. Adam Gatt, says that the Cromemco C-10 is perfect for the serious personal computer user, for the executive workstation, for distributed data processing or as a front end for a mainframe computer.

Starting at US$995, the new C-10 is based on the industry-standard high-speed Z80A microprocessor and has 64K of internal user-accessible RAM and 16K of internal ROM.

The C-10 comes with an integral intelligent high-resolution 12-inch CRT with a detachable, light and easy to use keyboard. It also has a wide range of peripherals available, including floppy disk drives and a new low-priced (US$895) letter-quality daisy-wheel printer.

Mr. Gatt envisages that the most popular configuration for the C-10 will be the special Super Pack, referred to as the C-10SP. This system configuration consists of the basic C-10, keyboard, 390K capacity 5¼" floppy disk drive, along with a CP/M-compatible operating system, 32K structured BASIC, word processing and financial spread sheet software.

Besides access to the entire range of other Cromemco products (such as FORTRAN, COBOL and RATFOR), because of its CP/M compatibility the C-10 gives the user access to the widest possible range of microcomputer software products available.

The new Cromemco personal computer is available from Adaptive Electronics Pty Ltd, 418 St Kilda Road, Melbourne Vic. 3004. (03) 267-6800.

## Solve Rubik's cube on your ZX81

**Now you can enlist the help of your ZX81 to solve that modern madness — Rubik's cube!**

Gloster Software have a cassette program for ZX81/cube owners claimed to provide instructions much easier to follow than the 'how to do it' books.

You tell the computer what colours are on your cube and where the various pieces are now and the computer displays the moves in easy-to-follow steps by reference to the colours.

Instructions are said to be more explicit and relevant to the actual cube being used and to its current state. The usual direction-based abbreviated moves are replaced by, for example:

YELLOW HALF TURN
RED ¼-TURN
BLUE ¼+TURN
ORANGE ¼+TURN, etc.

While to some it may seem that the challenge has been taken out of the cube, the computer adds another dimension by informing the user of the time taken to order the cube (excluding the computer's thinking time).

For those who are still unable to resolve the problem, the computer has a final word of advice. Noting that there are 43 252 003 274 489 856 000 combinations, it reasons that the cube owner now possesses a uniquely ordered cube. It therefore strongly advises the use of glue before some smart alex tries to arrange it to the same pattern on millions of other cubes!

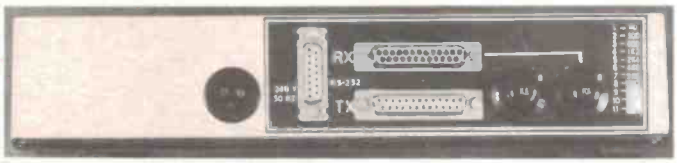
The program is on cassette and available from Gloster Software for $9.50. Further details from Gloster Software, GPO Box 5460cc, Melbourne Vic. 3001.

## Scoring schizophrenia

**Pacman, the latest rage in video games, develops screen schizophrenia if you score too highly — according to a report from the US.**

One Eric Schwibs, an 18 year-old computer science student of Buffalo, New York, racked up around 3 million points after a whole night of continuous play on a Bally-made Pacman video game, whereupon the screen image split in two — the left side showing the Pacman maze, the right showing a confused jumble of numbers!

On reaching 935 590 points (Pacman only scores to six digits), the game reset to zero and Schwibs was off again. He again reached 935 590 points and it reset, but on doing it the **third time**, apparently the machine just couldn't take it, the screen split and refused to play further. Pacman packed it in.




## CSIRO produce 'universal' interface

**A microprocessor-controlled, variable speed, serial into serial and parallel out buffered interface for computing equipment has been developed by the CSIRO Division of Applied Physics.**

There are many situations where an interactive computer (or data transmission device) is slowed down because of the slow peripherals it is attached to. Throughput can be increased if the transmission speed is upgraded. Usually it is a simple matter to upgrade the computer's rate, but not necessarily that of the peripheral because of its mechanical restrictions and response.


The buffer consists of a memory large enough to accept one page of data from a typical VDU screen (1920 characters). This is expandable to 8000 characters. Data are received at a preselected rate and are stored in the buffer. The data are then sent out to the peripheral at another preselected rate. For the 110 baud or 300 baud rate, there is an automatic insertion of a delay after the transmission of a carriage return character to allow for the carriage to return to the left hand margin. The transmit rate can be lower, higher, or the same as the receive rate.

A microprocessor incorporated in the buffer controls the reception, storage and transmission mode, annunciators, handshake, memory test upon power-up and various other aspects of its performance. When first switched on or after alteration of rate setting, the microprocessor transmits to the peripheral the baud rate which it has been set at. This is to ensure that the communication link is correctly set up. If the buffer fills up during operation, it inhibits the computer from sending any more characters until the buffer empties again. It also puts out a half-second beep tone to bring attention to the operator, and illuminates the FULL annunciator.

The versatility of this buffer is enhanced because of its dual outputs, serial and parallel, each with its own handshake lines. The two outputs cannot be used simultaneously. Availability of a parallel facility allows a computer to send serial data to a distant peripheral fitted with a parallel interface only.

General specifications are as follows:

- Communication speed 110 baud to 19.2 kilobuad
- 2K buffer memory expandable to 8K
- Receive and transmit speed completely independent
- Automatic insertion of delays for slow peripherals
- RS232 levels for serial input and output (data, RTS)
- TTL levels for parallel output (data, busy/ready, strobe)
- Memory test and baud rate factor transmission on power-up
- Optional XON-XOFF facility
- Approximate size (mm) 270 W x 170 D x 55 H

Further details can be obained from A. Bendeli, CSIRO Division of Applied Physics, National Measurement Laboratory, P.O. Box 218, Lindfield NSW 2070. (02)467-6211.

## Softalk

**One of the most informative magazines we've seen recently is 'Softalk', aimed specifically at Apple owners.**

It is published by Softalk Publishing Inc in California, and distributed here through Imagineering in Sydney. It is chock-a-block with programming notes and techniques, news, reviews and 'how to' articles — not to mention some very tantalising advertising. Well worth a look. Pop into your nearest Apple dealer and ask for a copy. It should be worth every penny you spend — and then some.

# Mr Howard increases sales tax by 2%.

# How does this affect your company's profits?

# 15 seconds to answer.

You're probably solving this sort of problem by pulling out an analysis pad and drawing up a spreadsheet by hand – taking your budget and recalculating every value in a series of columns – then checking them. If you're lucky you have a programmable calculator to help.

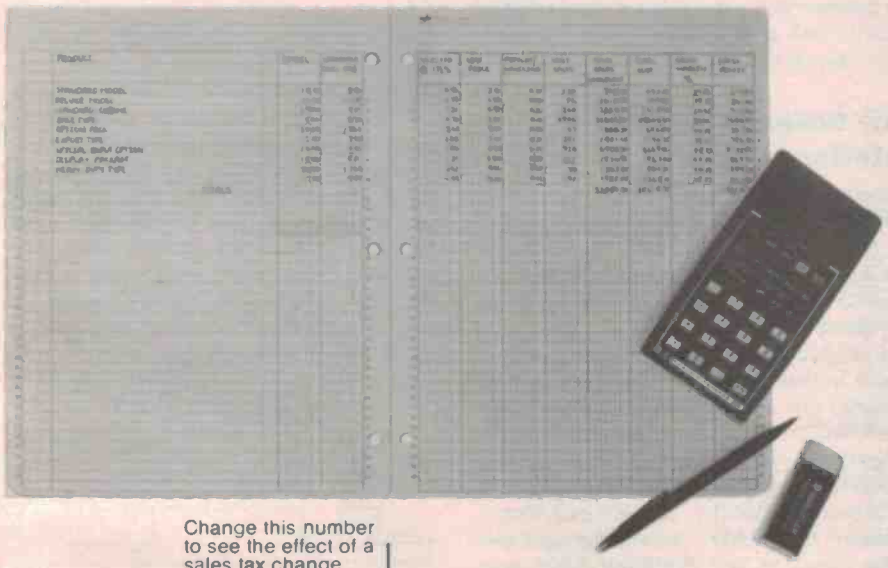
Here's what you should be doing: Multiplan running on a personal computer replaces pencils, paper, erasers, calculators and endless manhours in modelling, estimating and planning activities. Like the example here: if your sales tax rate is 17.5%, you simply put that figure at the top of the sales tax column – Multiplan calculates each product's sales tax value. If a price changes or the tax rate changes, you change one number –Multiplan changes the rest. You see all the results on a spreadsheet 63 columns wide, 255 rows deep and pages thick.

Multiplan is a computer program for non-computer people. Multiplan lets you assign names to cells or areas such as 'sales' or 'expenses', then lets you refer to that name in future formulas. On Multiplan you can have a formula like:
*Profit = Sales – Expenses*
On other spreadsheet programs that would look more like:
*Profit = R1C3 – R5C12*
Multiplan is also the only spreadsheet program capable of colour operation and there are none of the problems with forward reference handling that can cause other programs to give completely spurious answers. Multiplan lets you access data on other spreadsheets and allows multiple windows on the screen so you can see the effects of new entries on other parts of the sheet.

**A friendly system.** Multiplan is specifically designed to eliminate the routine and tedious tasks associated with forecasting, modelling and planning. In designing the program, Microsoft, the world's largest producers of personal computer software, aimed to provide users with an easy-to-use tool which maximizes executive thinking time while minimizing the time required to learn and use the system productively.

Multiplan is available right now for use on Apple™ computers, and will soon be available for use on the Osborne 1™ and standard 8" CP/M™ computers. Versions for other computers are under development.

Call into your nearest computer store and see Multiplan in action – your next forecast need only take you 15 seconds instead of hours.



Change this number to see the effect of a sales tax change

Column widths are individually variable

All dependent variables are automatically calculated to your formula

Simulated screen

Multiplan is expected in stock and the price is correct at time of going to press.

**Multiplan** Apple II version: $295 + tax

from MICROSOFT

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**Wiser-Microsoft**
**PO Box 95, Forestville 2087. Ph (02) 451 9445**

Glover & Assoc. WM/6

# Beating the RS232 blues

A serial interface should be the simplest way to connect two pieces of computer gear together. Unfortunately, RS232 complicates matters.

**Graham Wideman**

ONLY TWO pieces of wire are needed to allow one computer device to talk to another, and three if you want a two-way conversation. So you would think that hooking together computer equipment with serial interfaces would be easy — provided, of course, that the various equipment manufacturers had adopted a standard for their interfaces. And herein lies a problem.

The 'standard' which was adopted for serial interface was one known as 'RS232'. RS232 is a standard of the American Electronics Industries Association, and was originally intended for the interface between 'Data Terminal Equipment' (DTE — in other words a computer 'dumb' terminal) and 'Data Communications Equipment' (DCE — equipment which facilitates communication to a remote computer, like a modem).

The standard specifies the electrical characteristics of the interface signals, along with the shape and pin assignments of the connectors to be used. In addition there are certain other conventions which go along with this standard, like the commonly used data rates and formats.

Now, although it's possible to borrow the electrical and timing conventions from this standard, many aspects are ambiguous. As mentioned above, RS232 specifies two different 'sexes' of equipment, terminal equipment and communications equipment, each with their own sex of connector, and their own connector pin assignments. But the standard is now being applied also to computers, printers, plotters, digitising tablets, speech synthesisers and so on, which don't fall conveniently into the category of either sex. Consequently any particular piece of equipment has a more or less arbitrary sex assignment.

Furthermore, RS232 contains specifications for using its connectors and signals for a large number of different applications. Since today's equipment needs only the simplest of such arrangements, most of RS232's features are not used, and in fact merely add to the confusion as manufacturers arbitrarily select the few features they need for their interface.

OK, the fact that the interface is somewhat arbitrary on any particular piece of equipment would be compensated if the equipment manual told you how it worked. Not the case. In fact the description of how the RS232 interface works is *almost universally the worst described part of the manual,* ranging from extremely ambiguous to downright wrong.

This month I am going to describe the theory of how RS232 is supposed to work. In a following issue I will describe a test unit which will patch any two devices together, and monitor what they are saying. You may wish to build one, or borrow the principles to understand how to test an interface by some alternative method.

## The basics of a serial interface

There are many possible ways to make a serial communications 'channel'; RS232 is just one method. Let us examine serial interfaces in general, and see how RS232 implements the various features involved.

I should point out here that many of these features are not strictly a part of RS232, but are conventions which are used with it. The best way to declare something as a 'convention' is by referring to data on the ICs used to implement RS232 serial interfaces, namely the 'UART' which formats the data (such as the National 5303 and similar), and the 'line driver' and 'receiver' which actually send and receive the electrical signals on the serial cable (National LM1488 and 1489 respectively).

Suppose we are dealing with the simplest type of interface, one in which there is a 'sender' and a 'receiver', such as may be the case where a computer sends data to a line printer. Two wires connect the two devices, one wire being 'Ground' or zero volts, the other wire carrying the data.

## Ones and zeros

The first task is to decide how to represent the binary 'one' and 'zero' as voltages. A TTL logic IC regards a voltage less than 0.4 V as a logic zero, and a voltage greater than 2.8 V as a logic one. A TTL output is not, for various reasons, suited to sending data down a long wire, so RS232 does things differently. A 'zero' is represented by a 'high' voltage between +3 V and +12 V (for some reason also called 'space'), while a 'one' is represented by a 'low' voltage between −3 V and −12 V (also called 'mark'). The range between −3 V and +3 V is undefined.

Next we must decide in what order and with what timing the bits are to be sent down the wire. RS232 calls the unit of data transmission a 'character', even though the data sent may not actually represent a character. A particular device may be set to transmit or receive 5, 6, 7 or 8-bit characters, with seven being the most common (because seven bits will represent the entire ASCII set of 128 characters), and eight the next most popular. These characters are sent *least significant bit first.* Using the scheme as I have so far described it, the letter 'B', which is ASCII 42 hexadecimal, or 66 decimal, would appear on the line as (see also Figure 1):

High low high high high high low
(7-bit code)

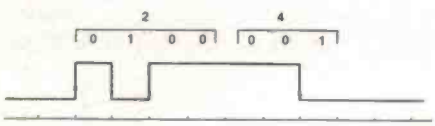


*Figure 1.* The letter 'B' (hex 42) represented as a sequence of voltage levels, as used by RS232 devices.

How does the receiver know when a particular character starts? We could use a third wire to signal that a character is starting on the second wire. This is a form of 'synchronous' communication, and is not used with any personal computer equipment. Instead RS232 has a way of telling the receiver that a character is starting. It works as follows.

## Start bit

Suppose the receiver receives the above letter 'B'. Normally the communications line sits at 'mark' or low. Along comes

bit one, which is a high, and immediately the receiver knows a character is coming in. Now, assuming that the receiver and sender are set so that they agree as to how long each bit is, the receiver will be able to recognise a high, then a low, then another low and so on, until the whole 'B' has been received.

However, suppose that instead the letter 'A' was sent, which is 41 hex, and therefore is represented (also see Figure 2) as:

Low high high high high high low

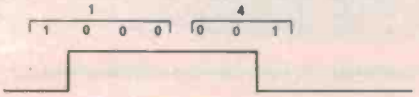


*Figure 2.* The letter 'A' (hex 41) represented in RS232 voltage levels.

This time, by the time the receiver finds out something is happening, it's already on the second bit! And what if you had a character composed entirely of lows?

The way around this problem is to prefix every character with a 'start' bit, which is invariably high.

## Stop bit

This still leaves one problem. Suppose we send several hundred characters in a row. It would be unreasonable to expect that the sender and receiver agree as to the time-per-bit to such great accuracy that they would still be in step after so many bits. To overcome this each character is suffixed with one or two (according to how the devices are set) 'stop' bits, which are always low. After each character we always have a low-to-high transition which can be relied upon to keep the two devices in step.

Notice that there is nothing particularly special about the start and stop bits. They look like any other bits, except that there is always a low-to-high transition at least once per character, and it's between these two bits. I point this out because it means, for example, that if you are sending serial data to a printer, if the signal is momentarily disconnected (transmission continuing but reception interrupted) then upon reconnection the printer will probably not be able to interpret the incoming stream of highs and lows. The printer will be confused until the next pause in transmission, unless the combination of received characters enables the printer to determine where the stop-start location is.

## Transmission speed: 'Baud Rate'

Naturally, both sender and receiver must be set to the same nominal communications speed. This speed is measured in bits-per-second, a unit also known as the baud. (One bit per second is one baud.) Commonly used rates are: 110 and 133 (for Selectric terminals, for example), 300 baud (modems communicating via telephone), 600, 1200, 2400, 4800 and 9600 baud. Some devices also communicate at 19 200, 38 400 and even 76 800 baud, but such are rare.

## Parity

An embellishment which is occasionally seen is the use of 'parity' as an error checking method. In a seven-bit code, for example, an extra bit may be added after the last bit (but before the stop bit). The sender counts the number of 'one' bits in the character, and if the answer is even it sets the parity bit to 'one', if not it is made 'zero'. (This is the even parity convention. There's an equally little-used odd parity convention which makes the parity bit 'one' for an odd total.)

When the receiver gets the character it does the same arithmetic and compares its answers to the parity bit received with the character. If it has the same answer it knows all is well; if the answer is wrong an error has occurred somewhere. For example, suppose an 'A' is transmitted (seven-bit, even parity). This would be represented as in Figure 3.

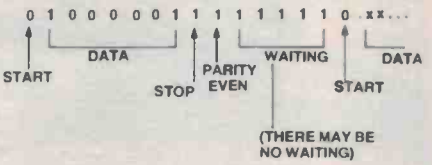


*Figure 3.* Representation of the letter 'A' in seven-bit even parity code. Note that a '1' is a low voltage and a '0' is a high. The line normally sits at low or '1'.

Now if one of those bits were accidentally changed somewhere along the way, there would be either one or three '1's, which is an odd number and does not agree with the parity bit. (And of course if the parity bit was accidentally changed, it wouldn't agree properly either.) You can probably see that this scheme cannot show where the error occurred or how to fix it, nor does it signal double errors. It is basically a low-overhead warning device.

In fact parity is generally ignored, since most personal computer equipment is not operated in electrically noisy environments where such errors are likely to occur, and in any case such equipment has no convention for requesting that the sender resend the faultily received data. (Often the receiving device may be set to expect the parity bit but not use it.) However, I have included this description so that you know what parity is when the equipment has a switch to select or deselect its use.

## Lots of options!

As you can see, even thus far there are plenty of options to choose from. In a typical device many of these options may be switch selectable, usually miniature DIP switches inside the box, or perhaps soldered jumpers. In some cases, such as terminals and computers, some of these features may be programmed from the keyboard or from software.

So there are plenty of ways in which your two little darlings won't be able to talk to each other! But wait, there's much more!

## How many duplexes?

Although not strictly of direct concern in the RS232 interface, some equipment, particularly terminals and modems, provide a 'Full/Half Duplex' switch.

'Full Duplex' means that when the terminal transmits a character to the remote computer the computer immediately echoes the character back to the terminal, whereupon it appears on the terminal's screen (or paper, if a teletype). If there is no echo then the character you typed will not appear on the terminal's screen. This is a kind of insurance method to let you know that the computer is listening.

In 'Half Duplex' set-ups it is assumed that the computer will not echo the characters from the terminal, and thus the terminal puts the typed characters on the screen whether or not the computer is awake.

The surprise comes if you have your terminal (or modem) set to Half Duplex, *and* the computer you are talking to echoes the characters. Then if you type 'FRED' you'll see 'FFRREEDD'.

## Not so fast!

A commonly needed feature is the ability to tell the sending device to slow down. I don't mean to send at a lower baud rate, but rather to pause for a moment. A typical situation where this occurs is in slow printers. When the carriage reaches the end of the line the printer must tell the sender to wait until the carriage returns before sending more characters.

Such a signalling system is known as 'handshaking'. Typically this is implemented by adding an extra wire to the interface cable. The receiver maintains this wire at a 'high' signal level while it's OK for the sender to send, pulling it 'low' to tell the sender to halt the flow of data. Sometimes an interface will have handshaking lines both ways, so that either device can halt the other.

A complete two-way interface would consist of two data wires, two handshaking wires and ground — a total of five ▶

wires. Most RS232 hook-up problems occur because one piece of equipment needs some of these signals which the other does not provide, or because the wires in each piece of equipment are not connected to the corresponding pins in the interfacing connectors.

## Not so fast type two

A quick note here that on some intelligent printers handshaking is carried out using a method called 'X-on, X-off'. Instead of a separate handshaking wire, the printer has a data output wire (normally printers only receive data). If the printer wishes to halt the sender the printer sends a control character to the sender (usually control-S, hex 13, which is also known as 'Direct Control 3'). Subsequently sending the same character will restart the data. Note that this is the same character which you use in CP/M (and Apple) to stop and start a continuous display to the screen from the keyboard.

## Handshaking and buffers, etc

How necessary is handshaking in practice? A major sore point in the small computer industry has been the need for handshaking in printers. The Epson MX-80, for example, was available at one time with a serial interface known as 8141. This interface could only remember a maximum of two characters as they arrived from the computer. Since the 'line-feed' time exceeds the time of two characters, even at the slowest baud rates it was necessary for the interface to signal a halt after each line. The Exidy Sorcerer and the standard Apple printer interface board do not have any handshaking inputs, and consequently it would be impossible to make this combination of equipment work serially. (This particular problem rarely comes up since the MX-80 has a parallel input which is usually used. The Sorcerer has a parallel output, and the Apple has available for it a parallel printer board. I am simply showing how close to the surface such problems are swimming.)

A solution to this dilemma which is finding widespread adoption is to incorporate a 'buffer' into the serial interface. Such is the Epson 8145 interface, which has a 2000-character (approx.) buffer. Since the MX-80 chugs along at 80 characters-per-second (cps), if the computer transmits at 300 baud (30 cps) the buffer is normally virtually empty. At line-feed time the buffer fills up a little as the computer continues to transmit. But the MX-80 catches up on the next line. There is thus no need for handshaking. You can, however, get into trouble if the computer sends a large number of form-feeds, which take a long time.

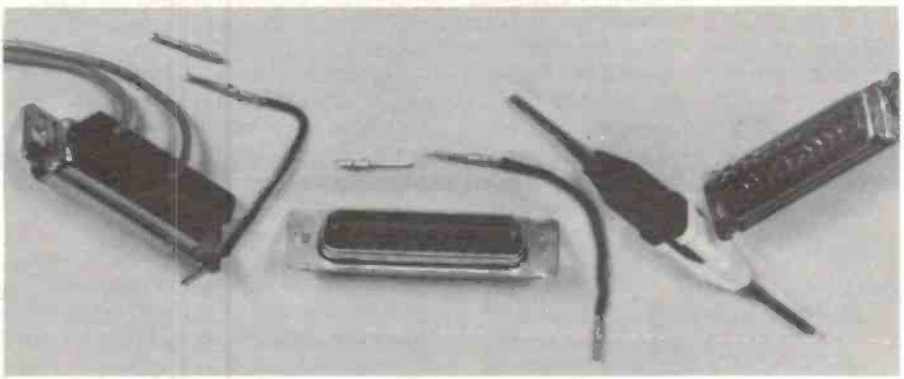

*Figure 4.* Photo showing two different styles of RS232 connectors. In each case the individual wires are soldered to the connector pins or receptacles.

To the left is a connector which comes with all the pins or receptacles permanently fixed in place; wires are soldered into 'cups' on the rear, which is the side in view here.

In the centre and to the right are shells which come 'empty', into which may be inserted male pins (into centre shell) or female receptacles (right). These can be more convenient, as the pins (shown separately and attached to wires) are easier to wire to before being placed in the shell, and in fact when installed are well separated by the shell (as can be seen in the rear view of the female connector on the right). The tool on the left is for the installation or removal of the male and female contacts.

In each case the connector may be bolted to a chassis, or put in a plastic cover for use as on the end of a cable.

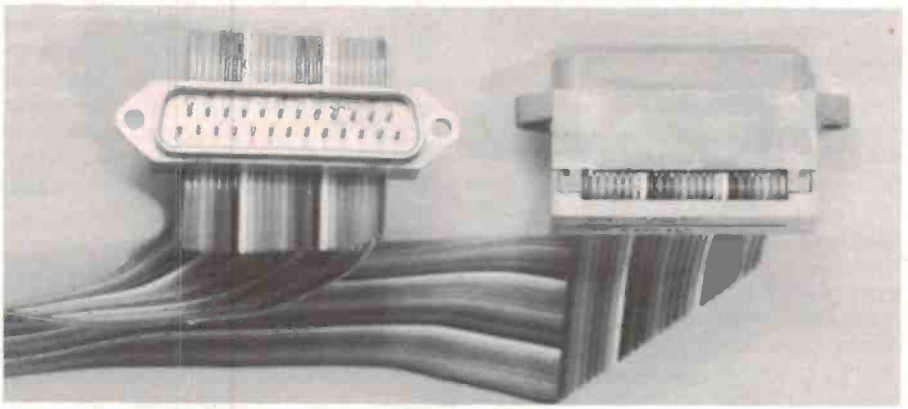

*Figure 5.* These are called 'Insulation Displacement Connectors' (IDC) and of course must be used with ribbon cable. They can only be used if it is desired to connect all 25 pins at one end to all 25 at the other. However, they are very easy to install; all that is needed is a small vice to squash the connector onto the ribbon.

## Wires and connectors and stuff

The connector used with RS232 is known as a 'DB25', which has 25 pins in the male, and 25 receptacles in the female. Various styles are shown in Figures 4 and 5, with pin numbering shown in Figure 6. But why 25 pins?

RS232 was endowed with a pile of features not now used, and these were implemented using many of the 25 pins. Now very few of the pins are used. The extra pins provide two opportunities for confusion and problems, however. One problem is that with such a profusion of pins it can be difficult to figure out which ones you are supposed to use for your application.

'Business end' of male, or solder side of female.

1 2 3 4 5 6 7 8 9 10 11 12 13
14 15 16 17 18 19 20 21 22 23 24 25

'Business end' of female, solder side of male.

13 12 11 10 9 8 7 6 5 4 3 2 1
25 24 23 22 21 20 19 18 17 16 15 14

IMPORTANT NOTE: This numbering scheme means that with the IDC connectors the pin numbers do *not* correspond to the ribbon conductor numbers; 1 will be 1, but pin 14 will be ribbon conductor 2, etc.

*Figure 6.* DB25 contact numbering.

The second problem area is that with all those extra tantalising pins available and otherwise doing nothing, many manufacturers use the 'spare' pins for other purposes. Exidy uses them for the cassette interface. IDS, in their Paper Tiger printers, use the same DB25 for both serial and parallel interfaces.

| 'Official' Signal Name | Abbrev(1) | Pin No. | DTE 'Terminal' | DCE 'Modem' | Comments |
|---|---|---|---|---|---|
| Protective ground | PG | 1 | — | — | Optional |
| Signal ground | SG | 7 | — | — | Necessary |
| **Data:** | | | | | |
| Transmitted data | TxD | 2 | Out | In | |
| Received data | RxD | 3 | In | Out | |
| **Handshaking:** | | | | | |
| Request to send | RTS | 4 | Out | In ) | Basically |
| Data terminal ready | DTR | 20 | Out | In ) | same use |
| Clear to send | CTS | 5 | In | Out ) | Basically |
| Data set ready | DSR | 6 | In | Out ) | same use |
| **Connector Sex:** | | | Male(2) | Female | |

(1) Note that the handshaking lines are sometimes indicated as inverted signals (e.g: DTR). The idea is that if for the data a low is a '1', then if the data terminal is ready it should send out a '1'. In fact it sends out a high, which corresponds to a zero, hence the desire to use inverted signal notation. This refers, however, to the identical signal. In contrast there is the rare occasion when the equipment actually does put out an inverted signal, i.e: low means ready, high means not ready. Yeah, I know, but don't complain to me!

(2) In fact almost all terminals use female chassis-mount connectors. (A notable exception is the Heathkit H19.) It seems that it is almost standard practice to use females on equipment chassis, and male on cables (except for much DEC equipment, which uses male chassis mounts on equipment, and female connectors on cables). Note that this means you can't tell the DTE/DCE gender from the sex of the connectors.

*Figure 7.* **Table of signals, what they do, and connector pin assignments.**

That's fine except that if between such units you use a cable with too *many* wires implemented (and this can easily be the case if you use a standard RS232 cable in a set-up which does not use handshaking) then you are likely to blow something at one or both ends!

The pins which *are* commonly used are shown in Figure 7. Note that the naming convention can result in a variety of confusions. If the equipment is masquerading as a DCE the manual may tell you that, for example, pin 2 is 'Transmitted Data', which strictly speaking is an *input*. However, the manual writer may not know this and instead call it 'Received Data', intending 'Received' in a looser sense.

## Fighting back

The first thing to do before connecting *anything* is to make yourself a chart like the one in Figure 8 for each piece of equipment you may have to connect together. This is *especially* important if you are involved with many different units. I have a whole binder full of such charts on the equipment I work with. Using this binder I can almost instantly connect any two units with few problems.

The point to this chart is that for each of your pieces of equipment (and I assume you're working with at least two!) it serves to collect the titbits of information you will glean from the manuals, the schematic and so on. You end up with the info in the same format for each unit, where it can be simply compared to give you the best idea of how to wire things up *before* you blow anything, and before you have the frustrating experience of having the system not work.

If handshaking lines are provided, try to find out if they actually do anything, or if they are dummies. For example, one printer may have an output which signals the sending computer to halt. Another printer may claim to have the same handshaking output, but it is actually internally wired permanently high, and is provided merely for supposed compatibility to a computer which may need such an input so as not to halt. Got that?!

## Wiring up the cable

You will notice that if one of your units is a true DTE and the other a true DCE then a standard cable (pin 1 goes to pin 1, 2 to 2 and so forth, which is called a 'straight-through') will work. You are unlikely to see this situation very often, which is something you should know before you buy such a cable made up (they're likely to be expensive ready-made), or before you get convinced by the salesman that the printer hook-up is trivial.

So you decide to wire your own cable. First, of course, you must obtain the appropriate sexes of connectors to mate with what you have on the equipment, and a cable with a sufficient number of conductors. If it's over 20 feet you may wish to use shielded cable, but I've used unshielded up to several hundred feet. ▶

| PIN NO. | SIGNAL ABBREV. | SIGNAL NAME | IN/ OUT | OPEN OK? | COMMENTS |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |
| 10 | | | | | |
| 11 | | | | | |
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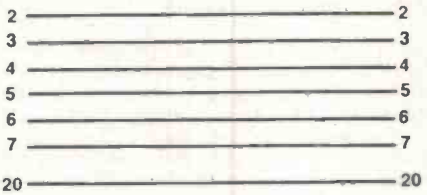
| 19 | | | | | |
| 20 | | | | | |
| 21 | | | | | |
| 22 | | | | | |
| 23 | | | | | |
| 24 | | | | | |
| 25 | | | | | |

EQUIPMENT TYPE: CONNECTOR SEX ON EQUIPMENT: DATE:

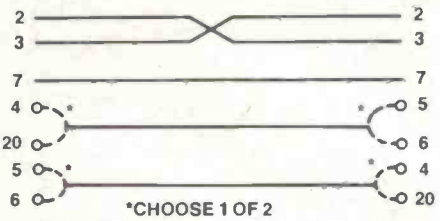
*Figure 8.* **Interface chart to save you headaches.**


*9a.* The simplest possible cable, opposite sexes and no handshaking.

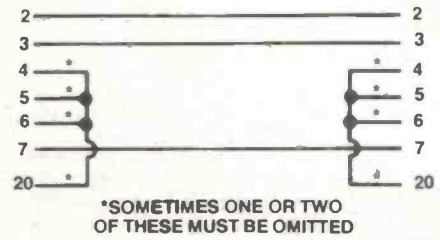

*9b.* The next simplest cable, DCE to DCE or DTE to DTE, and still no handshaking.




*9c.* Cable to join opposite sexes with handshaking. ('Standard' straight-through cable.)




*9d.* Joining same sexes with handshaking (one possibility).




*9e.* Joining opposite sexes, with defeated handshaking at both ends.

*Figure 9.* Some typical cable hookups.

Next, no matter what the equipment involved, wire pin 7 to pin 7. If it's a straight-through you are making, then go right ahead, 2 to 2, 3 to 3, etc.

The next-most-delightful situation is where the two units are of the same sex and need no handshaking lines. For the data lines simply wire 2 to 3 and 3 to 2.

If handshaking lines *are* needed then determine which handshaking outputs actually mean something (as opposed to the dummies). Then connect these to the handshaking inputs of the opposite units.

You may have a sender which is sending to a receiver which does not need to halt the sender. If this is the case you need to decide what to do with the sender's handshaking input. In some units it can merely be left open (unconnected), and this is seen as the same as 'high'. On other units open is taken as a 'low' and halts transmission. The handshaking input may be wired permanently high by jumpering it to a handshaking *output* on the *same device*. This is normally done inside the plug on that unit's end of the cable. Figure 9 shows some typical cable configurations.

## The initial hook-up

Armed with the appropriate (we hope) cable, plug in and see if it works! It probably won't, so refer to Figure 10, which is a summary of all the things to check to make the two pieces of equipment compatible communicators.

## A test box to defeat all problems

So perplexing are some RS232 problems which I have encountered that I highly recommend obtaining a test unit of some kind if you are going to be involved with many such situations. In the next part of this article we intend to present details of a device which is designed to handle these problems, and which also permits quickly patching together any trial interface configuration. Unlike commercial units, it will even enable you to determine the inputs and outputs of a completely unknown interface with no documentation. ●

1. Number of **bits per character**: 5, 6, 7, or 8.
2. Number of **Stop bits**: 1 or 2.
3. **Baud Rate:** 110, 150, 300, 600, 1200, 1800, 2400, 4800, 9600 or other.
4. What to do with **Parity**:

   On transmission: No Parity, Even Parity, Odd Parity, Parity bit set to 0, or Parity bit set to 1.
   On reception: No Parity expected, Ignore Parity, Expect Odd, or Expect Even.
5. **Full** or **Half Duplex**.
6. Make sure machines are On **Line** if they have the ability to be off line.
7. A rather rare final item which can cause problems is an option on a few machines which allows for the inversion of the polarity of the data signals and/or handshaking signals. You should set these to: Negative Mark for the data lines, and handshaking lines should indicate OK to proceed with a high level, STOP with a low level.
8. What to do with a system which can't be made to work after all this is the subject of next month's article.

*Figure 10.* **List of quick checks to make when hooking up two pieces of gear for the first time.**

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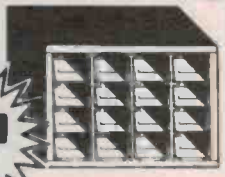

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| 0-1A | $10.00 | $9.00 |
| * 50uA | $ 6.50 | $5.90 |
| * 100uA | $ 6.50 | $5.90 |
| 0-50uA | $ 6.50 | $5.90 |
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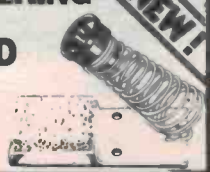

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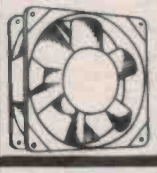

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| 10000 | 40V | $11.50 | |
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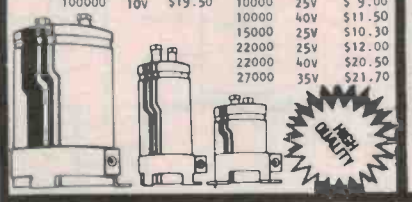
| 22000 | 40V | $20.50 | |
| 27000 | 35V | $21.70 | |



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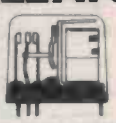

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# Turtle robot — interface fundamentals

**Allan Branch**
Flexible Systems, Hobart, Tasmania

This article covers the fundamental principles involved in interfacing the Minimum Turtle robot to a computer. A table of relevant interface connections for some popular microcomputers is included.

IGNORING SERIAL interfaces, parallel user data busses can be divided into three types:

a. Bidirectional (the most common on micros):
D0 I/O ⟷
D1 I/O ⟷
D2 I/O ⟷
D3 I/O ⟷
D4 I/O ⟷
D5 I/O ⟷
D6 I/O ⟷
D7 I/O ⟷

b. Unidirectional (e.g: S100):

| | | |
|---|---|---|
| DI0 | ⟵ | DO0 ⟶ |
| DI1 | ⟵ | DO1 ⟶ |
| DI2 | ⟵ | DO2 ⟶ |
| DI3 | ⟵ | DO3 ⟶ |
| DI4 | ⟵ | DO4 ⟶ |
| DI5 | ⟵ | DO5 ⟶ |
| DI6 | ⟵ | DO6 ⟶ |
| DI7 | ⟵ | DO7 ⟶ |

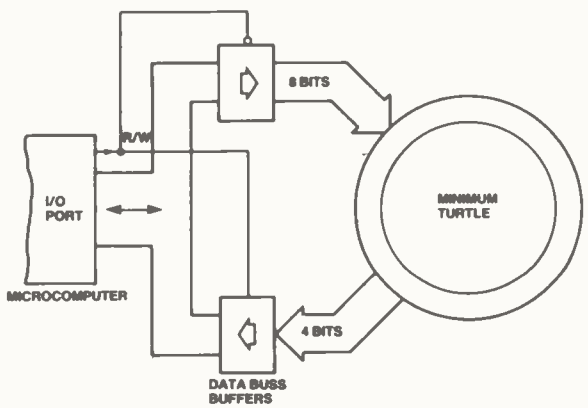
c. Interface adapted PIA, VIA, etc (e.g: PET):

| | | |
|---|---|---|
| PA0 | ⇄ | PB0 ⇄ |
| PA1 | ⇄ | PB1 ⇄ |
| PA2 | ⇄ | PB2 ⇄ |
| PA3 | ⇄ | PB3 ⇄ |
| PA4 | ⇄ | PB4 ⇄ |
| PA5 | ⇄ | PB5 ⇄ |
| PA6 | ⇄ | PB6 ⇄ |
| PA7 | ⇄ | PB7 ⇄ |

Each of these should be treated separately, since different circuitry is needed to interface each to the Minimum Turtle. Complete interface circuitry is shown at the end of this discussion.

## Bidirectional data buss

The Turtle robot has separate in/out control lines, and these have to be suitably connected to allow a microcomputer with a bidirectional data buss to drive it.

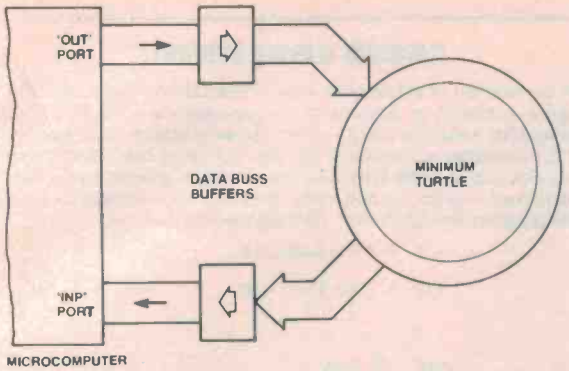



General interface technique where your microcomputer has a bidirectional I/O port.

Suitable high-impedance buffering controlled by the read-write signal from the microcomputer is the simplest way of facilitating this type of port.

## Unidirectional buss

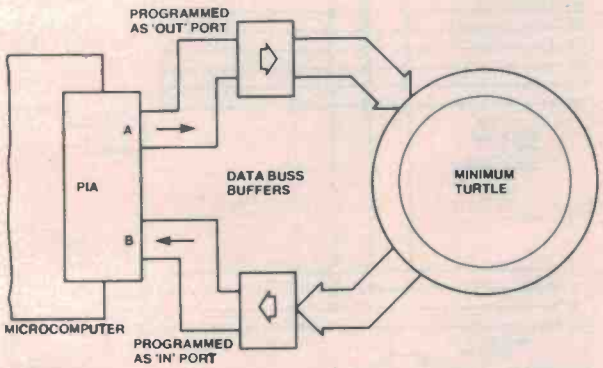
This type of data buss is already configured appropriately for the Turtle. Buffering is still recommended, as the Turtle cable is a long parallel ribbon type.



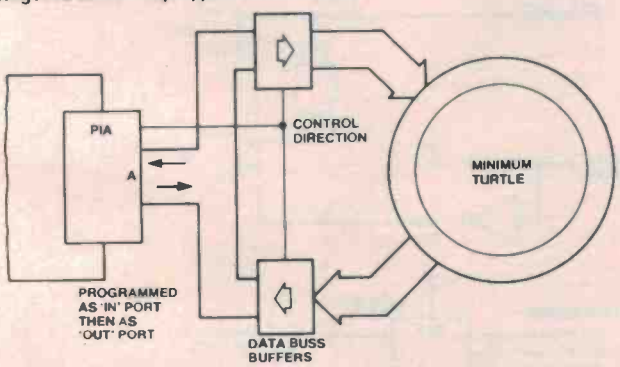

General interface technique where your microcomputer has a unidirectional data buss structure — one input and one output port.

## Interface adapted

Many semiconductor manufacturers supply special integrated circuits designed to support user parallel ports. These are called by various names, such as peripheral interface adaptor (PIA), variable interface adaptor (VIA), programmable peripheral interface (PPI), etc. They usually supply two or more eight-bit ports which can be configured in many different ways. Various registers within the IC control the direction of each bit of the port according to the data stored in them, and this data must be programmed prior to using the ports (e.g: ETI-685). These ports can take on the identity of both bidirectional and unidirectional ports with appropriate programming.




One method of using an 'interface-adapted' I/O scheme, where port A is configured as the output, port B as the input.




Another method of using an interface-adapted I/O. Here, one port is programmed first as an 'in' port, then as an 'out' port.

Although the configuration shown in Figure 4 would be slower and require more programming, some computers have a single PIA with one port already used (keyboard, cassette, etc), and only one port is available for the user (e.g: SYM).

## Device request

It is necessary for the Turtle to be 'called up' so that it knows what data to respond to and what to ignore.

Many computers provide a pin on their port called variously device request, device select, I/O request, peripheral enable, etc, and this can be used to address the Turtle directly. In some cases further addressing might be needed to supplement the device request signal.

Other computer ports have no special device request signal and one has to be generated from the address buss or some other means. The IEEE port, for example, uses the data buss for both data and address information. The ATN (attention) signal in this case calls up all peripherals (including the Turtle), and indicates that the data is actually an address.

## Read-write

Not only does the port have to address the Turtle and supply data, it also has to receive data from the Turtle sensors. The read-write signal at the port is used to indicate and control the direction of data flow.

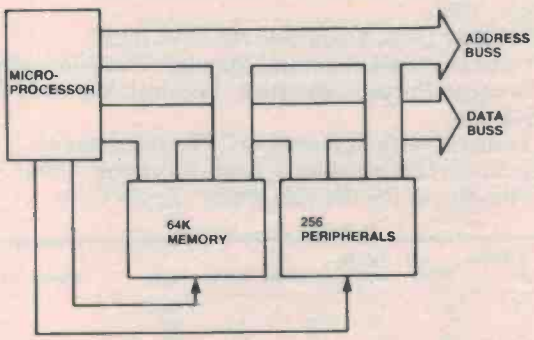
This signal can have various configurations, and is most often one of the following:

1. Read/write — a single line on which each polarity (0, 1) represents a direction of data flow.
2. Read / Write — two lines, each activating one direction of data flow.

The polarity (active high, active low) can vary, and with some microprocessors different signals for memory and peripherals can exist.

## Memory mapping vs. port based

Some microprocessors offer facilities to treat peripheral devices separately from the system memory.

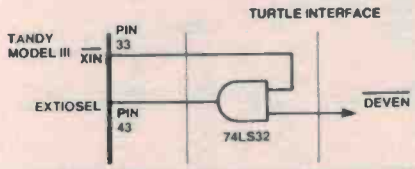



The user of these systems has the choice of allowing the Minimum Turtle to occupy part of memory space (by giving the Turtle a single address between 0 and 65536) or to let the Turtle be designated a particular peripheral number, called a port number. Different instructions in programming will then be used, depending on the choice (e.g: TRS-80).

In BASIC:

| | Memory mapped | Port based |
|---|---|---|
| To Turtle | Poke (Turtle address), (data) | OUT (T.A.), data |
| From Turtle | Peek (Turtle address) | INP (T.A.) |

On the Tandy Model III a special handshake is necessary:




The port then has to be enabled by a special OUT instruction (see Tandy manual). ▶

## Further reading


1. *Artificial Intelligence,* Patrick Henry Winston, Addison-Wesley Publishing Co. Inc.
2. *The Psychology of Learning,* Robert Borger and A.E.M. Seaborne, Penguin Books.
3. *Cognition and Reality,* Ulric Neisser, W.H. Freeman & Co.
4. *Computers and the Cybernetic Society,* Michael A. Arbib, Academic Press.
5. *As Man Becomes Machine,* David M. Rorvik, Souvenir Press.
6. *Science Fact,* Ed. Prof. Frank George, Topaz Records Ltd.
7. *Technological Change — Impact of Information Technology,* 1981, Australian Government Publishing Service.
8. *Analysis of Vertebrate Structure,* Milton Hildebrand, Wiley International Edition (brilliant treatise on animal movement).
9. *The Psychology of Computer Vision,* Ed. Patrick Henry Winston, McGraw-Hill Book Co.
10. *Problem-Solving Methods in Artificial Intelligence,* Nils J. Nilsson, McGraw-Hill Book Co.
11. *Artificial Intelligence,* Brumby.
12. *Robots, Fact, Fiction, Fantasy,*
13. *Mindstorms,* S. Papert.


## References


1. 'Apple II Reference Manual', Apple Computer Inc.
2. 'Apple I/O Card Documentation', University of Wollongong, reprint no. 80/8. Phillip McKerron.
3. 'The PET Revealed', Nick Hampshire, 1980.
4. 'Dick Smith System 80 Technical Manual', issue no. 1, Nov. 1980.
5. ETI May 1980: 'Update on the S100 Buss'
6. 'Tasman Turtle Technical Manual', Flexible Systems.
7. 'General Purpose Interface Techical Manual', Flexible Systems.
8. 'Tasman Turtle Information', Flexible Systems.
9. National Semiconductor 'Logic Databook', 1981.
10. 'TRS-80 and the Outside World', Tandy Corp.


| | SYSTEM 80 | TRS-80 | TRS-80 MOD.III | TRS-80C | APPLE II | S100 | | IEEE488 | PET |
|---|---|---|---|---|---|---|---|---|---|
| A0 | 10 | 25 | 17 | 19 | 2 | 79 | | | |
| A1 | 7 | 27 | 19 | 20 | 3 | 80 | | | |
| A2 | 9 | 40 | 21 | 21 | 4 | 81 | | | |
| A3 | 8 | 34 | 23 | 22 | 5 | 31 | | | |
| A4 | 6 | 31 | 25 | 24 | 6 | 30 | | | |
| A5 | 5 | 35 | 27 | 25 | 7 | 29 | | | |
| A6 | 4 | 38 | 29 | 26 | 8 | 82 | | | |
| A7 | 3 | 36 | 31 | 27 | 9 | 83 | | | |
| A8 | 22 | 11 | | 28 | 10 | 84 | | | |
| A9 | 24 | 17 | | 29 | 11 | 34 | | | |
| A10 | 26 | 4 | | 30 | 12 | 37 | | | |
| A11 | 28 | 9 | | 31 | 13 | 87 | | | |
| A12 | 29 | 5 | | 37 | 14 | 33 | | | |
| A13 | 27 | 6 | | 38 | 15 | 85 | | | |
| A14 | 23 | 10 | | 39 | 16 | 86 | | | |
| A15 | 21 | 7 | | | 17 | 32 | | | |
| | | | | | | in | out | | |
| D0 | 15 | 30 | 1 | 10 | 49 | 95 | 36 | 1 | 1 |
| D1 | 14 | 22 | 3 | 11 | 48 | 94 | 35 | 2 | 2 |
| D2 | 12 | 32 | 5 | 12 | 47 | 41 | 88 | 3 | 3 |
| D3 | 16 | 26 | 7 | 13 | 46 | 42 | 89 | 4 | 4 |
| D4 | 20 | 18 | 9 | 14 | 45 | 91 | 38 | 13 | A |
| D5 | 11 | 28 | 11 | 15 | 44 | 92 | 39 | 14 | B |
| D6 | 18 | 2 | 13 | 16 | 43 | 93 | 40 | 15 | C |
| D7 | 17 | 20 | 15 | 17 | 42 | 43 | 90 | 16 | D |
| D.S. | 38 | | 49($\overline{IORQ}$) | 32($\overline{IORQ}$) | 41 | | | 11 | 11(ATN) |
| RD | 41 | 19(IN) 15(RD) | | | | 78 | | | |
| WR | 40 | 12(OUT) 13(WR) | 35 | 18 | 18(R/W) | 77 | | | |
| IRQ | 31 | 21 | | | 30 | 73 | | 10 | 10(SRQ) |
| RESET | 46 | 2 | | | 31 | 75 | | 9 | 9(IFC) |
| WAIT | 37 | 33 | | | 21 | 72 | | 8 | 8(NDAC) |
| GND | 1,2,49,50 | 8,29,37 | 50 | 33,34 | 26 | 20,50,53 70,100 | | 18-24 | F-N |
| +5V | 19 | 39 | | 9 | 25 | | | | |
| +12V | | | | | 50 | | | | |

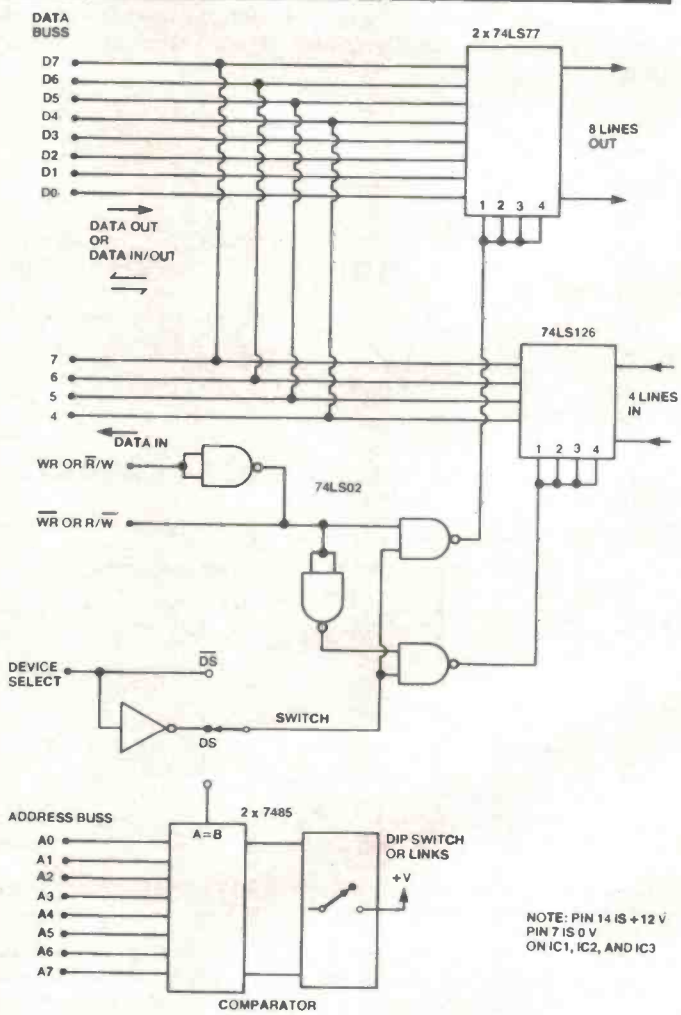
Table showing expansion connector pins and signals for various popular microcomputers.

## RANDOM TURTLE SCRIBBLE

With the addition of a few extra lines to Phil Cohen's Random Turtle Walk program, published on page 51 of the June issue, you can have the Turtle drawing while it wanders about — hence the word 'scribble' in the heading.

I have added two subroutines to the original program, one to lower the pen and one to pick it up when the Turtle executes a 'back off and turn' routine during the random walk — which can occur when the sensors are activated or as decided by the program from time to time. Here are the additional lines:

```
135  A = 5: GOSUB 610
165  A = 5: GOSUB 660
 .  .  .  .
610  REM DRAW
620  ARR(A) = 1
630  GOSUB 320
640  POKE W,OUT
650  FOR I = 1 TO 100: NEXT I: RETURN
660  ARR(A) = 0
670  GOSUB 320
680  POKE W,OUT
690  RETURN
```




Suggested arrangement of an interface for the Minimum Turtle which can attach to any computer expansion interface that provides access to the appropriate lines. You can obtain 'device select' from a device select line or decode it from the address buss — hence the switch. Read and write signals are then gated with the device select to steer data in or out of the interface appropriately.

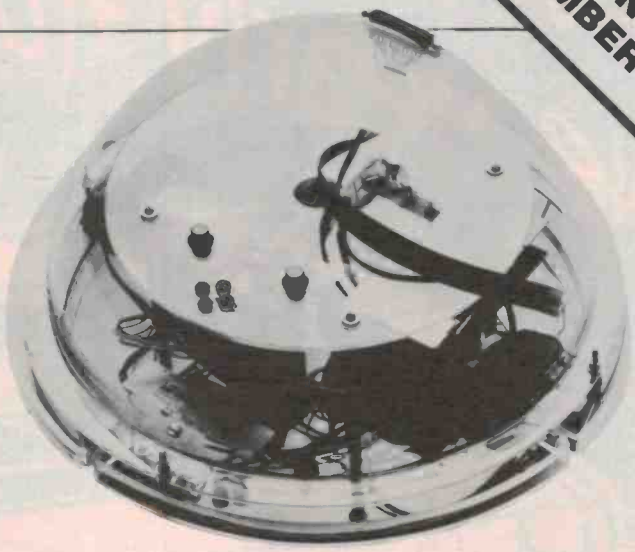
# TASMAN TURTLE ROBOT KIT

SPECIAL OFFER
OFFER EXTENDED TO SEPTEMBER 30

## EXCLUSIVE TO ETI READERS

**Special Offer Price: $349.00**
**(tax exempt: $297.00)**
**plus $6 post and handling (inc. registration).**

This product has never previously been offered as a kit and would normally retail for around $600.



## OFFER CLOSES SEPTEMBER 30

Here is a not-to-be-missed opportunity to get started in robotics. For minimum cost this kit will provide you with the basic equipment to construct a robot which can be driven by remote control, electronic hand control or under computer control. Called the 'Minimum Turtle Kit', it has been put together by Flexible Systems of Hobart, Tasmania, manufacturers of the Tasman Turtle (see Printout, page 82, February ETI). Using this kit as a start you can develop a sophisticated robot capable of a huge variety of tasks.
The complete Minimum Turtle Kit comes ready for assembly according to the construction description published in ETI, packed in a box which has been designed so that the Turtle may be housed or stored in it after assembly.

### HOW TO PURCHASE A MINIMUM TURTLE KIT

Fill out the coupon here and include a cheque or money order for a total of $355. Make out the cheque or money order to 'Flexible Systems, Turtle Kit Offer', and post it, together with the coupon, to:

**ETI/Turtle Robot Kit Offer**
**ETI Magazine**
**15 Boundary St**
**Rushcutters Bay NSW 2011**

The orders will be processed by ETI and, on clearance of the cheque or money order by Flexible Systems, the kit will be despatched directly to you by ETI via registered post.

**Alternatively:** You may call in to ETI's Sydney or Melbourne offices at the addresses given below and purchase a Minimum Turtle Kit for $349. A demonstration kit and/or model will be available for inspection during this offer.

**Sydney:** ETI, 4th Floor
15 Boundary St
Rushcutters Bay

**Melbourne:** Murray Publishers, 22nd Floor
150 Lonsdale St
Melbourne

**Tax exemption:** For schools, TAFEs, etc. this kit can be purchased at the tax exempt price only if the coupon is accompanied by a signed order and a tax exemption declaration.

**NOTE: This offer is made by Flexible Systems in co-operation with ETI Magazine. ETI is acting as a clearing and despatch agent for orders. All mail orders will be despatched by registered post. Please allow four to six weeks for delivery.**

### DEMONSTRATIONS: see the Turtle — live!

**Sydney:** at ETI's office, 4:30 — 6:00 pm, Monday to Thursday.
Apple II computer supplied for demonstrations courtesy Imagineering Pty Ltd.

**Melbourne:** at city office, by appointment.
Apple II computer supplied for demonstrations courtesy Computer Country Pty Ltd.

### WHAT YOU CAN DO WITH IT

You can use your Minimum Turtle to experiment with many aspects of robotics by interfacing it with a computer: draw figures under program command, solve mazes, make measurements, identify objects, etc, etc. It can be driven via a cable or a remote control. The Minimum Turtle has been designed so that a wide variety of add-on projects may be included to increase the sophistication as you desire.

### THE MINIMUM TURTLE KIT CONTAINS:

- **All hardware (base, nuts and bolts, perspex dome, 'touch' ring, pen solenoid, speaker, etc)**
- **All mechanical parts (wheels, gears, axles, two stepper motors, etc)**
- **'Standard Turtle' electronic control pc board and components**
- **All wire and cable for internal wiring**
- **A 25-pin plug for bidirectional data buss, control lines and power supply connections**
- **Comprehensive instruction manual**

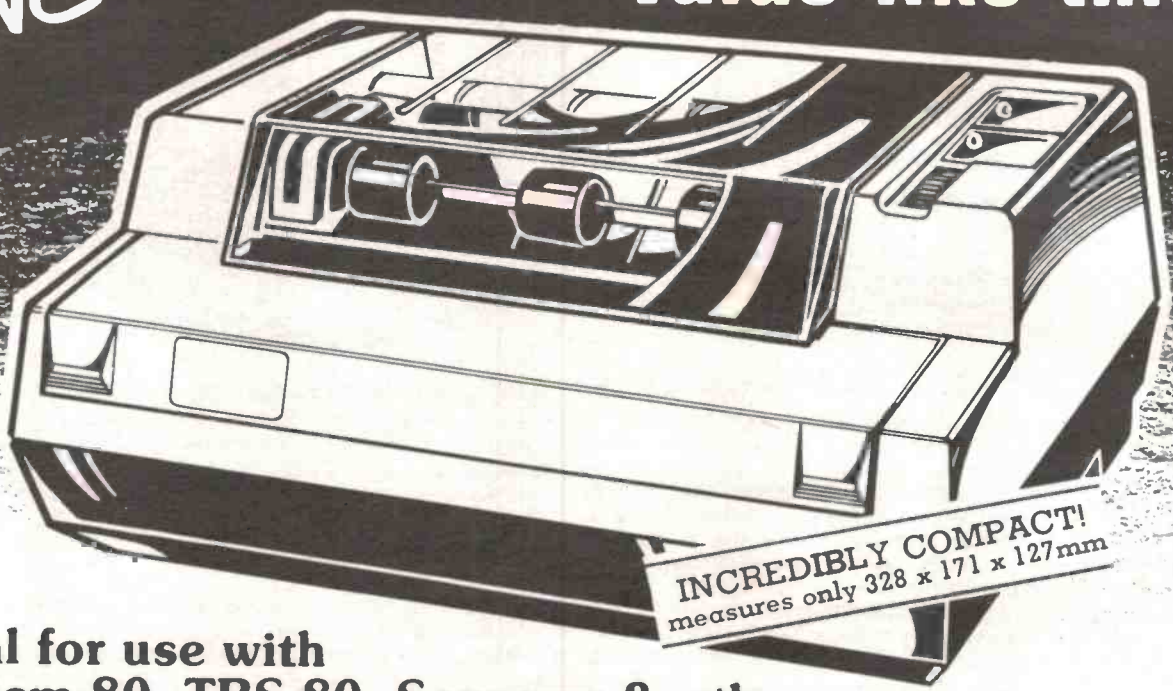
*Tasman Turtle is a registered trademark of Flexible Systems.

**COUPON**

Please supply ..... Minimum Turtle Kit(s)
I enclose $ ..... plus $6 each postage (inc. registration).
TOTAL $ .....
Name .....
Address .....
..... Postcode .....
Cheque or Money Order No .....
Signature .....
(please allow four to six weeks for delivery)

# Dot Matrix Printer save nearly $100!

# who else but DICK SMITH could offer value like this?




## Ideal for use with System 80, TRS 80, Sorcerer & other computers

Up until now you would expect to pay around $1,000 for a dot matrix printer. We've changed all that with the release of this compact 80 column tractor-feed impact printer.

ONLY **$399**

SAVE NEARLY $100!

WAS ~~$495~~!

### look at these features:

- Full 80-column printing
- Tractor-feed as standard
- Printing at 30 characters/second
- High-resolution graphics printing
- Standard Centronics-type parallel interface
- Compact size: only 328 x 171 x 127mm

**Cat. X-3252**

Optional cable required for connection of printer to computer. Type depends on computer.

**OUR MOST POPULAR PRINTER EVER!**

**Fan Form Paper**
2,000 sheets continuous fan form paper to suit printer
**Cat. X-3254** **$27.50**

**Replacement Ribbons**
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# DICK SMITH Electronics

**See Page 144 for address details**

DSE/A181M/PAI

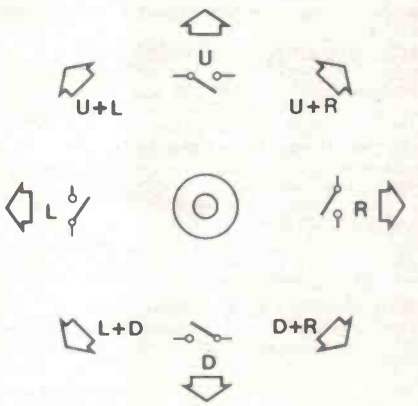
Project 652

# Atari-type joystick interface for the System 80

This simple add-on interface attaches to the System 80 expansion connector and permits attachment of an Atari-type joystick for graphics or games control.

**Geoff Nicholls**

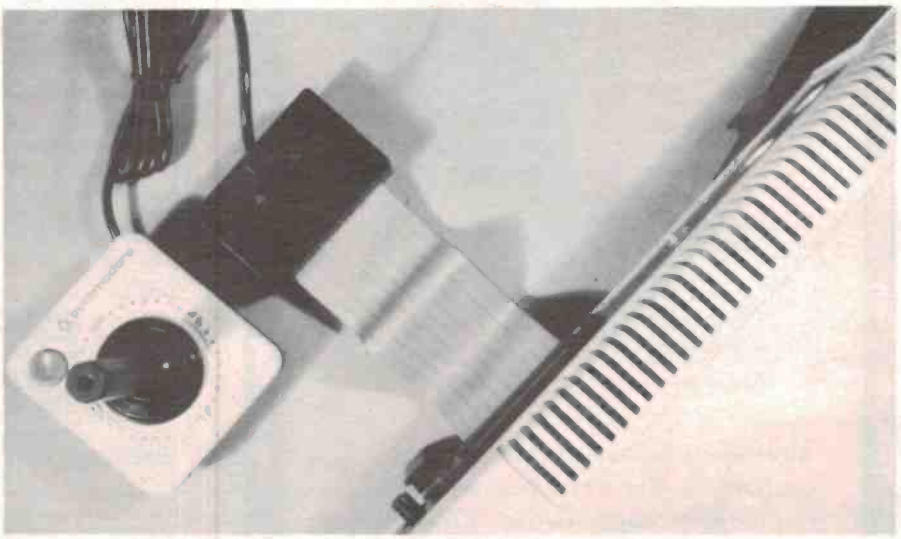
SOME OF THE popular cassette-based software suitable for the System 80, such as that by Big Five and Adventure International, calls for an Atari-type joystick input for controlling on-screen objects. This type of joystick has four switches arranged orthogonally and activated by a vertical shaft which is kept in the upright, or 'neutral', position by a rubber boot. You grasp the shaft with one hand and the base of the unit, containing the switches, with the other. Angling the shaft in any direction then activates a switch or combination of switches to indicate the direction of shaft movement. Eight directions can be indicated:




The 'directions' indicated by movement of the joystick shaft.

A button in the joystick base can be activated by the thumb to give another function — usually a 'write' or 'fire' function (as in games involving missiles, etc).

These joysticks first appeared with Atari TV games and latterly their home computers. The same type of joystick is available, under the Commodore label, for the Commodore VIC-20 home computer. Dick Smith lists the latter in his catalogue, No. X-2020, for $19.95.



The interface simply attaches to the System 80's expansion connector at the rear of the machine.

As it stands, the joystick is a '5-bit' device — four 'direction' bits and one 'fire' bit. Some joystick software requires '4-bit' input. In this instance, the U and D switches are paralleled by the fire button. A slide switch provides for both 4-bit and 5-bit modes of operation.

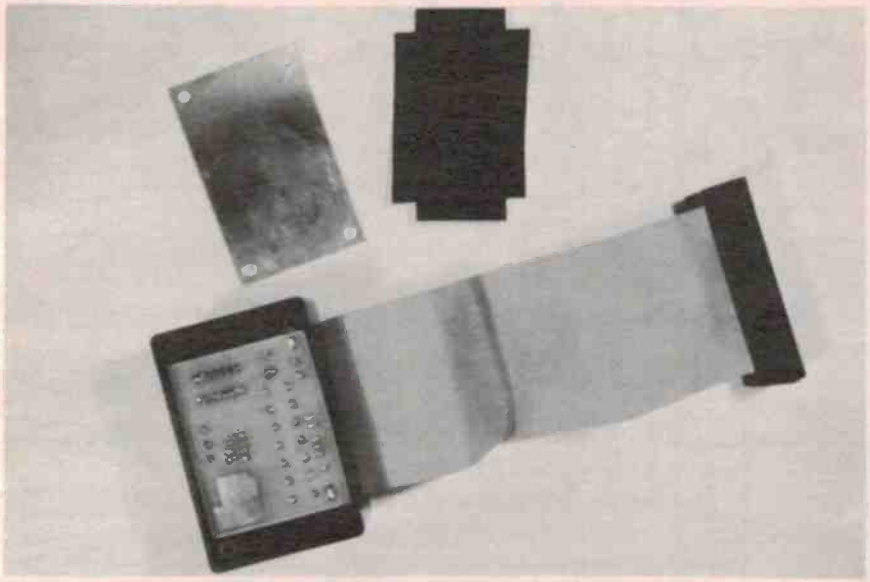
The interface is powered from the System 80.

## Construction

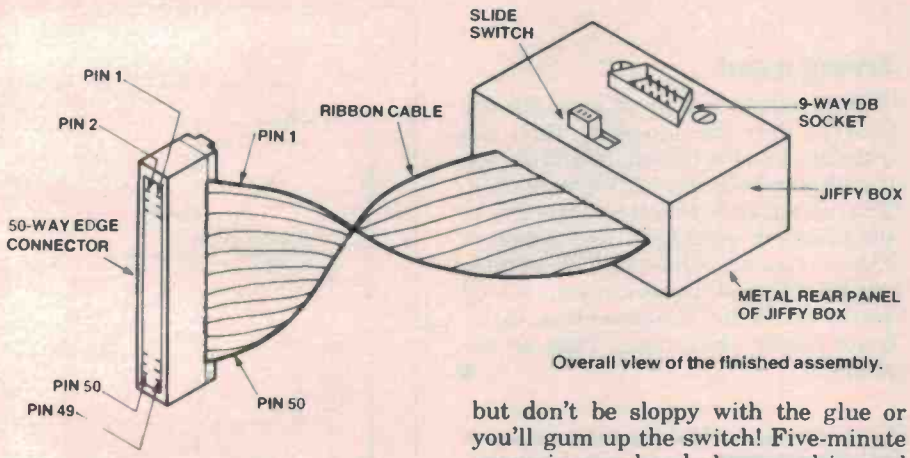
We recommend you use our pc board design as it simplifies construction and reduces the possibility of wiring errors. We fitted the pc board into a 28 x 54 x 83 mm jiffy box (Dick Smith catalogue No. H-2755). The 9-way chassis-mount plug for the joystick connector and the 5-bit/4-bit slide switch mount on the plastic base of the box (which now becomes the 'top'). Connection to the System 80 expansion interface is via a 50-way edge connector and a length of 50-way ribbon cable that passes through a slot cut in the side of the jiffy box to the pc board mounted inside.

Construction should commence with drilling and cutting the various holes in the jiffy box. Take your 'empty' pc board and, using it as a template, copper side down, mark the approximate position of the 9-way chassis-mount DB plug on the outside of the jiffy box bottom. Mark out the required hole for it and its two mounting screw holes, then mark out a suitable position for the slide switch slot, on the side opposite the 9-way plug. Drill out all of these and carefully file the 9-way plug hole and slide switch slot to shape so that both components fit nearly — *from inside the jiffy box*. A slot for the ribbon cable is cut in one side of the box. Drill a line of small holes and file the slot edges flat.

Before mounting the 9-way plug, solder 50 mm lengths of 22 gauge tinned copper wire to pins 1, 2, 3, 4, 6 and 8. These should drop straight down from the plug pins. Next solder a 75 mm length of three-way ribbon cable to the pins of the slide switch. Now both the 9-way plug and the slide switch may be mounted in the box. Bolt the 9-way plug in place. We glued the slide switch in —

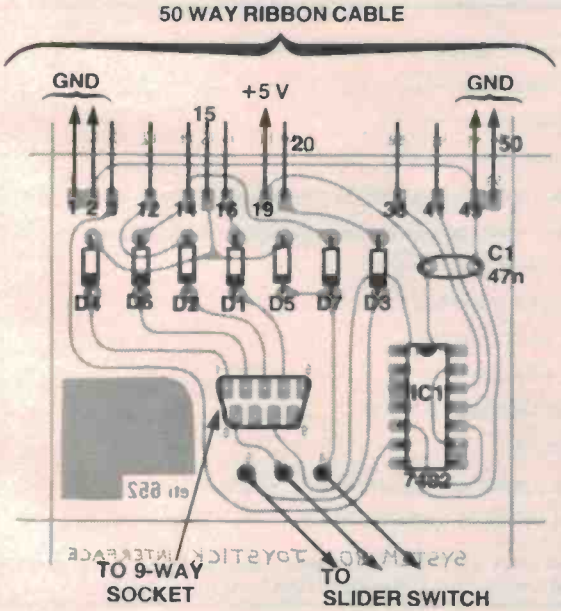


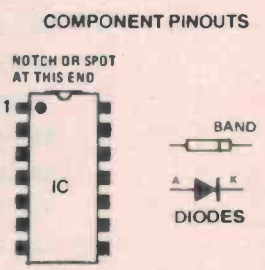
The pc board is held inside the jiffy box by the metal panel. Note the piece of insulating material that goes over the back of the board to prevent shorts.




Overall view of the finished assembly.

but don't be sloppy with the glue or you'll gum up the switch! Five-minute epoxy is very handy here, and is used later, as you shall soon see.




**PRINTED CIRCUIT ARTWORK** for this project can be obtained by sending a stamped, self-addressed envelope to:
ETI-652 ARTWORK
ETI Magazine
15 Boundary St
Rushcutters Bay NSW 2011

Make up the ribbon cable and edge connector now. We used a 50-way edge connector that 'crimps' on the end of the cable, making contact to the wires without the necessity of stripping the insulation by means of special pins on the connectors. The other end of the ribbon cable is fed through the slot in the jiffy box for 50 mm or so. Identify the wires to be soldered — 1, 2, 3, 12, 14, 15, 16, 19, 20, 38, 41, 49, 50 — and cut back the unused wires about 25 mm. Strip the ends of the remaining wires about 5 mm and tin them. Put the box assembly aside for the moment.

Now the pc board can be assembled. The diodes, capacitor and IC can be assembled in any order — just watch the orientation of the semiconductors.

Having completed that, the ribbon cable can be soldered to the board — make sure the wires are in their correct places, though. It's worth a double check. The pc board has been laid out to make this part of the job relatively easy, however. Now wire in the slide switch. Adjust the ribbon cable such that the full 50 wires (i.e: the uncut section) protrude through the inside of the box about 15 mm or so. Run a bead of five-minute epoxy along the cable right at the slot and let it set.

After the epoxy has set, put 10 mm lengths of spaghetti insulation over the tinned copper wires on the 9-way plug. Feed the wires through the correct holes in the pc board (which should be pretty well beneath the socket when lined up to go in the box) and push the board into the box. Straighten the wires by pulling them gently with pliers and solder each of them. Cut a piece of thin cardboard or plastic to fit over the rear (copper side) of the pc board to stop the metal lid from possibly shorting the tracks. Put this in place and secure the lid. ▶

## PARTS LIST — ETI-652

**Capacitors**
C1 ..... 47n greencap

**Semiconductors**
D1-D7 ..... 1N4148, 1N914 etc
IC1 ..... 7402

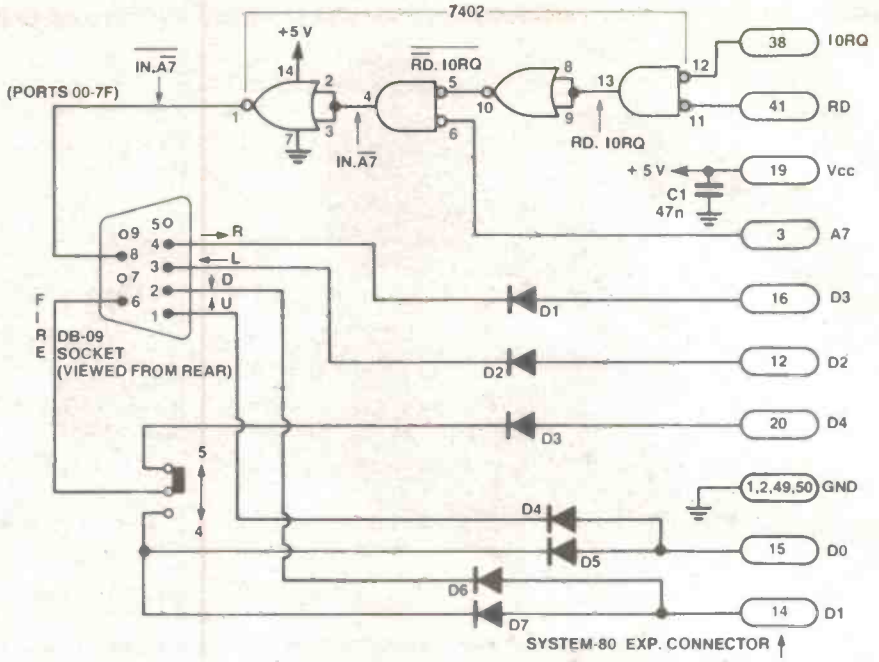
**Miscellaneous**
ETI-652 pc board; UB5 jiffy box (28 x 54 x 83 mm) or similar; 50-way edge connector socket; 300 mm length of 50-way ribbon cable; 9-way DB plug, chassis-mount, to suit joystick line socket connector; SPDT slider switch; nuts, bolts, glue etc.

**Price estimate**
**$35 — $40**
(includes joystick)

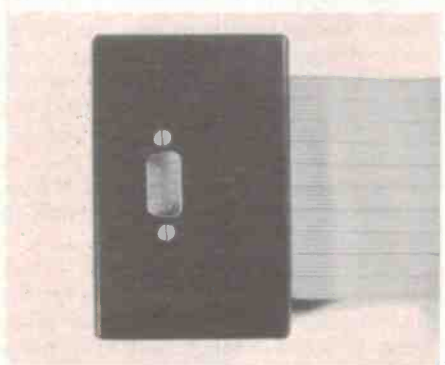
## HOW IT WORKS — ETI-652

The joystick unit itself comprises four direction switches and a fire switch in a square, shallow case, operated by the stick which you grasp in your hand. A cable and 9-way plug provides connections. When a switch is activated, it connects one of the pins 1, 2, 3, 4 or 6 in the plug to the common line — pin 8. The five switches are encoded into either four or five data bits according to the position of switch S1. The five-bit mode connects each switch to a separate data line. The four-bit mode indicates the fire switch by activating the UP and DOWN line simultaneously, via diodes D5 and D7. The four-bit mode is provided to ensure compatibility with early joystick software.

The System 80 data buss is pulled high by internal resistors. The joystick therefore uses an active low to indicate a key closure. IC1, a quad NOR gate, decodes the control signals IORQ, RD and address buss bit 7 to make the interface appear to the computer as an I/O device occupying input ports 00 to 7F. This leaves 128 input ports free for other purposes. When the computer executes an INPut instruction within the range 00 to 7F, pin 1 of IC1 goes low and allows the data buss lines to be selectively pulled down via the joystick switches and the diodes, which prevent the buss from being affected when the joystick interface is not selected.



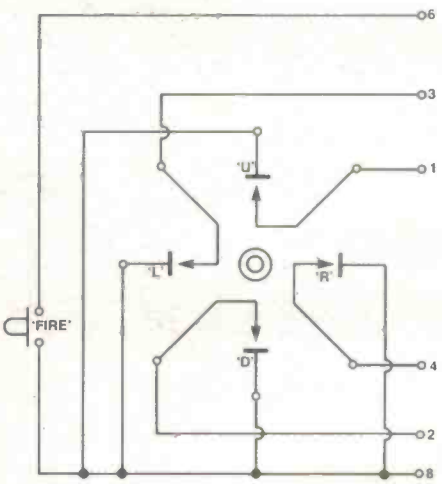

Circuit of the interface.



View of the completed interface. Note orientation of the 9-way DB plug and location of the slide switch.

## Trying it out

This is only a matter of plugging the joystick into the interface, then the interface into the System 80 and testing it with some suitable software running. You can try a cassette program or key in the program listed here. Any problems encountered are almost certainly due to wiring errors. A re-check of your wiring and orientation of components on the pc board should throw some light on the problem. ●



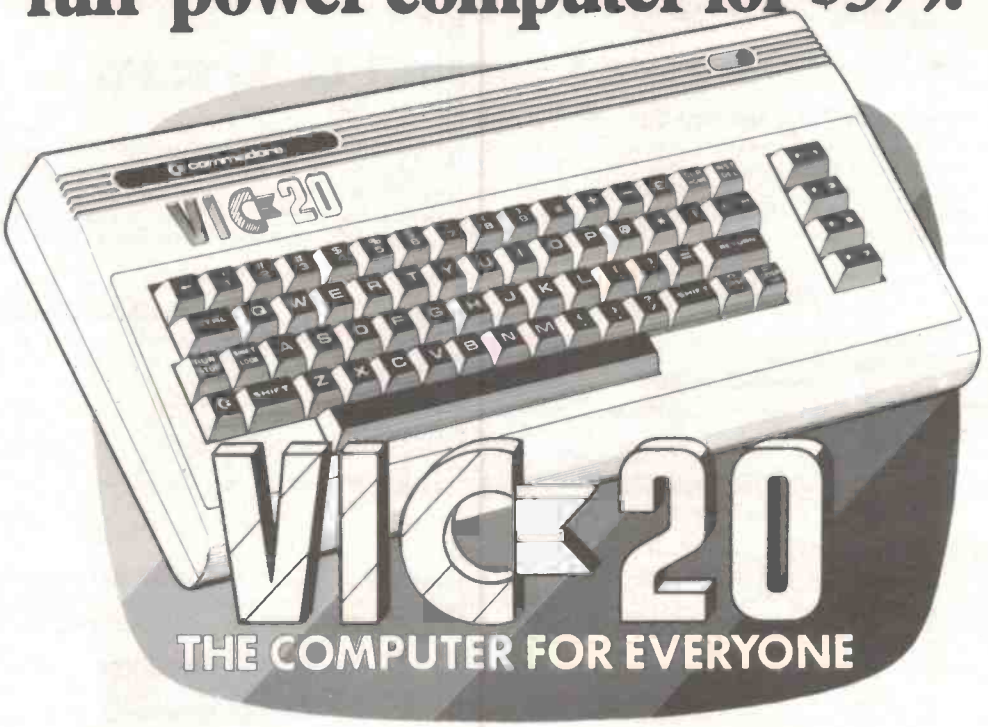

Circuit of the joystick showing pin connections on the 9-way line socket.

## JOYSTICK DEMONSTRATION PROGRAM

```
5    REM: POSITION CURSOR IN CENTRE
10   CLS: X=63 : Y=23
15   REM: READ AND INVERT JOYSTICK
20   A=255 - INP(0)
22   REM: SET POINT UNLESS FIRE BUTTON ON
25   SET(X,Y)
30   IF A>15 THEN RESET(X,Y) : A=A-16
35   REM: FLASH CURSOR ONCE , BUT LEAVE IT THE SAME
40   C=POINT(X,Y)
50   IF C=0 THEN SET(X,Y) : GOSUB300 : RESET(X,Y) : GOTO 70
60   RESET(X,Y) : GOSUB300 : SET(X,Y)
65   REM: THIS SECTION UPDATES CURSOR POSITION ACCORDING TO JOYSTICK
66   REM: DIRECTION. IF JOYSTICK IS IN CENTRE A=0 AND IT FALLS THROUGH
70   IF A>7 THEN X=X+1 : A=A-8
80   IF A>3 THEN X=X-1 : A=A-4
90   IF A=2 THEN Y=Y+1
100  IF A=1 THEN Y=Y-1
105  REM : THIS SECTION WRAPS THE SCREEN AREA AROUND TO AVOID AN
106  REM : ERROR MESSAGE CAUSED BY AN OUT OF RANGE PLOT INSTRUCTION
110  IF X>127 THEN X=0
120  IF X<0 THEN X=127
130  IF Y>47 THEN Y=0
140  IF Y<0 THEN Y=47
145  REM: LOOP BACK TO START
150  GOTO 20
295  REM : DELAY ROUTINE FOR FLASHING CURSOR
300  FOR N=1 TO 20 : NEXT N : RETURN
```

This program puts up a flashing cursor in the middle of the screen. When you move the joystick the cursor 'writes' according to the direction in which you move the joystick shaft. You can move the cursor without writing by holding down the 'fire' button. Now try writing your name! Have fun with your joystick.

# Where to get the world's first full colour full-power computer for $399.

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## CATCH '660

First up this month we have another colour program. This one is from David Button of Sassafras in Victoria. The program is called 'Catch '660' because the object is not to get caught! Blocks appearing on the screen can 'catch' your 'man'. So watch it! The object of the game is to remain free as long as possible. Running into blocks on the edge of the screen ends the game. At the end your score will be displayed. Here's how to get it going:

First load the colour routines as per Programming the '660 in Colour, page 88 of the April '82 issue of ETI. Background colour may be changed by adding or deleting calls to 07A2 (these calls may be located at 0600, 0602 and 0604 — the first three lines of the program). Foreground colours may be changed by changing VD (variable D) at 0606.

To move your man, the following keys provide motion as follows:

KEY 1 = UP

KEY 9 = DOWN

KEY 6 = LEFT

KEY 4 = RIGHT

When the game ends, just press any key to start a new game.

Note that when you've loaded the program and debugged it, after pressing 8 to run the game, it takes a few seconds for the display to appear. Patience, people . . . patience.

```
0600  00FF  NOP
      07A2  GOSUB MLS
      00FF  NOP
      07C1  GOSUB MLS
      6D02  VD=COLOUR
      6E00  VE=00
      6F00  VF=00
      27AB  DO 07AB
0610  7E01  VE=VE+1
      3E08  SKF VE=08
      160E  GOTO 060E
      6E00  VE=00
      7F01  VF=VF+01
      3F18  SKF VF=18
      160E  GOTO 060E
      00FF  NOP
0620  6100  V1=00
      6201  V2=01
      A656  SET I
      D121  DXYN
      7108  V1=V1+08
      3140  SKF V1=40
      1626  GOTO 0626
      6100  V1=00
0630  622C  V2=2C
      D121  DXYN
      7108  V1=V1+08
      3140  SKF V1=40
      1632  GOTO 0632
      6100  V1=00
      6200  V2=00
      A657  SET I
0640  D121  DXYN
      7201  V2=V2+01
      322E  SKF V2=2E
      1640  GOTO 0640
      613F  V1=3F
      6200  V2=00
      D121  DXYN
      7201  V2=V2+01
0650  322E  SKF V2=2E
      164C  GOTO 064C
      1660  GOTO 0660
      FF80
      40E0
      40E0
      E0E0
      00FF  NOP
0660  6800  V8=00
      6A1E  VA=1E
      6B18  VB=18
      A658  SET I
      DAB3  DXYN
      A658  SET I
      FC0A  WAIT KEY
      7801  V8=V8+01
0670  3C01  SKF VC=01
      1680  GOTO 0680
      DAB3  DXYN
      6F00  VF=00
      7BFC  VB=VB+FC
      DAB3  DXYN
      4F01  SKF VF≠01
      170C  GOTO 070C
0680  3C09  SKF VC=09
      1690  GOTO 0690
      DAB3  DXYN
      6F00  VF=00
      7B04  VB=VB+04
      DAB3  DXYN
      4F01  SKF VF≠01
      170C  GOTO 170C
0690  3C04  SKF VC=04
      16A0  GOTO 06A0
      DAB3  DXYN
      6F00  VF=00
      7AFC  VA=VA+FC
      DAB3  DXYN
      4F01  SKF VF≠01
      170C  GOTO 070C
06A0  3C06  SKF VC=06
      1734  GOTO 0734
      DAB3  DXYN
      6F00  VF=00
      7A04  VA=VA=04
      DAB3  DXYN
      4F01  SKF VF≠01
      170C  GOTO 070C
06B0  16B8  GOTO 06B8
      78FF  V8=V8+FF
      166C  GOTO066C
      00FF  NOP
      6F00  VF=00
      6403  V4=03
      C50F  CXKK
      8455  V4-V5
06C0  3F01  VF SET ?
      16B8  GOTO 06B8
      00FF  NOP
      A65B  SET I
      86A0  V6=VA
      87B0  V7=VB
      3500  SKF V5=00
      16DA  GOTO 06DA
06D0  6F00  VF=00
      7604  V6=V6+04
      D673  DXYN
      4F01  SKF VF≠01
      1706  GOTO 0706
      3501  SKF V5=01
      16E8  GOTO 06E8
      6F00  VF=00
06E0  76FC  V6=V6+FC
      D673  DXYN
      4F01  SKF VF≠01
      1706  GOTO 0706
      3502  SKF V5=02
      16F6  GOTO 06F6
      6F00  VF=00
      7704  V7=V7+04
06F0  D673  DXYN
      4F01  SKF VF≠01
      1706  GOTO 0706
      3503  SKF V5=03
      166A  GOTO 066A
      6F00  VF=00
      77FC  V7=V7+FC
      D673  DXYN
0700  4F01  SKF VF≠01
      1706  GOTO 0706
      166A  GOTO 066A
      D673  DXYN
      16B8  GOTO 06B8
      00FF  NOP
      00E0  CLEAR SCREEN
      A730  SET I 0730
0710  F833  CONV V8 DEC
      F265  TRF DATA
      6318  V3=18
      6410  V4=10
      F029  FETCH
      D345  DXYN
      7306  SHIFT
      F129  FETCH
0720  D345  DXYN
      7306  SHIFT
      F229  FETCH
      D345  DXYN
      F60A  WAIT KEY
      00E0  CLEAR SCREEN
      1620  GOTO 0620
072E
0730  SCRATCHPAD
0732
      4C01  SKF VC≠01
      16B8  GOTO 06B8
      4C09  SKF VC≠09
      16B8  GOTO 06B8
      4C04  SKF VC≠04
      16B8  GOTO 06B8
0740  16B2  GOTO 06B2
```


## HOW THE 'COLOUR PATTERNMAKER' WORKS

As promised last month in this column, here is a complete annotated listing of the Colour Patternmaker by Noel Plummer. Now if this doesn't generate a few ideas . . . If it does, we'd like to hear about them (and don't forget — we pay!).

### MAINLINE

| | | | |
|---|---|---|---|
| 0700 | 00FF | NOP | PROMPT & SET BACKGROUND COLOUR |
| 2 | 07C1 | Call enable colour | |
| 4 | 6D06 | VD = 06 (Pale Blue) | |
| 6 | 2738 | Do colour 'SELECT . . . GROUND' | |
| 8 | 2818 | Do write 'BACK' | |
| A | 2800 | Do write 'SELECT, GROUND' | |
| C | 2818 | Do write 'BACK' | |
| E | 6D05 | VD = 05 (Yellow) | |
| 10 | 2746 | Do colour #'s | |
| 2 | 2818 | Do write 'BACK' | |
| 4 | 2848 | Do Display Background Colours | |
| 6 | 2754 | Do Select Background Colour | |
| 8 | 00E0 | Erase | |
| A | 00FF | NOP | |
| C | 6D05 | VD = 05 (Yellow) | PROMPT & SET FOREGROUND COLOUR(S) |
| E | 2738 | Do colour 'SELECT . . . GROUND' | |
| 20 | 2820 | Do write 'FORE' | |
| 2 | 2800 | Do write 'SELECT, GROUND' | |
| 4 | 2820 | Do write 'FORE' | |
| 6 | 6D06 | VD = 06 (Pale Blue) | |
| 8 | 2746 | Do colour #'s | |
| A | 2820 | Do write 'FORE' | |
| C | 2878 | Do Display Foreground Colours | |
| E | 2762 | Do Select Foreground Colour(s) | |
| 30 | 00E0 | Erase | |
| 2 | 6D00 | VD = 00 | |
| 4 | 1602 | Go Kaleidoscope | |
| 6 | 00FF | NOP | |

### COLOUR 'SELECT . . . GROUND'

| | | | |
|---|---|---|---|
| 0738 | 6900 | V9 = 00 | $Y_o$ |
| A | 6A06 | VA = 06 | $X_n$ |
| C | 6B08 | VB = 08 | $Y_n$ |
| E | 6E00 | VE = 00 | $X_o$ |
| 40 | 2788 | Do colour | |
| 2 | 00EE | Return | |
| 4 | 00FF | NOP | |

### COLOUR #'S

| | | | |
|---|---|---|---|
| 0746 | 690B | V9 = 0B | $Y_o$ |
| 8 | 6A08 | VA = 08 | $X_n$ |
| A | 6B03 | VB = 03 | $Y_n$ |
| C | 6E00 | VE = 00 | $X_o$ |
| E | 2788 | Do colour | |
| 50 | 00EE | Return | |
| 2 | 00FF | NOP | |

### SELECT BACKGROUND COLOUR

| | | | |
|---|---|---|---|
| 0754 | F50A | Get Key | |
| 6 | 4500 loop | SKP V5 ≠ 00 | |
| 8 | 00EE | Return | |
| A | 75FF | V5 = V5-01 | |
| C | 07A2 | Call Step Background | |
| E | 1756 | Go LOOP | |
| 60 | 00FF | NOP | |

### SELECT FOREGROUND COLOUR(S)

| | | | | |
|---|---|---|---|---|
| 0762 | 6900 | | V9 = 00 | $Y_o$ |
| 4 | 6A08 | | VA = 08 | $X_n$ |
| 6 | 6B10 | | VB = 10 | $Y_n$ |
| 8 | FD0A | | Get Key | Colour |
| A | 6E00 | | VE = 00 | $X_o$ |
| C | 4D08 | | SKP VD ≠ 08 | |
| E | 1774 | | Go two colours | |
| 70 | 2788 | | Do Colour | |
| 2 | 00EE | | Return | |
| 4 | FD0A | Two | Get Key | Colour (outer colour) |
| 6 | 2788 | Colours | Do Colour | |
| 8 | 6904 | | V9 = 04 | $Y_o$ |
| A | 6A04 | | VA = 04 | $X_n$ |
| C | 6B08 | | VB = 08 | $Y_n$ |
| E | FD0A | | Get Key | Colour (inner colour) |
| 80 | 6E02 | | VE = 02 | $X_o$ |
| 2 | 2788 | | Do Colour | |
| 4 | 00EE | | Return | |
| 6 | 00FF | | NOP | |

### COLOUR

| | | | |
|---|---|---|---|
| 0788 | 88A0 | V8 = VA | $X_n$ (V8 = loop 2 Counter) |
| A | 8CB0 loop 2 | VC = VB | $Y_n$ (VC = loop 1 Counter) |
| C | 8F90 | VF = V9 | $Y_o$ |
| E | 27AB loop 1 | Do Colour Routine | |
| 90 | 7CFF | VC = VC−1 | |
| 2 | 7F01 | VF = VF+1 | next y |
| 4 | 3C00 | SKP VC = 00 | |
| 6 | 178E | Go loop 1 | |
| 8 | 78FF | V8 = V8−1 | |
| A | 7E01 | VE = VE+1 | next x |
| C | 3800 | SKP V8 = 00 | |
| E | 178A | Go loop 2 | |
| A0 | 00EE | Return | |

## 07A2 — 07FF ETI COLOUR ROUTINES

### WRITE 'SELECT, GROUND'

| | | | |
|---|---|---|---|
| 0800 | A8C0 | I = 'SE' | |
| 2 | 6003 | V0 = 03 | $X_o$ |

```
 4  6103   V1 = 03          y
 6  6303   V3 = 03          loop counter (prompt)
 8  2838   Do Prompt
 A  6013   V0 = 13          2nd line
 C  610A   V1 = 0A
 E  6303   V3 = 03          3 bytes
10  2838   Do Prompt
 2  60EE   Return
 4  00FF   NOP
 6  00FF   NOP
```

### WRITE 'BACK'

```
0818  A8DE   I = 'BACK'
   A  2828   Do write 'Back/Fore'
   C  00EE   Return
   E  00FF   NOP
```

### WRITE 'FORE'

```
0820  A8E8   I = 'FORE'
   2  2828   Do Write 'Back/Fore'
   4  00EE   Return
   6  00FF   NOP
```

### WRITE 'BACK/FORE'

```
0828  6003   V0 = 03          X0
   A  610A   V1 = 0A          y
   C  6302   V3 = 02          2 bytes
   E  2838   Do Prompt
  30  00EE   Return
   2  00FF   NOP
   4  00FF   NOP
   6  00FF   NOP
```

### PROMPT

```
0838  6705   V7 = 05          dI
   A  D015 loop Shows @ V0, V1
   C  7008   V0 = V0+08       next x
   E  F71E   I = I+V7         next I
  40  73FF   V3 = V3−1
   2  3300   SKP V3 = 00
   4  183A   Go loop
   6  00EE   Return
```

### DISPLAY BACKGROUND COLOURS

```
0848  6007   V0 = 07          X0 (#'s)
   A  6117   V1 = 17          y (#'s)
   C  6210   V2 = 10          dX
   E  6300   V3 = 00          #'s
  50  6400   V4 = 00          XA0 (Show Colour)
   2  6508   V5 = 08          XB0 (Show Colour)
   4  6910   V9 = 10          Y0 (Colour)
   6  6A02   VA = 02          Xn (Colour two bytes wide)
   8  6B08   VB = 08          Yn (Colour)
   A  6D02   VD = 02          blue
   C  6E00   VE = 00          X0 (Colour)
   E  2788   Do Colour
  60  2898   Do Write #'s
   2  6D00   VD = 00          black
   4  2788   Do Colour
   6  2898   Do Write #'s
   8  6D04   VD = 04          green
   A  2788   Do Colour
   C  2898   Do Write #'s
   E  6D01   VD = 01          red
  70  2788   Do Colour
   2  2898   Do Write #'s
   4  00EE   Return
   6  00FF   NOP
```

### DISPLAY FOREGROUND COLOURS

```
0878  6003   V0 = 03          X0 (#'s)
   A  6117   V1 = 17          y (#'s)
   C  6208   V2 = 08          dX
   E  6300   V3 = 00          #0
  80  6400   V4 = 00          X0 (Show Colours)
   2  6A01   VA = 01          Xn (Colour one byte wide)
   4  6B08   VB = 08          Yn
   6  6D00   VD = 00          first colour (black)
   8  6910 loop V9 = 10       Y0 (Colour)
   A  8ED0   VE = VD          X = Colour
   C  2788   Do Colour
   E  7D01   VD = VD+01       next colour (and next X)
  90  2898   Do write #'s      display # & reveal colour
   2  3D08   SKP VD = 08       reached R.H.S. of screen?
   4  1888   Go loop
   6  00EE   Return
```

### WRITE #s

```
0898  F329   I = Dsp, V3
   A  D015   Show 5 @ V0, V1
   C  28A8   Do Show Colours
   E  8024   V0 = V0+V2       Next X (#'s)
  A0  7301   V3 = V3+01       next #
   2  00EE   Return
   4  00FF   NOP
   6  00FF   NOP
```

### SHOW COLOURS

```
08A8  661F   V6 = 1F          Y0−1
   A  7601   V6 = V6+01 loop  next y
   C  A8F2   I = (FF)
   E  D461   Show 1 @ V4, V6  (A)
  B0  3208   SKP V2 = 08      V2 = 08 for foreground colours
   2  D561   Show 1 @ V5, V6  (B)
   4  3637   SKP V6 = 37      reached bottom of screen?
   6  18AA   Go loop
   8  8424   V4 = V4+V2       next X(A)
   A  7510   V5 = V5+10       next X(B)
   C  00EE   Return
   E  00FF   NOP
```

### CHARACTER DATA

```
08C0  EE88     (SE)
   2  EE28
   4  EE
         8E    (LE)
   6  888E
   8  88EE
   A  EE84     (CT)
   C  8484
   E  E4
        EE     (GR)
  D0  8A88
   2  A8E8
   4  EAAA     (OU)
   6  AAAA
   8  EE
        EC     (ND)
   A  AAAA
   C  AAAC
   E  EEAA     (BA)
  E0  EEAA
   2  EA
         E8    (CK)
   4  8A8C
   6  8AEA
   8  EE8A     (FO)
   A  EA8A
   C  8E
        EE     (RE)
   E  A88E
  F0  888E
   2  FF
```

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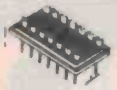

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| | |
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| | |
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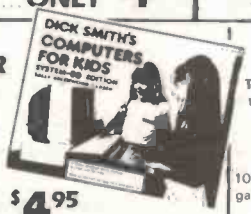


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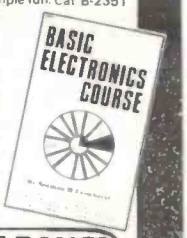



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# DICK SMITH ELECTRONICS

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# CHIP-8 COLUMN

In a routine written recently, six variables, V0-V5, were used. Now to use this routine with any program, great care needs to be taken not to have conflict between the calling program and the routine over possible joint use of the same variables.

How this is done is shown in an example involving not six but all sixteen variables. In this particular case the routine used information conveyed from the main program in the workhorse of CHIP-8, the V0 variable. How information can be conveyed back to the calling program is also shown.

CHIP-8 is a wonderful language for the computer hobbyist, having instructions which are easy to remember and use. The FX55 and FX65 are powerful instructions which may be a bit tricky at first, but the following should make them clear. In the instructions 6XKK and 8XY1 the X and Y represent a variable, but in FX55 and FX65 the X represents the variables V0 to VX, which could involve all variables if VX = VF. These instructions are a great moving combination when allied with the AMMM pointer.

Let's look at our example 1(a). On arrival at the subroutine a copy of all variables is stored, and just before return from the subroutine all variables are restored to their original values. The first instruction, AMMM, points to the start of memory locations set aside to store copy of variables. The number of locations required is indicated by the number of the variable used in the next instruction, FF55, which is F hexidecimal or 16 decimal. When FF55 is executed a copy of all 16 variables is put in locations 0MMM to 0MMM plus 15 decimal. Upon completion of the subroutine the reverse takes place and AMMM again points to the start of temporary store locations.

FF65 comes into the act and restores all variables by copying the contents of locations 0MMM to 0MMM +15 decimal into the variables V0 to VF, just before returning to the program which called the subroutine.

Should a result from the subroutine need to go back to the program it is only necessary to load variable V0 with information and store it using AMMM +X pointer, where X is the number of the variable to which the contents of V0 must be copied on return to the program, and AMMM again points to the first location of the temporary store. The routine then becomes as in 1(b).

**FRANK REES**

---

**SUBROUTINE**

(a) Start Location:

AMMM: Start of 16 locations.
FF55: Store copy of V0 to VF there — your subroutine less '00EE'.
↓
AMMM: Same location again.
FF65: Copy contents of location into V0 to VF.
00EE: Return.

(b) Start Location:

AMMM
FF55
↓
AMMM + X, where X is number of variable.
F055: Store copy of V0 from subroutine there.
AMMM
FF65
00EE

**NOTE:** When speaking of CHIP-8 instructions, 0 to 9 and A to F are numbers. All other letters in Instructions are arbitrary numbers.

**Try this 'program' for better understanding.**

| | |
|---|---|
| For 660 at 0600: | A600 |
| | FF65 |
| | A480 |
| | FF55 |
| | 0000 |
| | 1234 |
| | 5678 |
| | 9ABC |
| For VIP 0200: | A200 |
| | FF65 |
| | A100 |
| | FF55 |
| | F000 |
| | 1234 |
| | 5678 |
| | 9ABC |

Run 'program' and then inspect screen memory locations 0480 (or D100) onward; you have just block moved a copy of 'program' and data (1—C) to a new location.

Next: 1. 'Alpha' visuals (captions) to screen mover.
2. Invert screen video.

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| 74148 | 1.40 |
| 74150 | 1.20 |
| 74151 | .60 |
| 74152 | 4.90 |
| 74153 | .70 |
| 74154 | 1.20 |
| 74155 | .90 |
| 8T28 | 3.00 |
| 9310 | .65 |
| 9311 | 1.00 |
| 9312 | 1.35 |
| 74156 | 1.50 |
| 74157 | .60 |
| 74161 | 1.00 |
| 74162 | 1.00 |
| 74163 | .85 |
| 74164 | .60 |
| 74165 | .60 |
| 74174 | .50 |
| 74175 | .90 |
| 74176 | 1.10 |
| 74177 | 1.10 |
| 74180 | .90 |
| 74181 | 2.30 |
| 74182 | .90 |
| 74184 | 3.75 |
| 74185 | 1.20 |
| 74190 | 1.00 |
| 74191 | 1.20 |
| 74192 | 1.20 |
| 74193 | .80 |
| 74194 | 1.10 |
| 74195 | .65 |
| 74196 | .85 |
| 74197 | 1.10 |
| 74198 | 1.10 |
| 74199 | 1.30 |
| 74221 | .90 |
| 74290 | .90 |
| 73293 | .90 |
| 74365 | .80 |
| 74366 | .80 |
| 74367 | 1.00 |
| 74368 | 1.00 |
| 8T96 | 1.80 |
| 9314 | 1.30 |
| 9368 | 2.50 |
| 9370 | 2.00 |

**74LS SERIES**

| | |
|---|---|
| 74LS00 | .40 |
| 74LS01 | .40 |
| 74LS02 | .40 |
| 74LS03 | .40 |
| 74LS05 | .40 |
| 74LS08 | .40 |
| 74LS09 | .40 |
| 74LS10 | .40 |
| 74LS11 | .40 |
| 74LS13 | .50 |
| 74LS14 | .90 |
| 74LS15 | .40 |
| 74LS20 | .40 |
| 74LS21 | .40 |
| 74LS22 | .40 |
| 74LS26 | .40 |
| 74LS28 | .40 |
| 74LS30 | .40 |
| 74LS32 | .40 |
| 74LS33 | .40 |
| 74LS37 | .50 |
| 74LS38 | .50 |
| 74LS40 | .50 |
| 74LS42 | .75 |
| 74LS47 | .85 |
| 74LS48 | 1.00 |
| 74LS49 | 1.00 |
| 74LS51 | .40 |
| 74LS54 | .50 |
| 74LS55 | .55 |
| 74LS58 | .65 |
| 74LS73 | .55 |
| 74LS74 | .60 |
| 74LS75 | .45 |
| 74LS76 | .50 |
| 74LS78 | .50 |
| 74LS83 | 1.00 |
| 74LS85 | 1.00 |
| 74LS86 | .50 |
| 74LS90 | .70 |
| 74LS92 | .90 |
| 74LS93 | .80 |
| 74LS95 | .65 |
| 74LS96 | 1.55 |
| 74LS107 | .60 |
| 74LS109 | .60 |
| 74LS112 | .60 |
| 74LS113 | .65 |
| 74LS114 | .50 |
| 74LS122 | .50 |
| 74LS123 | .75 |
| 74LS125 | .50 |
| 74LS126 | .70 |
| 74LS132 | .80 |
| 74LS133 | .50 |
| 74LS136 | .50 |
| 74LS138 | .80 |
| 74LS139 | .85 |
| 74LS151 | .75 |
| 74LS153 | .60 |
| 74LS154 | 1.50 |
| 74LS155 | 1.00 |
| 74LS156 | 1.00 |
| 74LS157 | .90 |
| 74LS158 | .70 |
| 74LS160 | .85 |
| 74LS161 | .85 |
| 74LS162 | 1.00 |
| 74LS163 | .85 |
| 74LS164 | 1.30 |
| 74LS165 | .50 |
| 74LS168 | 1.90 |
| 74LS169 | 1.90 |
| 74LS170 | 2.80 |
| 74LS173 | .90 |
| 74LS174 | .90 |
| 74LS175 | .90 |
| 74LS181 | 2.50 |
| 74LS189 | 3.80 |
| 74LS190 | 1.30 |
| 74LS191 | 1.10 |
| 74LS192 | .85 |
| 74LS193 | .85 |
| 74LS194 | .70 |
| 74LS195 | .80 |
| 74LS196 | 1.25 |
| 74LS197 | 1.00 |
| 74LS221 | 2.10 |
| 74LS245 | 2.35 |
| 74LS247 | .90 |
| 74LS249 | 1.30 |
| 74LS251 | .80 |
| 74LS253 | .90 |
| 74LS257 | .65 |
| 74LS258 | .50 |
| 74LS259 | 2.45 |
| 74LS260 | .90 |
| 74LS266 | .90 |
| 74LS273 | 1.60 |
| 74LS279 | .65 |
| 74LS283 | 1.15 |
| 74LS290 | 1.10 |
| 74LS293 | 1.15 |
| 74LS295 | 1.60 |
| 74LS298 | 1.00 |
| 74LS352 | 1.30 |
| 74LS353 | 1.30 |
| 74LS365 | .50 |
| 74LS366 | .70 |
| 74LS367 | .50 |
| 74LS368 | .50 |
| 74LS373 | 1.50 |
| 74LS374 | 1.70 |
| 74LS386 | .50 |
| 74LS670 | 2.70 |
| 81LS95 | 2.10 |
| 95H90 | 15.50 |
| 11C90 | 19.50 |
| 81LS96 | 2.10 |
| 81LS97 | 2.10 |

**TRANSISTORS**

| | |
|---|---|
| 2N301 | 2.20 |
| 2N657 | .60 |
| 2N930 | .60 |
| 2N1613 | 1.10 |
| 2N1711 | .50 |
| 2N1893 | 1.00 |
| 2N2219A | .60 |
| PN2222 | .30 |
| 2N2463 | .35 |
| 2N2484 | .65 |
| 2N2646 | 1.00 |
| 2N2647 | 1.10 |
| 2N2894 | .80 |
| 2N2904 | .45 |
| 2N2905 | .40 |
| 2N2906 | .45 |
| 2N2913 | 1.20 |
| PN2907 | .60 |
| 2N3053 | .60 |
| 2N3054 | 1.90 |
| 2N3055 | .90 |
| 2N3301 | .40 |
| 2N3440 | 1.10 |
| 2N3502 | .70 |
| 2N3503 | .70 |
| 2N3563 | .30 |
| 2N3564 | .30 |
| 2N3569 | .30 |
| PN3565 | .30 |
| PN3566 | .30 |
| PN3567 | .30 |
| 2N3568 | .30 |
| 2N3638 | .30 |
| 2N3639 | .30 |
| 2N3640 | .30 |
| 2N3641 | .30 |
| 2N3645 | .30 |
| PN3642 | .30 |
| PN3643 | .30 |
| PN3644 | .30 |
| 2N3646 | .30 |
| 2N3692 | .50 |
| 2N3693 | .35 |
| 2N3702 | .30 |
| PN3694 | .30 |
| 2N3704 | .30 |
| 2N3709 | .30 |
| 2N3713 | 2.20 |
| 2N3819 | .80 |
| 2N3866 | 2.00 |
| 2N3904 | .30 |
| 2N3906 | .30 |
| 2N4030 | 1.10 |
| 2N4032 | .90 |
| 2N4033 | .90 |
| 2N4036 | 1.00 |
| 2N4037 | .90 |
| PN4121 | .30 |
| 2N4233 | 1.60 |
| 2N4235 | 1.90 |
| 2N4236 | 2.20 |
| 2N4248 | .30 |
| PN4249 | .30 |
| 2N4250 | .30 |
| 2N4258 | .30 |
| 2N4292 | .70 |
| 2N4354 | .30 |
| 2N4355 | .30 |
| 2N4356 | .30 |
| 2N4398 | 5.00 |
| 2N4401 | .50 |
| 2N4402 | .50 |
| 2N4403 | .50 |
| 2N4416 | 1.00 |
| 2N4906 | 2.80 |
| PN4868 | .30 |
| 2N5088 | .30 |
| 2N5089 | .30 |
| 2N5179 | 1.90 |
| 2N5303 | 3.30 |
| 2N5320 | .80 |
| 2N5401 | .30 |
| 2N5458 | .70 |
| 2N5459 | .70 |
| 2N5461 | .70 |
| 2N5484 | .70 |
| 2N5485 | .70 |
| 2N5486 | .70 |
| 2N5769 | .30 |
| 2N5770 | .25 |
| 2N5830 | .25 |
| 2N5831 | .30 |
| 2N5856 | .30 |
| 2N5873 | 1.10 |
| 2N5874 | 1.40 |
| 2N5961 | .30 |
| 2N5963 | 1.10 |
| 2N6027 | .60 |
| 3N201 | 1.50 |
| AC127 | 1.00 |
| AC128 | 1.00 |
| AC187 | 1.00 |
| AC188 | 1.00 |
| AO149 | 3.10 |
| AD161 | 2.00 |
| AD162 | 2.00 |
| BC318 | .30 |
| BC319 | .18 |
| BC327 | .15 |
| BC328 | .30 |
| BC337 | .30 |
| BC338 | .30 |
| BC547 | .15 |
| BC548 | .15 |
| BC549 | .15 |
| BC549C | .40 |
| BC557 | .16 |
| BC558 | .16 |
| BC559 | .16 |
| BC637 | .60 |
| BC638 | .60 |
| BC639 | .40 |
| BC640 | .40 |
| BCY70 | .85 |
| BCY71 | .85 |
| BD115 | 1.50 |
| BD135 | .70 |
| BD136 | .70 |
| BD137 | .70 |
| BD138 | .70 |
| BD139 | .70 |
| BD140 | .70 |
| BD235 | .65 |
| BD234 | .50 |
| BD237 | .50 |
| BD262 | 1.20 |
| BD301 | .75 |
| BD302 | .75 |
| BD263 | 1.25 |
| BD435 | .75 |
| BD646 | 1.70 |
| BD647 | 1.80 |
| BD675 | .80 |
| BDV64B | 4.50 |
| BDV65B | 4.50 |
| BF115 | .50 |
| BF173 | .70 |
| BF180 | .70 |
| BF195 | .30 |
| BF198 | .30 |
| BF199 | .30 |
| BF336 | .80 |
| BF337 | .80 |
| BF458 | .90 |
| BF494 | .40 |
| BFX85 | .75 |
| BFY50 | .90 |
| BFY90 | 1.30 |
| BSV17 | 1.00 |
| BU126 | 3.00 |
| BU208 | 3.00 |
| BUX80 | 7.90 |
| FT2955 | 1.40 |
| FT3055 | .75 |
| MEL12 | .90 |
| BU326A | 3.40 |
| MJ2955 | 1.00 |
| MJ4032 | 7.40 |
| MJ802 | 3.40 |
| MJ4035 | 6.90 |
| MJ4502 | 3.70 |
| MJE340 | 1.20 |
| MJE350 | 1.70 |
| MJE295 | 1.90 |
| MJE8055 | 1.90 |
| MJE3521 | .60 |
| MJ15003 | 5.00 |
| MJ15004 | 5.00 |
| QF102 | .60 |
| MPF131 | 1.40 |
| MPSA05 | .60 |
| MPSA06 | .60 |
| MPSA12 | .60 |
| MPSA14 | .60 |
| MPSA42 | .60 |
| MPSA56 | .80 |
| MPSA92 | .60 |
| MRF475 | 4.40 |
| TT31B | .90 |
| TI3PIC | 1.00 |
| TIP32B | .90 |
| TIP32C | 1.00 |
| TIP33A | 1.10 |
| TIP34A | 1.20 |
| TIP42B | 1.50 |
| TIP42B | 1.10 |
| TIP110 | 1.30 |
| TIP120 | .90 |
| TIP2955 | 1.90 |
| TIP3055 | 1.90 |
| VN88AF | 3.90 |

**MICRO CHIPS**

| | |
|---|---|
| ADCO 800 | 15.00 |
| OACO 080 | 3.90 |
| 2102 650 NS | 1.40 |
| 2111 | 8.60 |
| 2513 | 14.50 |
| 2516 | 55.00 |
| 2532 | 12.00 |
| 2650 | 23.00 |
| 2708 | 4.50 |
| 2716 | 4.90 |
| 4116 | 1.90 |
| 5101 | 9.00 |
| MM5307 | 18.00 |
| MM5309 | 6.50 |
| MM5312 | 9.00 |
| MM5369 | 2.60 |
| 5387 | 8.50 |
| MM5395 | 6.50 |
| 6502 | 10.50 |
| 6508 | 5.50 |
| 6520 | 5.50 |
| 6522 | 10.00 |
| 6532 | 17.00 |
| 6551 | 17.00 |
| MC6900P | 9.00 |
| MC6802 | 13.60 |
| MC6808 | 12.50 |
| 6810A | 4.90 |
| 6820 | 5.50 |
| 6821 | 6.00 |
| 6850 | 5.15 |
| 6852 | 6.40 |
| 7106 | 12.60 |
| 7107 | 15.00 |
| 7210 | 13.20 |
| Z80 CPU | 14.00 |
| Z80A CPU | 16.00 |
| Z80 P10 | 13.80 |
| Z80A P10 | 16.50 |
| Z80 CTC | 13.80 |
| Z80A CTC | 16.50 |
| Z80 DMA | 20.00 |
| Z80 S10/0 | 19.00 |
| Z80 S10/1 | 56.90 |
| Z80 S10/2 | 56.90 |
| Z80A S10/0 | 63.00 |
| Z80A S10/1 | 63.00 |
| Z80A S10/2 | 63.00 |
| 8035 | 27.00 |
| INS8050 | 15.00 |
| INS8080 | 8.00 |
| P8085 | 25.00 |
| 8155 | 22.00 |
| 8165 | 22.00 |
| 8205 | 5.90 |
| P8212 | 4.00 |
| 8214 | 8.00 |
| 8216 | 5.90 |
| 8224N | 5.50 |
| 8224 | 7.50 |
| 8226 | 5.90 |
| 8228 | 9.50 |
| 8238 | 8.00 |
| 8243 | 8.00 |
| 8251 | 14.00 |
| INS8251 | 6.50 |
| 8253 | 19.50 |
| 8255A | 8.60 |
| 8257 | 19.00 |
| 8259 | 15.00 |
| 8275 | 41.00 |
| 8279 | 11.00 |
| 8295 | 25.00 |
| Ay-5-2376 | 19.56 |
| 8748A | 29.00 |
| 8755A | 45.00 |
| MCT2 | .80 |
| MCT6 | 3.30 |
| MCT275 | 1.50 |
| MCC671 | 3.00 |
| 4N28 | .85 |
| 4N33 | 1.20 |
| 4N26 | .85 |
| MM80C95 | .90 |
| 80C96 | .90 |
| MM80C97 | .90 |
| 8098 | .90 |

**OPTOCOUPLERS**

| | |
|---|---|
| MCT2 | 1.00 |
| MCT6 | 3.30 |
| MC275 | 1.50 |
| MCC671 | 3.00 |
| 4N28 | 1.00 |
| 4N33 | 1.20 |
| 4N26 | 1.00 |

**VOLTAGE REGULATORS**

| | |
|---|---|
| 78L05 | .50 |
| LM341P-5 | .80 |
| 7805 | 1.00 |
| 7905 | 1.70 |
| LM309K | 1.95 |
| 7805K | 2.10 |
| LM323-K | 6.90 |
| 78H05KC | 8.50 |
| 78L12CP | .50 |
| 79L12 | .90 |
| LM341P12 | .75 |
| 7812 | 1.00 |
| 7912 | 1.90 |
| 7812KC | 2.15 |
| 7912KC | 2.60 |
| 79M12KC | 8.00 |
| 78L15 | .50 |
| 79L15 | .90 |
| LM341P15 | .80 |
| 7815 | 1.00 |
| 7915CT | 1.80 |
| 7915KC | 2.60 |
| 78M15KC | 6.50 |
| 78L18 | .50 |
| 7818 | 1.40 |
| 78L24 | .50 |
| 79L24 | .90 |
| 7824 | 1.10 |
| LM371T | 2.40 |
| LM337T | 3.80 |
| LM317K | 4.50 |
| LM337K | 5.90 |
| LM350K | 8.40 |
| 78HGKC | 10.50 |
| 78P05 | 16.50 |

**BRIDGES**

| | |
|---|---|
| VM48 | 1.50 |
| W02 | .60 |
| W04 | .60 |
| KHPC02 | 2.00 |
| KBP602 | 2.50 |
| KBP604 | 2.60 |
| KBP606 | 2.80 |
| KHPC1002 | 2.60 |
| KBPC1004 | 3.20 |
| KBPC1006 | 3.20 |
| MDA3501 | 4.20 |
| MDA3502 | 4.20 |
| MOA3504 | 4.50 |

**DISPLAYS**

| | |
|---|---|
| MAN2A | 6.30 |
| MAN72A | 2.20 |
| MAN74A | 2.20 |
| MAN52A | 3.40 |
| MAN82A | 3.40 |
| MAN84A | 3.40 |
| MAN6740 | 3.60 |
| MAN8610 | 3.30 |
| MAN8640 | 3.30 |
| TIL306 | 12.00 |
| OL704 | 2.20 |
| OL707 | 2.30 |
| DL747 | 3.40 |
| DL750 | 4.00 |
| FND357 | 1.80 |
| FND500 | 1.80 |
| FND507 | 1.80 |

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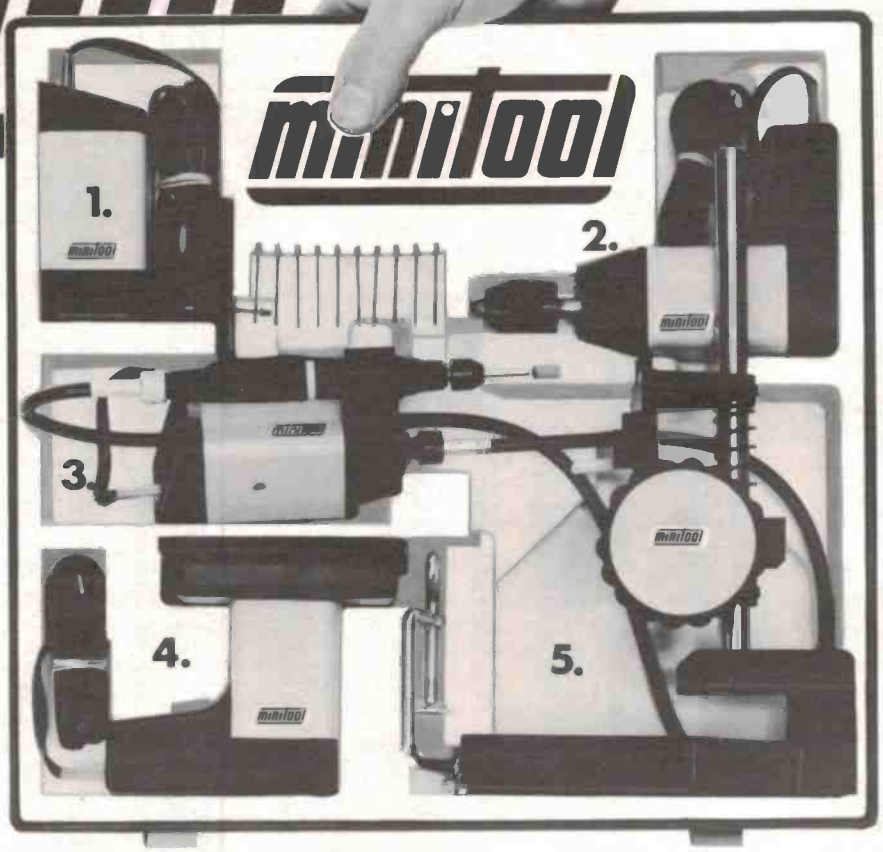


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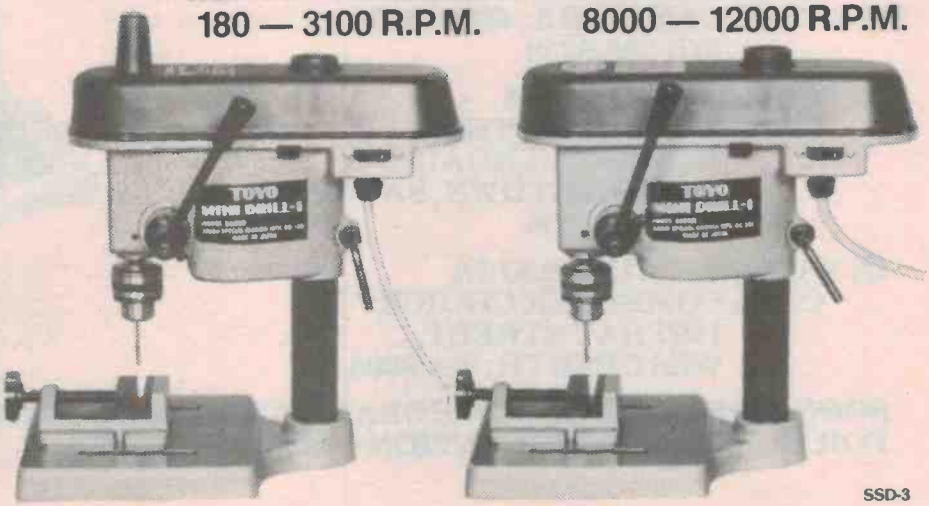


SSD-3

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# ELECTRONIC LIFESTYLE

# Technics introduce Compact Disc digital player

Matsushita Electric Industrial Co Ltd of Osaka, Japan has announced that it will introduce and demonstrate its first Compact Disc digital audio player, SQ-CD10.

**The Technics SQ-CD10 features automatic disc loading from the front, as in most cassette decks. The unit can be connected to the 'aux' inputs of any preamplifier or integrated amplifier and requires no system alterations whatsoever. The unit is 430 mm wide, the same as all regular-size Technics amplifiers.**

The unit features an optical pickup system using a semiconductor laser to ensure high reliability and long service life, Technics say. It also has automatic disc loading, play, stop/clear, fast forward, reverse, pause and repeat functions from a microcomputer governed full-logic electronic control. A combination of FL bar display, digital display and keyboard facilities provide a variety of programming and information readout. These include: pickup position indicator in one minute steps; band interval position indicator; program-in-play indicator; digital indication of band number; digital indication of elapsed playing time (min, sec); programming of up to 41 locations in any sequence; random access to any band number and its elapsed playing time and skip play to the next program.

The CD (Compact Disc) format has a very strong possibility of becoming the accepted worldwide standard, Technics claim.

Being an exclusive audio medium, a CD with 60 minutes of playing time per side is only 12 cm in diameter, saving the record collector a great deal of space. As new LSI's are being developed, the disc player will also be made in very compact size, say Technics.

As there is no mechanical contact in playback, disc service life is theoretically unlimited. Absence of mechanical wear is also claimed to greatly extend the service life of the optical pickup system.

Quick random access is possible. As an address code can be included in the signal format, it is possible, through keyboard operation, to gain instant access to any selection or song number, and any time slot. It is also technically possible to include visual information such as lyrics or performer's names for display on the player or on a CRT.

Technics give the following specifications for the SQ-CD10: disc playing time, per side — approx. 60 minutes; disc scanning velocity — 1.2-1.4 m/s; disc track pitch — 1.6 um; disc diameter — 120 mm; disc thickness — 1.2 mm; player frequency response — 20 Hz to 20 kHz; quantization — 16 bits/channel; signal-to-noise, dynamic range and channel separation — all better than 90 dB; harmonic distortion — less than 0.05%.

No date has been set for the unit's release in Australia.

## 'Go-anywhere' video from Sanyo

**Sanyo's new portable video system comprises a recording deck, tuner-timer unit, ac power adaptor and a fully remote-controlled colour video camera. An optional carry-case is available for the portable recorder.**

As with all Beta format video systems, the smaller size of the tape cassette has enabled Sanyo's engineers to develop an extremely compact design.

A unique feature of the system is said to be Sanyo's VSC 5800 colour camera with full remote facility. All controls are located on the side of the camera, within easy reach for fast action. All the tape deck's functions can be controlled from the camera itself — no need to take your hands off the camera at any time during recording!

The camera's reverse and forward search controls let you view the programme while the tape is rewound or advanced to the desired position. The 'play' button on the camera can be used for viewing a recorded tape through the viewfinder.

Other features of the system's camera include hue control, a removeable eyepiece for direct viewing, CRT viewfinder for bright, well defined focusing, microphone jack, remote control terminal and an earphone jack. A condenser microphone with a four-position telescopic boom is designed to minimise camera noise.

A colour check switch is used when adjusting the white balance, and an automatic iris adjustment ensures professional picture quality. The camera also has a macro function for filming small objects at close range, and there is a choice of power or manual zoom.

VCT 5800P is available now from selected video specialists, department stores and electrical retailers throughout Australia at around $2250 including tuner. A range of handy accessories such as a camera case at $59 and camera extension leads at $35 is also available.

For further information contact Sanyo Australia Pty Ltd, 225 Miller Street, North Sydney NSW 2060. (02)436-1122.

## Electronic Lifestyle?

**Whatever happened to Sight & Sound? Its concept has been expanded — that's what!**

This section of the magazine was originally 'Sound' section. When video came along, we changed the section's name to 'Sight and Sound'. What with the increasing range, variety and styles of electronic entertainment equipment appearing and making its presence felt in almost every aspect of our daily lives, this section of the magazine seemed due for an update. Hence, Electronic Lifestyle.

What will we cover? Predominantly home electronic entertainment equipment, plus anything else that seems relevant. The emphasis will still be on audio and video though, as this sort of equipment has the greatest impact in the home and the widest interest among readers.

# PEERLESS SPEAKERS

## The name behind the big names in hi-fi!

### Chosen for their high quality by the world's leading speaker makers!

Peerless is a world authority on loudspeaker design. In fact, many of the world's top hi-fi manufacturers select Peerless speaker components for inclusion in their own Brand Speaker Systems. Made in Denmark, Peerless speakers are incomparable for their high-power handling, smooth frequency response, low distortion and colouration.

Peerless speakers can be purchased three ways:—

1. Fully-assembled in timber cabinets — from bookshelf to floor-standing models.
2. Speaker Kits — build-it-yourself and save up to 40% on assembled speaker prices.
3. Individual speaker components to suit your exact hi-fi needs.

Peerless makes speakers to suit amplifiers from 20-100 watts. For true-to-life sound, Peerless is the name behind the biggest names in hi-fi. Hear Peerless speakers at one of the authorised dealers below — or contact the sole importer for full technical details.

Sole Australian Importer: G.R.D. GROUP PTY. LTD.
698 Burke Road, Camberwell, Vic. 3124. Trade Enquiries welcome.

Peerless

**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 |
| **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 |

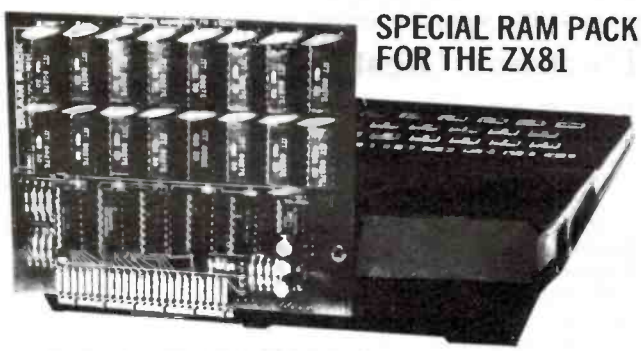
**W.A.**

| | |
|---|---|
| **Claremont** | |
| Danish Hi-Fi Aust. Pty. Ltd. | Ph: (09) 384 2852 |
| **Kalamunda** | |
| Kalamunda Hi Fi | Ph: (09) 293 4333 |

**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 |

# 32K BYTES FOR THE ZX81



**SPECIAL RAM PACK FOR THE ZX81**

This board uses Dynamic RAM chips for lower cost and lower power consumption.

Simply plugs into the ZX81 expansion port offering 32K bytes for Basic programs and data handling. No extra PSU required. AMAZING!!!

Extra memory to help you build up your ZX81 into a powerful microprocesser system at an affordable price. Compare the price with other RAM PACKS available on the market!!!

**PRICE FOR 32K RAM PACK (RP32)**
**ONLY: $165.00 incl. p&p (Australia)**

VEN 0057

**SEND ORDER TO:**
VENDALE PTY. LTD., Dept. T7, P.O. Box 456, Glen Waverley, VICTORIA 3150.
36 Plymouth St., Glen Waverley
(03) 232 0444.

VENDALE

# 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

# MODEL: ANDROMEDA II

## GENERAL DESCRIPTION:

The Andromeda II is a development of five years work, over a painstaking process of elimination, to come up with something this good. All the components are heavily modified and have been changed to suit our design. The reflex twin load porting which is also damped, is at 50Hz to maximise the rear wave in phase to the front, and remain tight also. The use of two midranges is to gain the best in vocal and solo instrument display pattern. The attenuators are constant impedance, the H.F. radiator also modified. One of our "top of the range."

## CABINET MATCHING:

1,000mm de luxe only veneer.

SOUND PRESSURE LEVEL: 1 watt, 1 meter. 94db.

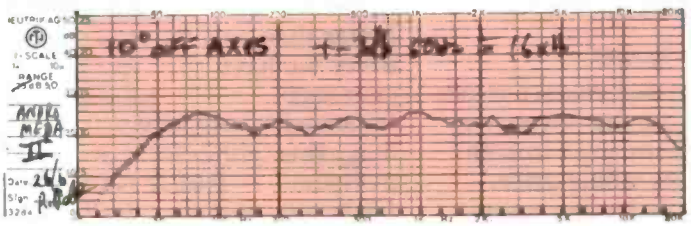
SHIPPING: 1 speaker per carton (matched pairs).

| WEIGHT | IN CARTON | OUT OF CARTON |
|---|---|---|
| | 37.5 Kg. | 36 Kg. |

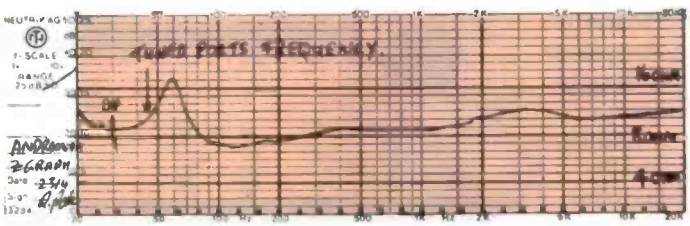
| DIMENSIONS: | | |
|---|---|---|
| Height | 1070 mm | 1000 mm |
| Width | 460mm | 390mm |
| Depth | 480mm | 430mm |

## SPECIFICATIONS:

TYPE: 30cm (12") tuned twin reflex
SYSTEM: 30cm (12") 3-way, 4-element
MAXIMUM RATING: 150 watts (8 ohm)
MINIMUM PREF. DRIVE: 30 watts (8 ohm)
DRIVER SIZE: 30cm (12")
CAPACITY: 108 litres
BAFFLE: 26mm heavy braced
COLOURS AVAIL.: Sen Ash Oak Veneer
ATTENUATION: Mid and high constant
CROSSOVER TYPE: Inductive-cap-res.
CROSSOVER *frequ*:360 Hz-5kHz
MIDRANGE ROLLDOWN: 6db.
MIDRANGE ROLLOFF: 6db.
DRIVER ROLLOFF: 6db.
TWEETER ROLLDOWN: 18db.
TWEETER ROLLOFF: N/A
SUPERTWEETER ROLLDOWN: N/A
FREQUENCY RANGE: 20 Hz to 20 kHz
EFFECTIVE RANGE: 35 Hz to 20 kHz



FREQUENCY GRAPH: CALIBRATED. 0 - 50 db Scale



IMPEDANCE GRAPH (Z) CALIBRATED. 0 - 25 db Scale

ALL GRAPHS ARE LIVE ENVIRONMENTAL

ALL S.P.L. LEVELS ARE CALCULATED FROM A PINK NOISE SOURCE. 1 WATT, 1 METER.

(THIS IS, WE FEEL, A MORE ACCURATE INDICATION OF MUSICAL LISTENING LEVELS, THAN RANDOM SPOT FREQUENCY METHODS).

# PETERSON SPEAKER LABORATORIES P/L

**VICTORIA:** Clive Peeters, all stores; Frankston Sound, Frankston; Brash's, all stores; Reliance Hi-Fi, Footscray; Gleeson & Tonta, Dandenong; Col McKinnon, Sunbury; Crosbies Hi-Fi, Northcote. **COUNTRY:** Mildura Audio World, Mildura; Maryvale Electronics, Morwell & Moe; John Thomas, Ballarat; Roy Vincents, Echuca; Sounds Alive, Shepparton; Peter Huthnance Audio, Bendigo; Brystan, Ryrie St. Geelong. **NEW SOUTH WALES:** Orange Audio, Orange; Car Radio & Hi-Fi, Wagga Wagga; The Record Centre, Griffith; Brian Bambach Electronics, Newcastle; Nitronics, Coffs Harbour; Kent Hi-Fi, Sydney. **WESTERN AUSTRALIA:** High Fidelity Stereo, Picadilly Sq. Perth. **QUEENSLAND:** Queensland Entertainment Co., Eight Mile Plains; Downtown Hi-Fi, Charlotte St. Brisbane. **SOUTH AUSTRALIA:** Audio World, Rundle St. Adelaide; Ernsmiths, The Parade Norwood; Astra Hi-Fi, Woodville Sth. **SOUTH AUSTRALIA (COUNTRY):** O'Connells Stores.

# LIFESTYLE NEWS

## Technics' SP-10Mk3 turntable breaks records!

**Featuring a record-breaking wow and flutter figure of 0.015%, Technics' new quartz synthesiser direct-drive turntable, the SP-10Mk3 is slated to set new standards in turntable performance, according to Technics.**

Its predecessor, the SP-10Mk2 has gained a worldwide reputation for quality and performance — so much so that the Australian Broadcasting Commission's tender specification for turntables says "Technics SP-10 or equivalent".

The SP-10Mk3 incorporates an integral-platter rotor direct-drive motor with a start-up torque quoted as 16 kg.cm which can bring the massive 10 kg platter up to rated 33⅓ RPM speed in quarter of a second! To translate this performance, Technics say that, in theory, as many as 1000 arms, each with 2 g tracking force, could trace a record on this turntable without slowing down the platter at all! A combination of electrical and mechanical braking is incorporated to bring the platter to a stop from 33⅓ RPM within 0.4 second.

The platter, a two layer structure of diecast aluminium and a copper alloy, weighs 10 kg and provides a moment of inertia of 1.1 ton.cm. The turntable body is made of zinc diecast and aluminium diecast and supported on a lower base of anti-resonant compound guarding it effectively against floor-borne and air-borne acoustic feedback.

The quartz oscillator, phase locked servo system reduces wow & flutter to 0.015% WRMS and keeps speed deviation within 0.001%. Rumble is extremely low, the S/N ratio measuring at 92 dB (DIN B, weighted).

One of the few turntables equipped with 78 rpm speed in addition to the standard 33 and 45 rpm, the SP-10Mk3 also offers pitch control in 0.1% increments.

The turntable cannot only be 'fine-tuned' to fit the pitch of musical instruments, but playing times can be precision adjusted to fit available time slots in broadcasting.

The power supply and all controls are located in a separate, cable-connected unit. Remote control is also possible. The unit's dimensions are practically identical with those of the SP-10Mk2, making replacement easy.

It should be available in Australia late this year or early next year.

## New Dynavector arm

**Concept Audio, importers and distributors in Australia for Dynavector Products, have released a new Dynavector tone arm designated the DV-501.**

This new tone arm has similar features to its now well-established and famous big brother, the DV-505, inasmuch as it is a biaxis inertia controlled structure with an electromagnetic damping system. In addition to this, the new DV-501 has an arm lifting device built-in.

Of special interest to Rega turntable enthusiasts, Concept Audio are pleased to announce that the new DV-501 will fit on a Rega turntable with the lid closed, which was previously not possible with the DV-505.

At $450 recommended retail price, the new Dynavector tone arm is expected to gain popularity in the audiophile marketplace very quickly, Concept say. More details from Concept Audio, 22 Wattle Rd, Brookvale NSW 2100. (02) 938-3700.

## Support your records

**Impedance matching a record to a turntable seems an unlikely idea, but the TriPad from Monster Cable claims to do just that.**

The TriPad is constructed of three layers of vastly differing materials, each designed to combat a different problem, they say.

The top surface is an aggregate of cork and rubber particles claimed to damp vinyl resonances. A soft centre area under the record label isolates and damps vibrations arising in the spindle, according to the manufacturers.

The bottom surface is the same soft material used in the top label area, said to damp microvibrations from the turntable platter.

The core of the mat is claimed to isolate the upper and lower surfaces, isolating the conflicting set of vibrations. The top surface is contoured to match the tapered shape of the record. The mat has a low mass, preventing undue extra stress on the turntable.

The makers claim the sonic improvement when using the mat has to be heard to be believed. Enquiries to Convoy International, 4 Dowling St, Woolloomooloo NSW 2011. (02)358-2088.


**POWERLINE — FROM MONSTER CABLE**

**Monster Cable, makers of the well-known speaker cable of the same name, have come up with what they claim is a new 'high definition' speaker cable, called 'Powerline'. It's a four-conductor, 'controlled impedance' cable using two cables per line in a special cross-coupled configuration. The cable exhibits extremely low resistance and is claimed to provide maximum power transfer and negligible phase-shift and high frequency attenuation. Distributed by Convoy International, 4 Dowling St, Woolloomooloo NSW 2011. (02)358-2088.**

# Why Technics Space Dimen

**Leave the walls where they are.** Why do so many users of good quality sound equipment wish to change or modify their listening environment?

Because no matter how good a stereo set-up may be, it will always lack a vital ingredient of a live performance – the ambience and echo characteristic of a concert hall – the third dimension of sound.

Now Technics can provide an interesting answer.

**Let Technics process the signal.** To add this extra dimension to sound reproduction, Technics have developed a special signal processing device – the Space Dimension Controller.

You may think the name sounds dramatic.

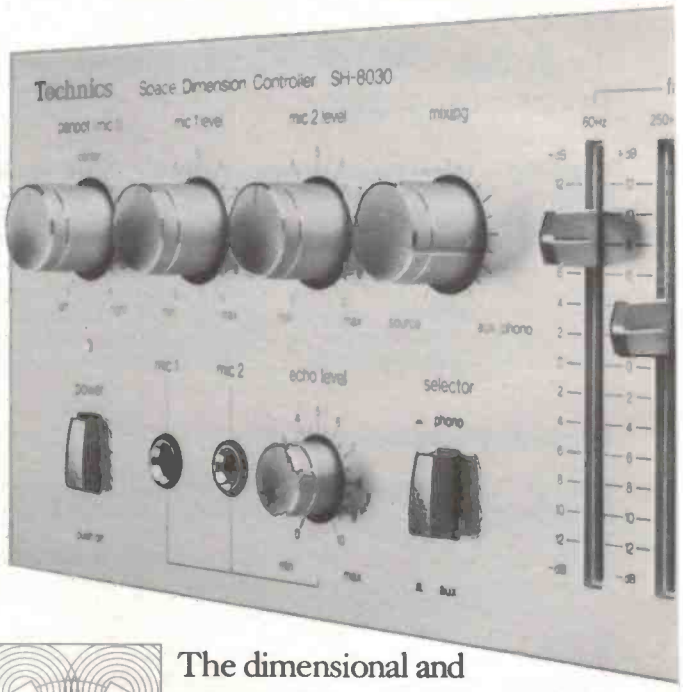
The effect this processing has on conventional stereo reproduction is more than dramatic.

Conventional Stereo Reproduction. With Ambience Effect. With Ambience Plus Echo Effect.

It is stunning; a whole new listening experience.

**Surrounded by sound – from 2 speakers.** The Space Dimension Controller is based on the results of studies in psychoacoustics – or how the brain interprets sound.

Technics can now create a complex aural illusion, that you can control to suit your personal tastes.




The dimensional and echo facilities on this remarkable device add presence and impact to the sounds you hear.

They can completely alter your 'listening stage'.

From being limited to the space between your speakers, the Sound Dimension Controller expands the stereo image to a maximum of 240° – in other words, to 30° *behind you.*

And remember, this is still using only your original two speakers.

**Your own concert hall or recording studio.** Technics have included other useful

# developed
# sion Control.


additional facilities as well: A built-in graphic equalizer; a 'pan pot' (a device to relocate the aural position of anything recorded through the Mic 1 input); plus a program source mixer for fade effects using a second turntable.

However you choose to use the Space Dimension Controller, the end result will be a vastly more entertaining and exciting performance from your existing system.

Of course, all Technics components have a two-year warranty.

Ask your Technics dealer for a demonstration. Very soon.

**Technics**

Expanding the music experience.

Dalley/NPA132

# GRAND HI-FI CONTEST!

***Here's an unbeatable opportunity to win some fabulous hi-fi gear***

We've assembled ***over $7000 worth*** of 'top-shelf' equipment and accessories from some of the world's best-known audio equipment manufacturers to be presented as prizes in the Grand Hi-Fi Contest. We've equipment from Allsop, Audio-Technica, KEF, Marantz, Monster Cable, National Technic, Pioneer, Rega, Sansui, Sennheiser, SME, Sharp, Shure, and TDK.

**YOU COULD WIN A COMPLETE SYSTEM, PLUS ACCESSORIES, WORTH NEARLY $5000! — that's some first prize!**
**OR — YOU COULD WIN A COMPLETE PORTABLE SYSTEM AND ACCESSORIES WORTH MORE THAN $1100!**
**AND THERE ARE 12 CONSOLATION PRIZES! — ranging in value from about $220 to about $15. ALL IN OUR UNBEATABLE**

# $7000 GRAND HI-FI CONTEST!

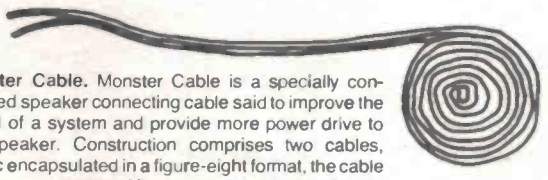
## JUST LOOK AT THE PRIZE LIST:

**Audio-Technica.** One **Audio-Technica ATH8 stereo headphones set.** This superb set of electret headphones — complete with adaptor — offers superb performance. Reviewing them in ETI, September '81, our audio consultant Louis Challis said these headphones ". . . offer a rare example of . . . the sort of quality now regarded as the norm from the best loudspeakers." Value: $353.50. Six **Audio-Technica AT125LC cartridges.** Audio-Technica's new 'para-toroidal' 100-series range of moving-magnet cartridges feature special toroidal-wound coils and dual magnets. AT claim this provides them with outstanding linearity, efficiency and frequency response. Value: $65 each.

**KEF.** A pair of **KEF 104AB loudspeakers** are included in the first prize. KEF's constant research — in particular, their pioneering of the 'cumulative delay response' test technique — has earned them a deserved reputation as being amongst the world's top loudspeaker manufacturers. The KEF 104ABs have an almost unrivalled reputation for linearity and sound quality. Value: $890.

**Allsop.** Twenty **Allsop 3, Model 70300 cassette deck cleaners.** These unique cleaners, housed in a cassette case, are driven by the cassette drive mechanism and clean the heads, capstan and pinch roller with non-abrasive felt pads. Value: $8.50 each. Six **Allsop 3, Model 58000 Orbitrac record cleaning systems.** Another unique Allsop product; the soft bristles of the special cleaning pad, together with the special cleaning solution sprayed on the pad, remove dust and grit from the grooves. Cleaning is not done on the turntable, which can upset drive mechanisms. Value $37.95 each.

**Marantz.** Marantz have offered their superb **ST-8 FM/AM tuner.** This tuner features an oscilloscope tuning display, 'quartz-lock' tuning, low distortion detection and very high signal-to-noise ratio. On FM stereo, Marantz quote an 80 dB S/N ratio, 55 dB on AM. THD on FM stereo is quoted as 0.06% and frequency response as 30 Hz-15 kHz, +0.2, −1 dB. Value $713.



**Monster Cable.** Monster Cable is a specially constructed speaker connecting cable said to improve the sound of a system and provide more power drive to the speaker. Construction comprises two cables, plastic encapsulated in a figure-eight format, the cable being many strands of fine copper wire. Value: $3.58/metre (length to suit).

**National Technics.** One of their latest **microprocessor controlled, dbx cassette decks** is offered — the **RS-M255.** This is a three-head, two-motor machine with colour-coded fluorescent bargraph level display, soft touch controls and metal capability. It has both Dolby and dbx noise reduction systems. This deck is included in the first prize.

**Pioneer.** Pioneer have provided an **A8 amplifier.** Reviewed in **ETI** only last month, this 90 W/channel amp features extremely low distortion — with a THD of 0.0036% at 1 kHz — superb transient response and excellent signal-to-noise ratios. Louis Challis used words like 'superlative' and 'exemplary'. Value $759.

**Rega.** The **Rega Planar 3 two-speed turntable** has been offered by Concept Audio. Noted for their superb engineering and simple design, Rega turntables have a deservedly good reputation among hi-fi buffs. Value: $445. (This will be fitted with the SME arm and Shure cartridge mentioned later).

**Sansui.** Sansui have provided their **SE-8 stereo graphic equaliser/analyser,** featuring a 10-band equaliser in each channel and a plasma spectrum analyser display. In reviewing the SE-8 in ETI's December '81 issue, Louis Challis said the unit "... comes closer to the amateur's expectation of a panacea than anything else ... yet seen ..." Value: $499.

**Sennheiser.** Six **Sennheiser Model HD40 headphones.** These super-light headphones feature a frequency response of 22 Hz-18 kHz and the finest reproduction, the manufacturers say. They have nominal impedance of 600 ohms and are supplied with three metres of cable. Value $29.75 each.

**SME.** Audio Engineers have provided an **SME tonearm** — to be fitted to the Rega turntable. Whenever tonearms are mentioned in conversation, SME is **always** mentioned. Their reputation is unrivalled. Value: $280.


**Shure.** With the SME tonearm, Audio Engineers have thrown in the fabulous new **Shure moving magnet cartridge — the V15 Mk V.** This cartridge has received critical acclaim from reviewers all over the world. Its predecessor, the V15 Mk IV, virtually set a 'standard'; the Mk V looks like establishing a new standard. Value: $375.

**Sharp.** The **Sharp VZ2000 portable hi-fi system** was only recently released here. It features a vertical, bilateral, linear tracking disc player that can **play both sides** of a record without having to turn it over! The system includes a cassette deck with Dolby noise reduction, metal tape capability and an 'auto program search system'. There's a stereo FM/AM tuner too, and the two-way loudspeaker system has separate amplifiers for the woofers and tweeters, providing a total 10 W/channel output. The VZ2000 can be powered from mains, internal batteries or 12 Vdc. Value: $995.


**TDK. 50 TDK SA-C90 cassettes.** TDK tapes need no introduction. The SA on these cassettes stands for 'Super Avilyn', which is TDK's designation for TDK's cobalt-enriched ferric oxide formulation medium. SA tapes are used on high bias/eq setting on a cassette and offer better MOL and frequency response than top-ranked chrome tapes, according to TDK. Value: $6.38 each.

## Prizes have been kindly donated by the following firms:

**Audio Engineers (SME, Shure)**
342 Kent St, Sydney NSW 2000

**Pioneer Electronics (Australia)**
178-184 Boundary Rd, Braeside Vic. 3195

**Concept Audio (Rega)**
22 Wattle Rd, Brookvale NSW 2100

**R.H. Cunningham (Sennheiser)**
146 Roden St, West Melbourne Vic. 3003

**Convoy International (Monster Cable)**
4 Dowling St, Woolloomooloo NSW 2011

**Marantz Australia**
19 Chard Rd, Brookvale NSW 2100

**National Panasonic (Aust.)**
95-99 Epping Rd, North Ryde NSW 2113

**Vanfi Australia (Sansui)**
198 Normanby Rd, South Melbourne Vic. 3205

**Maurice Chapman Aust. (Audio-Technica)**
44 Dickson Ave, Artarmon NSW 2064

**Communication Power Inc. (Allsop)**
P.O. Box 246, Double Bay NSW 2028

**TDK Australia**
Unit 5, Level B South, 100 Harris St, Pyrmont NSW 2009

**Audioson (KEF)**
64 Winbourne Rd, Brookvale NSW 2100

**Sharp Corporation of Australia**
64-72 Seville St, Fairfield NSW 2165

***NOW TURN THE PAGE FOR YOUR CHANCE TO WIN THESE GREAT PRIZES!***

# GRAND HI-FI CONTEST!

## WE'RE LOOKING FOR FOURTEEN LUCKY WINNERS FOR THESE FOURTEEN SUPER PRIZES — YOU COULD BE AMONG THEM!

### HOW TO ENTER

All you have to do is answer the questions on the entry form on the opposite page, fill out the coupon and send your entry to:
**ETI, GRAND HI-FI CONTEST,**
**15 Boundary St,**
**Rushcutters Bay NSW 2011.**

Please read the rules carefully.
Multiple entries will be accepted. You must enter your name and address on each entry submitted. Photostats or clearly written copies of the entry form will be accepted, but if sending copies you **must** cut out and include with **each entry form** the month and page number from the bottom of the page of the contest. When sending multiple entries, then, you will need extra copies of the magazine so that you send an original page number with each entry.

**CONTEST CLOSES 31 AUGUST 1982**

### FIRST PRIZE

**Complete hi-fi system, comprising:**
- Shure V15 Mk V cartridge
- SME tonearm
- Rega Planar 3 turntable
- Allsop 3 Orbitrac record cleaner
- Technics RSM255 cassette deck
- 10 TDK SA-C90 cassette tapes
- Two Allsop 3 cassette deck cleaners
- Marantz ST8 FM/AM stereo tuner with oscilloscope
- Pioneer A8 stereo amplifier
- Sansui SE8 equaliser
- KEF 104AB loudspeakers
- Pair of speaker wires by Monster Cable
- Audio-Technica ATH8 headphone set

**TOTAL : OVER $4900!**

### SECOND PRIZE

**Complete portable hi-fi system, comprising:**
- Sharp VZ2000 portable hi-fi system
- Two Allsop 3 cassette deck cleaners
- Allsop 3 Orbitrac record cleaning system
- 10 TDK SA-C90 cassette tapes
- Sennheiser model HD40 headphones

**TOTAL: OVER $1100!**

## PLUS THESE SIX OTHER GREAT PRIZES!

### 1ST CONSOLATION
- One Audio-Technica AT125LC cartridge
- Two Sennheiser HD40 headphones
- Two Allsop 3 cassette deck cleaners
- One Allsop 3 Orbitrac record cleaning system
- Eight TDK SA-C90 cassette tapes

**TOTAL: OVER $220!**

### 2ND CONSOLATION
- One Audio-Technica AT125LC cartridge
- One Sennheiser HD40 headphones
- One Allsop 3 Orbitrac record cleaning system
- Two Allsop 3 cassette deck cleaners
- Six TDK SA-C90 cassette tapes

**TOTAL: OVER $185!**

### 3RD CONSOLATION
- One Audio-Technica AT125LC cartridge
- One Sennheiser HD40 headphones
- One Allsop 3 Orbitrac record cleaning system
- Two Allsop 3 cassette deck cleaners
- Four TDK C-90 cassette tapes

**TOTAL: OVER $170!**

### 4TH CONSOLATION
- One Audio-Technica AT125LC cartridge
- One Sennheiser HD40 headphones
- One Allsop 3 Orbitrac record cleaning system
- Two Allsop 3 cassette deck cleaners
- Two TDK SA-C90 cassette tapes

**TOTAL: OVER $150!**

### 5TH CONSOLATION
- One Audio-Technica AT125LC cartridge
- One Sennheiser HD40 headphones
- One Allsop 3 cassette deck cleaner
- One TDK SA-C90 cassette tape

**TOTAL: OVER $115!**

### 6TH CONSOLATION
- One Audio-Technica AT125LC cartridge
- One Allsop 3 cassette deck cleaner
- Two TDK SA-C90 cassette tapes

**TOTAL: OVER $85!**

**PLUS — SIX RUNNERS-UP**, each receiving:
- One Allsop 3 cassette deck cleaner worth $8.50
- One TDK SA-C90 cassette tape, worth $6.38.

### RULES

This contest is open to all persons normally resident in Australia with the exception of members of the staff of Audio Engineers Pty Ltd, Pioneer Electronics (Australia) Pty Ltd, Concept Audio Pty Ltd, R.H. Cunningham Pty Ltd, Convoy International Pty Ltd, Marantz Australia Pty Ltd, National Panasonic (Aust.) Pty Ltd, Vanfl (Australia) Pty Ltd, Maurice Chapman Aust. Pty Ltd, Communications Power Inc. (Aust.) Pty Ltd, TDK (Australia) Pty Ltd, Audioson Pty Ltd, Sharp Corporation of Australia Pty Ltd, Murray Publishers, Offset Alpine, Australian Consolidated Press and/or associated companies.

**Closing date for the contest is 31 August 1982.**

Entries received within seven days of the closing date will be accepted if postmarked prior to and including 31 August 1982.

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

Following closing of the contest, all entries will be put into a box and thoroughly mixed. Entries will then be drawn from the box at random and the first fourteen correct entries drawn will be declared winners in the order drawn.

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

Contestants must enter their name 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, accompanying this contest, that they have read the above rules and agree to abide by their conditions.

**You may enter as many times as you wish but you must use a separate entry form for each entry and include the month and page number cut from the bottom right hand portion of the page containing the entry form. You must put your name and address on the entry form and sign it where indicated.**

# ENTRY FORM

TC.82-801

**QUESTION 1**
It can be established without any shadow of doubt that one and only one of the following statements is true. In each instance the statement relates to whether or not significant scientific discoveries were made in Britain between September 3rd and September 13th 1752.

- ☐ Many significant discoveries were made
- ☐ A few significant discoveries were made
- ☐ No significant discoveries were made
- ☐ The question is impossible to answer

**QUESTION 2**
On February 14th 1876 Alexander Graham Bell filed his now-famous patent for a telephonic apparatus. Just three hours later (and hence three hours too late) someone filed a caveat with the Patent Office regarding a basically similar device. What was that person's surname?

- ☐ White
- ☐ Brown
- ☐ Gray
- ☐ Siemens
- ☐ Edison

**QUESTION 3**
Who utilised a diaphragm and hog bristle to develop what? And (roughly) when?

Who? .....

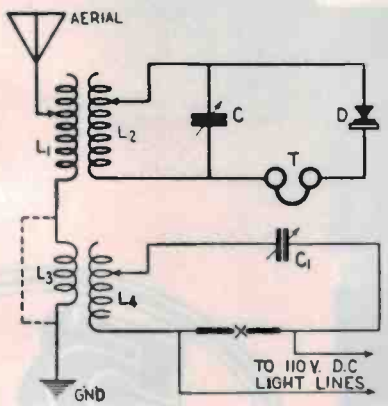
What? ..... When? .....

**QUESTION 4**
What were the physical dimensions of Hollerith's first punched cards? What influenced him to use that specific size?

.....

.....

.....




**QUESTION 5**
What is this device — please explain in less than 25 words. (note — the caption 110 V.DC is not an error)

.....

.....

**QUESTION 6**
What is/was a 'Rheotome'?

- ☐ Early wave-form plotter
- ☐ Book of resistor terminology
- ☐ Type of rheostat
- ☐ Early 'Variac'
- ☐ Transformer with variable primary/secondary ratio

**QUESTION 7**
Who wrote "Is it a fact — or have I dreamt it — that, by means of electricity, the world of matter has become a great nerve, vibrating thousands of miles in a breathless point of time?"
Clue: the year was 1851.

- ☐ Nathaniel Hawthorne
- ☐ Neville Williams
- ☐ Joseph Joubert
- ☐ Charles Lamb
- ☐ William Hazlitt
- ☐ Dennis Lingane

**QUESTION 8**
Decimal time was actually introduced by one European country and retained for two years.

Which country? .....

Approximately when? .....

**QUESTION 9**
Who is this man (born 1806) and how did he have great influence on computing? Limit answer to 25 words maximum please.

.....

.....

**QUESTION 10**
The discovery of thermoelectricity is usually attributed to T.J. Seebeck. There is evidence that his discovery was anticipated by someone else. Further to this, the effect was also discovered quite independently by yet another. Who were these two people? (Tick two names.)

- ☐ Peltier
- ☐ Cummings
- ☐ Dessaignes
- ☐ Nobilli
- ☐ Faraday
- ☐ Melloni

**QUESTION 11**
Taking facsimile transmission to mean 'a method by which printed, handwritten and graphic data may be transmitted via communication channels and recreated as hard copy', when was the concept first patented?

- ☐ 1843
- ☐ 1877
- ☐ 1905
- ☐ 1923
- ☐ 1931

**QUESTION 12**
Babbage is best known for his work with calculating machines. Nevertheless, his genius extended beyond this. One of his inventions was used by the Russians in the Crimean War. Which?

- ☐ Mirror for indirect sighting of artillery
- ☐ Rocket for boosting projectiles
- ☐ Signalling lamp
- ☐ Railway dynamometer car

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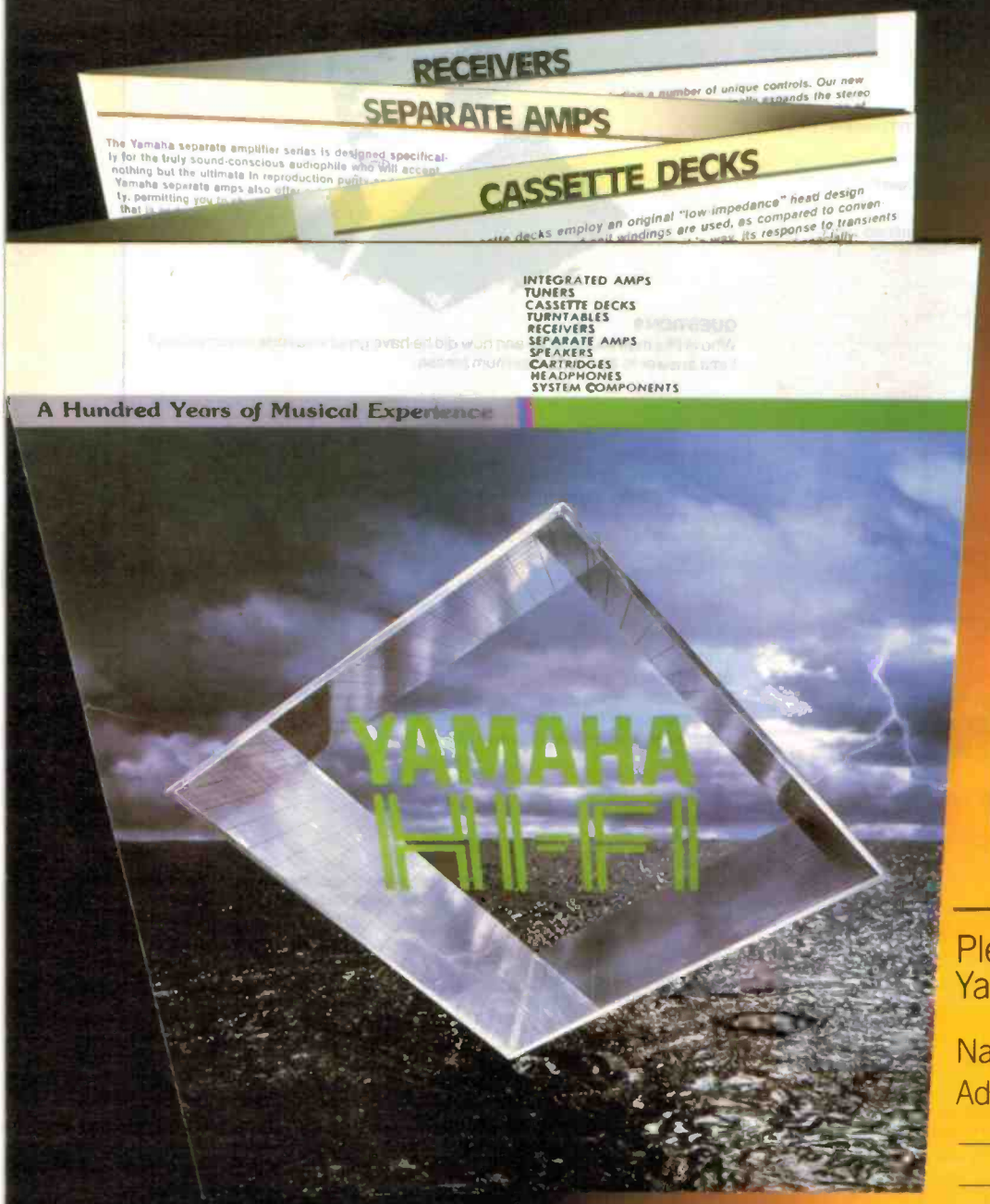



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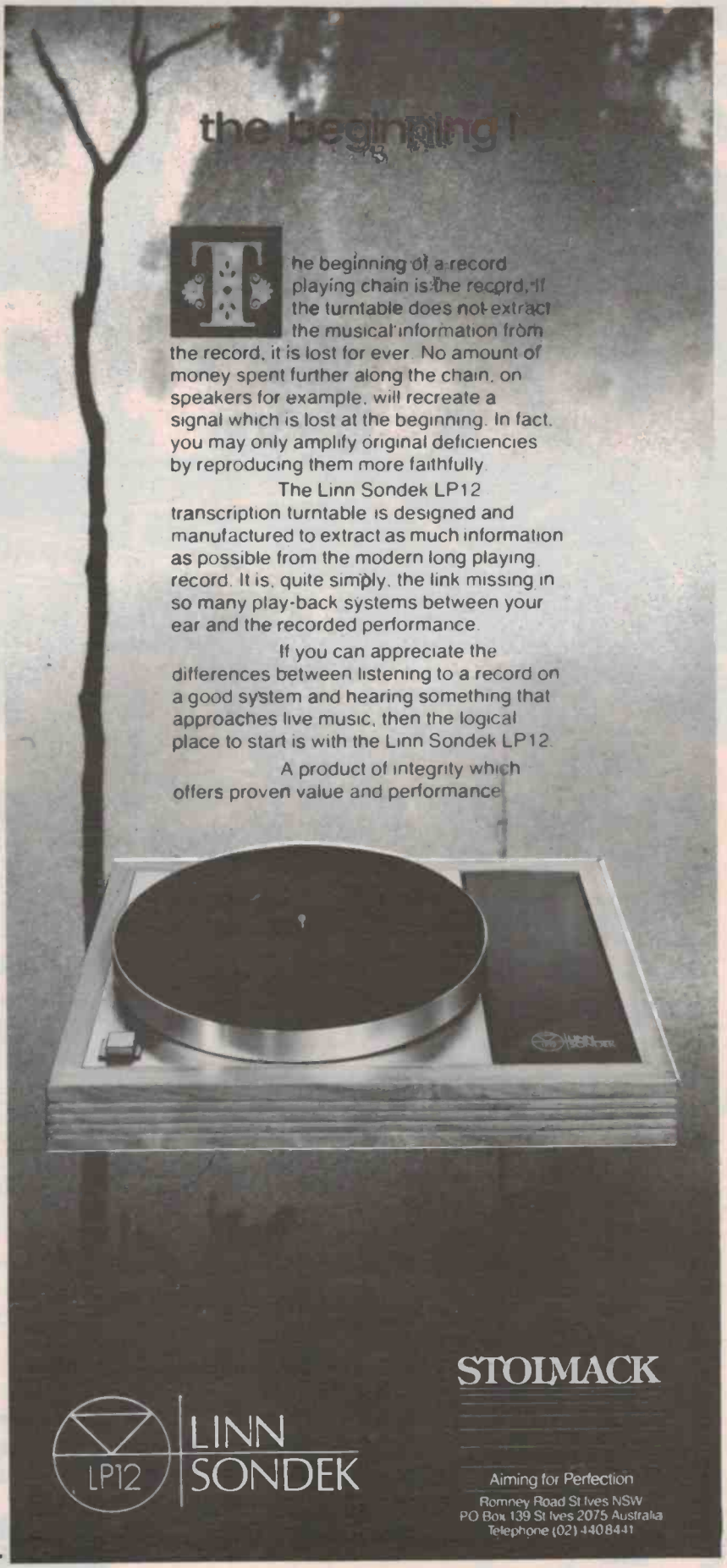

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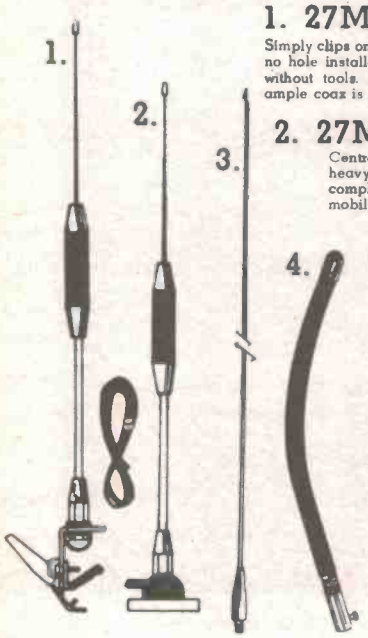


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# Setting up an outdoor PA system

Geoff Nicholls

This article covers the background theory and practical techniques you need to know to successfully set up and operate an outdoor PA system — with particular reference to the ETI-498/499 150 W PA project.

SETTING UP an outdoor public address system correctly can mean the difference between effective audience communication and totally indifferent results. And guess whose can get kicked when the system doesn't work as expected?

Before starting out, it is wise to know a little background theory to the various parts of the system. A little theory is introduced at each stage, to provide the appropriate background, so let's start off with sound propagation.

## Sound propagation

Sound propagates from a vibrating source in the form of longitudinal mechanical waves, which oscillate the particles in the medium along an axis in the direction of sound propagation.

The velocity of sound in still air is temperature dependent, and is approximated by the formula:

$$v = 20\sqrt{273 + T}$$

where $v$ = velocity of propagation in m/s
$T$ = air temperature in °C

Logic would suggest that the sound pressure level should fall off with increasing distance from the sound source by an inverse square law, because of the expanding area of the sound wavefront. In fact, additional losses are present due to dissipation of the sound energy by mechanisms too complex to discuss in this article.

These loss processes are frequency dependent, and lead to increasing attenuation of high frequencies with distance, but fortunately they can be ignored for speech frequencies up to distances of about 100 m. The inverse square law is therefore adequate for *general* outdoor PA calculations. The decibel SPL formula is given by:

$$\text{dB SPL(X)} = \text{dB SPL(R)} + 20 \log \frac{D_R}{D_X}$$

where dB SPL(X) is the SPL in decibels at point X
dB SPL(R) is the SPL in decibels at the rise to refraction or bending of the sound reference point R
$D_R$ is the reference distance from the sound source
$D_X$ is the reference to point C from the sound source

Temperature gradients in the air give rise to refraction or bending of the sound from its original direction. When the sound is refracted it bends towards the coolest region because the sound travels faster through the warmer region. This is analagous to a bimetallic strip which bends because of differential expansion.

Most outdoor venues are warmest near the ground during the day, and so the sound tends to bend upwards. One notable exception is over a large water surface, which during the day tends to be cooler than the air, and so causes sound to bend down towards the surface. This can cause sound to carry long distances over water.

Windy conditions cause sound to be refracted because of gradients in wind speed in a similar manner to temperature gradients. In general winds are slower near the ground, and this causes an upward bend when the sound is into the wind and a downward bend when the sound is with the wind. Transverse winds have little effect on refraction, although irregularities in all winds cause scattering of the sound.

The ground will reflect a certain amount of sound and absorb the rest. The reflected part can be utilised to reinforce the direct sound and increase the overall level by up to 3 dB, depending on the ground surface.

## Setting up a PA

A PA system will be satisfactory if all the listeners can understand what is being announced without concentrated effort. The following criteria will generally allow this:

- The SPL at the listener is below the tolerable limit.
- The articulation of consonants is acceptable.
- The PA SPL at the listener exceeds the ambient noise SPL by at least 10 dB SPL.
- The sound at the listener does not contain annoying echo.
- The system is not 'howling'.

It is obvious that no one will remain in an area where the sound is so loud it is uncomfortable. Certain outdoor events involving high-powered motors (such as drag boat racing) can have an ambient level over 120 dB SPL, but only for a short period of time. It is impractical to have the PA loud enough to override such ambient levels. ▶

The articulation of consonants depends primarily on the voice characteristic of the announcer. Successful announcers usually have good consonant articulation. It is possible to improve this factor by using a shaped filter response, such as the speech filter employed in the ETI-498.

The public address system sound must obviously be perceived as louder than the ambient noise, or it will be drowned out. An increase of SPL by 10 dB subjectively sounds twice as loud, and for outdoor set-ups forms a good signal-to-noise ratio to aim for at the limit of the PA coverage area.

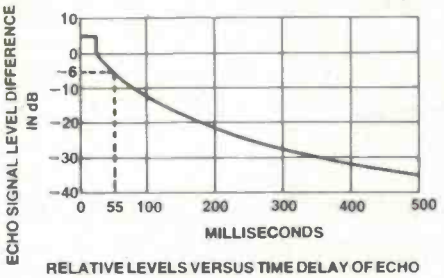
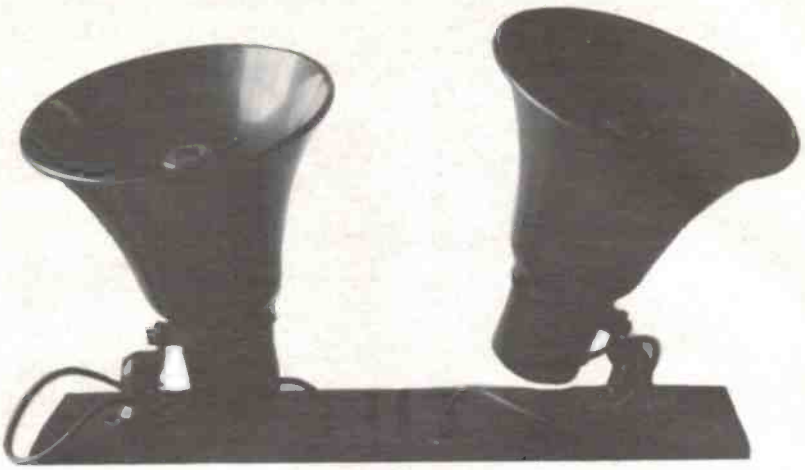



*Figure 1.* **Echo level versus time delay for 10% audience annoyance, produced by Doak and Bolt (see References at end of article).**

An echo will arise when there are unequal distances between the listener and two (or more) loudspeakers being driven by the same signal. An investigation by Doak and Bolt resulted in the compiling of a chart which allows us to estimate when an echo will become annoying to 10% of the audience. The chart plots the difference in SPL between the main signal and the echo against the time delay of the echo. An echo can also arise due to reflection off a hillside or building.

## Acoustic feedback

Nearly everyone will have experienced the howling that occurs when a microphone is placed too near a loudspeaker it is driving. This phenomena is acoustic feedback and arises when the total gain of a sound system from the microphone through the amplifier to the speakers and back to the microphone exceeds unity. This usually occurs at a single frequency or a few dominant frequencies, because of peaks in the system response.



The problem of acoustic feedback is complicated when public address systems are used indoors because of the room shape which gives rise to many resonances. Complex equalisers are employed to smooth out the overall response and therefore allow the sound level to be increased before feedback occurs. Indoor public address techniques will be the subject of a future article in ETI.

Acoustic feedback is less of a problem in open spaces since there is usually only direct sound present — little or no reverberation from reflecting surfaces. Correct system layout should avoid feedback problems.

## Speakers

The horn loudspeaker is by far the best type for outdoor use. Horns can be made weatherproof and have an efficiency of better than 20% compared to a few per cent for ordinary speakers. This allows an amplifier of lower power to be used, with consequent savings in electricity, physical size and weight. Horn speakers are available with inbuilt 100 V line transformers, usually with several taps to select different power levels. This allows some speakers to be placed closer to the audience and their output reduced to compensate without affecting other speakers on the 100 V line.

Horns are intrinsically limited in their frequency response, and their efficiency is inversely proportional to their bandwidth. PA horns are designed to operate over the voice band at maximum efficiency. The horn itself is esentially an impedance transforming device which increases the acoustic loading on the driving diaphragm to allow better matching to the air. The shape of the horn is usually based on the exponential function and provides a cross sectional area which is dependent on distance along the horn by the formula:

$$A = A_0 E^{mx}$$

where $A$ = area of cross-section at distance 'x' from throat
$A_0$ = throat area
$E$ = Naperian base (2.718128)
$m$ = 'flaring' constant.

The horn may be straight, as shown in Figure 2, or folded, as shown in Figure 3. The folded horn is physically smaller and is the most common type in low cost PA systems. Folding the horn reduces the efficiency slightly but increases the coverage or dispersion, which is usually an advantage. The straight horn has a long 'throw' and is useful for narrow sound coverage at greater distances but is more cumbersome, especially when you are 8 m up a ladder! ▶

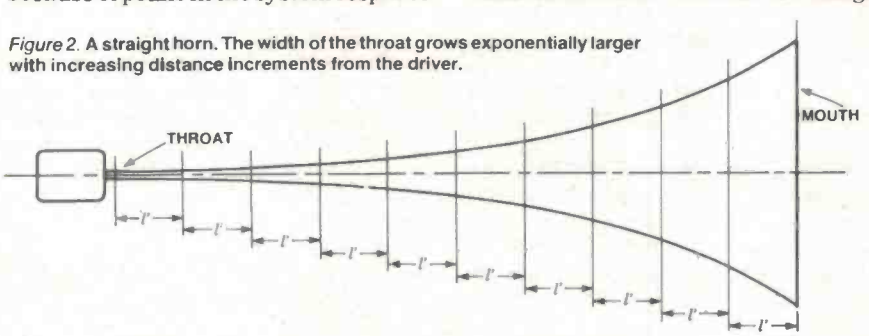



*Figure 2.* **A straight horn. The width of the throat grows exponentially larger with increasing distance increments from the driver.**

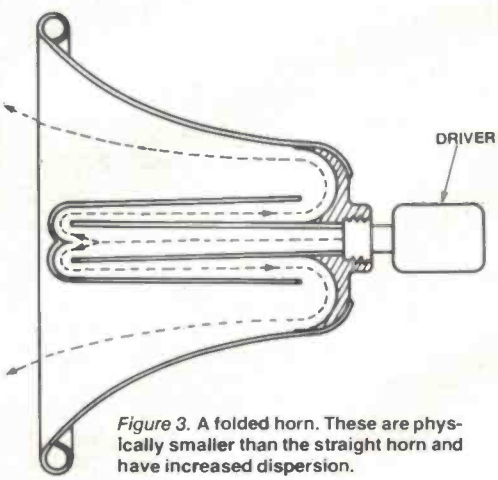



*Figure 3.* **A folded horn. These are physically smaller than the straight horn and have increased dispersion.**

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| | Force At The Stylus Tip | Total Tone Arm Setting With Dynamic Stabiliser Operating |
|---|---|---|
| Optimum | 10 mN (1.0 gram) | 15mN (1.5 grams) |
| Maximum | 12.5 mN (1.25 grams) | 17.5 mN (1.75 grams) |

**Force Exerted By Dynamic Stabiliser:** 5 mN (0.5 grams)

**Tip Geometry** (Typical): Hyperelliptical, 5μ x 38μ (0.2 mil x 1.5 mil) long contact

**Trackability At 10 mN** (1 gram) **Tracking Force** (Typical in cm/sec peak velocity):

400Hz: 30cm/sec — 5kHz: 80cm/sec
1kHz: 46cm/sec — 10kHz: 60cm/sec

**Total Trackability Index (TTI):** 91.7 minimum

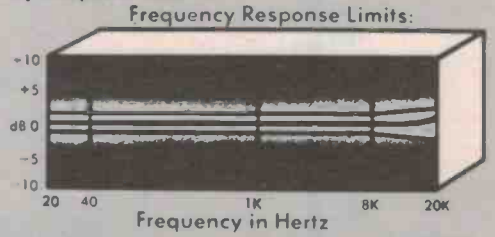
**Vertical Tone Arm Resonance:** Less than 5dB rise at 14Hz in SME Series III Tone Arm (without SME damper)

**Channel Balance:** Within 1.5dB

**Channel Separation:** 1kHz: 25dB or greater
10kHz: 18dB or greater

**Output Voltage** (Typical): 3.2mV RMS at 1kHz at 5cm/sec peak velocity

**Frequency Response Limits:**




**Recommended Load:** 47 kohms in parallel with 250pF (includes tone arm wiring, connecting cables, and preamplifier input) Capacitive loading from 100pF to 400pF will cause negligible change from the recommended 250pF loading

**Resistance** (Typical): 815 ohms, dc

**Inductance** (Typical): 330mH at 1kHz

**Cartridge Weight:** 6.6 grams

**Replacement Stylus:** V15V: VN5HE, Nude Hyperelliptical tip, 5 x 38μ (.0002 x .0015 in) Black serial numbers
V15V-G: VN5G, Nude Spherical tip, 15μ (.0006 in) Red serial numbers

**Optional 78 RPM Stylus:** VN578E, Biradial (Elliptical) tip, 13 x 63μ (.0005 x .0025 In)

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## Microphones

A good microphone forms the heart of a good PA system and vice versa. The most suitable type for outdoor use is the unidirectional, low impedance dynamic microphone. This type is rugged and can withstand the abuse an outdoor setup will inflict. The directional characteristic is extremely important when the announcer is within the range of the speakers, and can make a big difference to the sound level attainable before feedback occurs. The low impedance microphone can also be used with a longer cable than the high impedance types, and will not pick up as much interference.

## System layout

The overall performance of an outdoor PA is dependent on the location and type of loudspeakers and microphones. The placement of the amplifier and microphone is usually dictated by the facilities at the venue, i.e: commentators are found in control towers, dias' etc., which are fixed structures. If mains power is needed, the amplifier position is limited by the length of available extension cords.

WARNING! *Check the integrity of extension cords before allowing anyone to use the system.*

Assuming that the amplifier location is determined, the next job is to arrange the horn speakers to cover the listening area.

The simplest layout is the centralised cluster, where all speakers are together. This eliminates any time delay effects and simplifies wiring. To be effective, the cluster must distribute the sound so that nearby listeners are not deafened and distant listeners are able to hear the PA. This will require a high mount and possibly the use of straight horns to reach the furthest listeners.

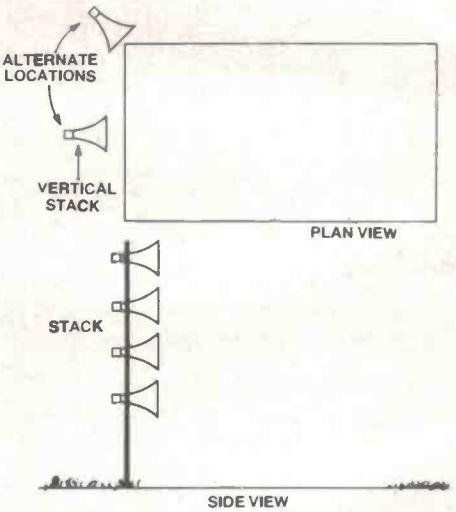



*Figure 4.* **The centralised cluster of speakers. Note the speakers should point slightly downwards.**

Venues suitable for a centralised cluster are ovals and parks where the length-to-width ratio is less than about 2 to 1. The speakers should be positioned away from the commentary along the short end position and should point slightly downwards from the horizontal in a vertical stack. If they must be sited along the long side of a rectangular area then an additional vertical stack should be added and splayed about 75° apart.

It may be necessary to use long-throw straight horns to reach the furthest areas, these should be mounted on the top of the stack.

Additional 'side fill' horns are used to service listeners behind the main coverage area.

The vertical stacking results in a horizontal 'fan' of sound and reduces wasted acoustic energy upwards and downwards.

### PERCEIVED SOUND PRESSURE LEVELS

The human sense of hearing is stimulated by small variations in the air pressure at the ear. In order to perceive a sound the local pressure variations must conform to a limited range of frequencies and a minimum amplitude of vibration.

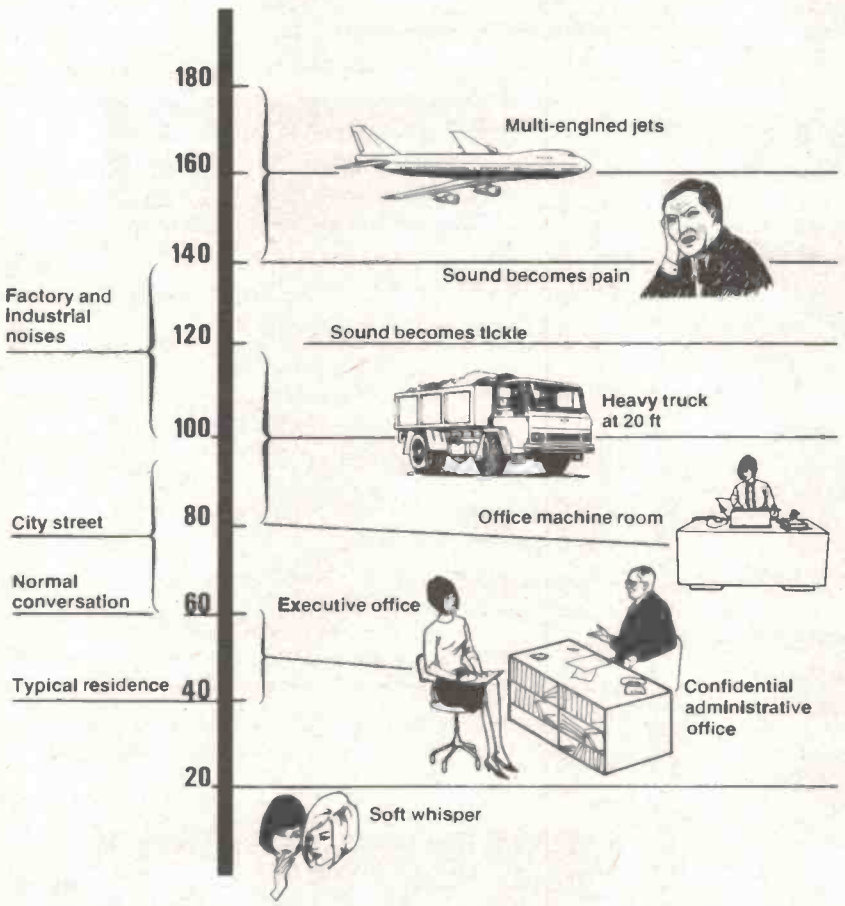
The amplitude frequency range is usually quoted as 20 Hz to 20 kHz, although the precise range depends on individual characteristics, particularly age and when the ears were last cleaned out! The minimum amplitude of pressure variations required for the perception of a 1 kHz sound in a young person's ear is about 20 uN/m$^2$ (or 20 uPa). Since this level represents a lower limit it is used as a reference for sound pressure levels and is given the value 0 dB SPL.

The largest sound pressure variation that can be tolerated without pain is about 100 N/m$^2$, which can be expressed as:

$$20 \log_{10} \frac{100}{20 \times 10^{-6}} \text{dB}$$

or about 134 dB SPL.

It is interesting to compare this to the variation in air pressure that often accompanies the approach of a storm, when a drop of 10 000 N/m$^2$ can occur in a few hours! Such slow changes in pressure cause our ears no distress because the inner ear is vented to the atmosphere through the Eustachian tube, which equalises the pressure on the eardrum.




- For a sound to be perceptibly louder or softer, it must be changed by three decibels.
- A noise twice as loud or half as loud is a change of ten decibels.
- A reduction in noise of a few decibels in the low noise region (administrative office) is not significant. The same change at high sound levels (office machine room) is significant.

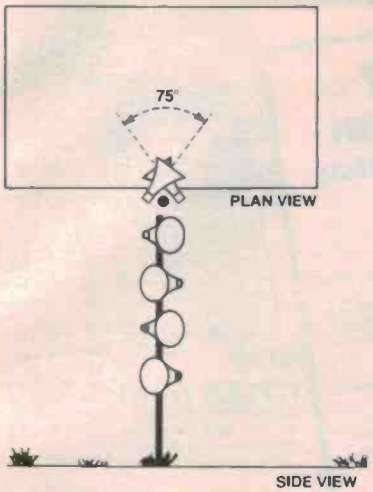



*Figure 5.* Mounting a cluster along the side of the area to be covered requires the horn throats to be angled at about 75° and they must overlap.

Some venues are not suited to a centralised cluster. For instance, riverside events tend to concentrate the crowd in a thin rectangle along the bank. Such cases require multiple loud speakers, and care must be used in planning the sound sources to avoid annoying echo effects.

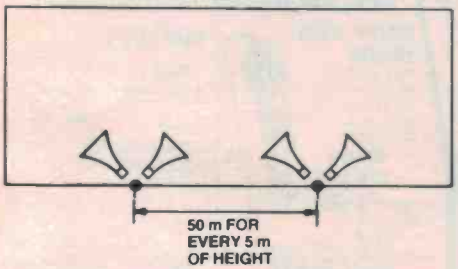



*Figure 6.* Horn positioning for covering a long, narrow area.

The best results are obtained by using a large number of speakers evenly spaced along the long axis operating at fairly low levels, but this is expensive. The higher the speakers can be mounted the further apart they may be spaced. As a rule of thumb, each 5 m of height allows a speaker spacing of 50 m.

## Wiring

I have found that figure-8 lighting cable is well suited for wiring 100 V loudspeaker systems. Although somewhat overrated for audio power levels, the cable is durable and cheap, and is easy to strip. Many connections are made with the strip-twist-tape technique atop ladders, and a light fiddly cable is a hassle to use. It is convenient to have fixed lengths of pre-cut cable to avoid constantly breaking and rejoining a single cable.

I have mounted pairs of horn speakers on wooden battens with spring connectors mounted on them. Holes in the battens allow the speakers to be tied to various poles or trees with rope or spare figure-8 cable. The spring connectors prevent progressive shortening of the cable from the speaker due to repeated cutting and stripping of the end of the cable.

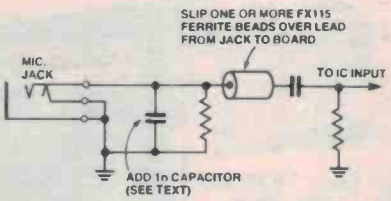
*All budding sound or PA engineers should get a copy of what is almost 'the Bible' — "Sound System Engineering", by Don and Carolyn Davis, published by Howard Sams (USA). This is currently available through ETI Book Sales. See pages 28-29 this issue.* ●

## RF INTERFERENCE SUPPRESSION — TECHNIQUES

**Interference pickup on speaker leads may be cut by winding part of the lead, nearest the amplifier terminals, on a ferrite rod — available at many parts suppliers.**

Public address amplifier systems may be prone to RF interference from a variety of sources — and the source may be unknown or hard to track down. Sometimes the source is well known but impossible to eliminate — a nearby AM broadcast transmitter, for example. CB or marine transceivers in the vicinity of a PA system are notorious sources of annoying intermittent interference. But it's not the fault of the 'offending' transmission; the characteristics of modern solid state devices are the major culprits.

A number of techniques can be employed to protect a PA amp from interference. As it will depend on the individual application, we leave it to the constructor how much, or how little, interference protection to incorporate.




**Adding RF suppression to the low level inputs.**

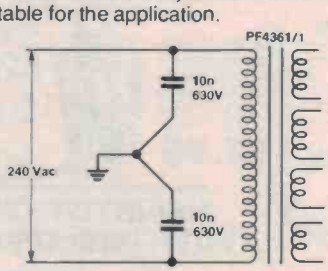
### THE 'FRONT END'

The low-level input stages are particularly prone to RF pick-up. There are two components you can add quite simply to protect each low-level input. Firstly, a ferrite bead, such as the commonly available FX115 type, can be slipped over the lead running between the jack socket and the pc board. Secondly, a 1n 'greencap' capacitor can be soldered directly across the input jack socket terminals. If the leads of this capacitor are cut to a length of 25 mm, the capacitor will have a broad series resonance around 27 MHz, greatly aiding suppression of CB and marine radio interference. These components may be added to both MIC 1 and MIC 2 inputs.

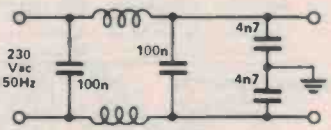
For the AUX input, a greencap with a value between 2n7 and 10n should be used.

### THE 'BACK END'

Long runs of loudspeaker cable have the annoying tendency to act as antennas. 'Choking off' the RF once it gets on a cable run can be problematical. One of the most effective methods is to wind that part of the cable nearest the amplifier speaker terminals on a ferrite rod — such as is used for transistor radio loopstick antennas. This makes a very good broadband RF choke, but it *must* be installed as close to the amplifier output terminals as possible. There's nothing critical about it, but the ferrite rod should be at least 100 mm long, preferably longer. Ferrite rod in 200 mm lengths, 9.5 in diameter, is commonly available and quite suitable for the application.




**Adding interference suppression on the mains input. The value of each capacitor may be anything between about 4n7 and 100n. They should be rated at 630 V or 1 kV.**




**Circuit of a mains input filter. The chokes should have an inductance between 5 mH and 50 mH and be capable of carrying up to 2 A. The capacitors may be greencaps or ceramic types rated at 630 V or 1 kV.**

### MAINS-BORNE INTERFERENCE

Apart from radio interference coupled into mains cables, light dimmers, motor controllers and switch contacts on mains equipment connected to the same line as the PA amp can cause a variety of clicks, pops and buzzes to be heard on the system. Proprietary mains filters can be obtained and often prove very effective. Alternatively, you can build a filter into the PA amp.

One of the simplest suppression methods is to connect a 10n/630 V greencap or ceramic capacitor from each side of the mains transformer primary to the chassis — at the same point. Three-pin mains plugs can be obtained with capacitors installed and may be quite effective. A 'pi' filter can be built up, as shown in the accompanying circuit, and installed in the amp's chassis.

## CORRECTION ...

In the Dick Smith Kit Catalogue (inserted in EA last month and available from all Dick Smith stores) two kits were shown with their magazine references transposed. The Earth Leakage Detector Kit (Cat K-3315 @ $45.00) was published in ETI while the Infra Red Light Beam Relay Kit (Cat K-3380 @ $59.00) appeared in EA magazine. Also on the Playmaster Speaker Kits page, readers should note that the 200mm system shown is not the new style, but the original. The 250 and 300mm systems are the new style as photographed.

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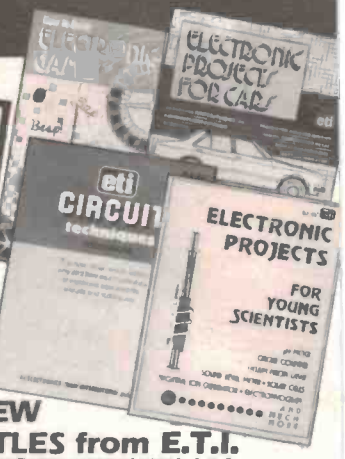
*These bands include the entire aircraft bands plus the 2 metre amateur band, police, fire, ambulance frequencies, two way car radio, taxis etc.*

Cat D-2833

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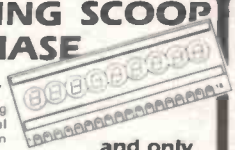

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| .0018 | R-2018 | 25c | 20c |
| .0022 | R-2020 | 25c | 20c |
| .0027 | R-2027 | 25c | 20c |
| .0033 | R-2025 | 25c | 20c |
| .0039 | R-2030 | 25c | 20c |
| .0047 | R-2035 | 25c | 20c |
| .0056 | R-2040 | 25c | 20c |
| .0068 | R-2045 | 25c | 20c |
| .0082 | R-2050 | 25c | 20c |
| .01 | R-2055 | 25c | 20c |
| .012 | R-2057 | 25c | 20c |
| .018 | R-2062 | 25c | 20c |
| .015 | R-2060 | 25c | 20c |
| .022 | R-2065 | 25c | 20c |
| .027 | R-2067 | 25c | 20c |
| .033 | R-2070 | 25c | 20c |
| .039 | R-2075 | 25c | 20c |
| .047 | R-2080 | 25c | 20c |
| .056 | R-2085 | 25c | 20c |
| .068 | R-2090 | 25c | 20c |
| .082 | R-2095 | 25c | 20c |
| .1 | R-2100 | 28c | 23c |
| .12 | R-2102 | 28c | 23c |
| .15 | R-2105 | 28c | 23c |
| .18 | R-2107 | 28c | 23c |
| .22 | R-2110 | 28c | 23c |
| .27 | R-2115 | 35c | 30c |
| .33 | R-2120 | 35c | 30c |
| .39 | R-2125 | 39c | 34c |
| .47 | R-2130 | 49c | 38c |
| 1.0 | R-2135 | $1.25 | $1.15 |
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| 5A | S-4425 |

3AG TYPE

| | |
|---|---|
| 100mA | S-4449 |
| 150mA | S-4451 |
| 250mA | S-4453 |
| 350mA | S-4455 |
| 500mA | S-4457 |
| 1A | S-4461 |
| 1.5A | S-4465 |
| 2A | S-4467 |
| 3A | S-4469 |
| 5A | S-4471 |
| 7.5A | S-4473 |
| 10A | S-4475 |
| 15A | S-4477 |
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**Remote Bleeper**

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DSE/A314/PAI

# Polk RTA-12B loudspeaker system

"The Polks are different and the Polks are impressive" — but they're certainly not the 'reference monitors' the manufacturers claim them to be, according to Louis Challis.

**Louis Challis**

OVER THE LAST six years the name Polk Audio has repeatedly stared out at me from advertisements in American hifi magazines. Most of these ads have revealed unusual configurations, which by and large tend to indicate that the company's designers are searching for new and innovative approaches to achieve improved acoustics.

The company's chief designer, Mathew Polk, formed the company in 1972 with two fellow graduates of John Hopkins University. From the outset his design philosophy has differed from that of his contemporaries in that he strongly believes that, "Reproduced sound can never sound the same as the original live sound . . . therefore the loudspeaker designers must make products that can accurately *represent* that recorded material rather than the live performance." He also strongly believes that whilst objective measurements can put his designs into the correct ballpark, they cannot provide sufficient data to correct for the emotive design factors which he rates so highly in his designs. Not surprisingly, Polk has already earned a widespread reputation and is attracting a large following in the American market. Many buffs are convinced of the quality of his designs and more particularly by the quality of the sound that his speakers produce.

## The RTA-12B

This particular model, the RTA-12B, is apparently an upgraded version of the RTA-12, for which the manufacturers originally claimed excellent phase response, good stereo imaging and a very wide frequency response.

**POLK RTA-12B LOUDSPEAKER SYSTEM**

| | |
|---|---|
| *Dimensions:* | *Height 1002 mm; width 402 mm; depth 303 mm.* |
| *Weight:* | *26 kg* |
| *Price:* | *Rrp $1450* |
| *Manufactured:* | *In Baltimore, USA, by Polk Audio* |
| *Distributor:* | *Leisure Sound Pty Ltd, 401 Pacific Hwy, Artarmon NSW. (02)438-4166.* |

The RTA-12B is an unusual-looking speaker. Instead of the normal 200 mm, 300 mm or even 350 mm diameter woofer, this unit incorporates a pair of long throw 170 mm diameter woofers mounted side by side at the top of the cabinet. These are positioned above a 300 mm diameter passive radiator, which is centrally located on the front panel of the enclosure, behind a black open-weave cloth-faced cover panel. The concept of using such small drivers for the main woofers is not in itself unusual, as Aram Bose, of the American Bose Corporation, and the Swedish Audio Pro sub-woofer systems have each shown that properly designed small drivers are capable of working at frequencies as low as 20 Hz.

The significant difference between this system and other loudspeaker systems is, however, that the two drivers are not designed to share the load equally. The outer woofer in each pair is designed for work up to only 600 Hz, whilst the inner woofer is designed to extend its output up to 2 kHz, at which point the tweeter takes over. The designers claim to have taken this unusual step in order to reduce the 'comb filtering' effect that a pair of drivers produces in their radial polar plot. This cyclical cancellation from two drivers handling the same signal only occurs off the main axis, where the diffraction effects of the two speakers result in enhancement and notching of the primary signal. This phenomenon results in a polar plot not unlike the petals of a daisy, and becomes more complex because the phase response at these same points and even directly on axis must also be adversely affected as a result of this novel 'design feature'.

At frequencies above 2 kHz a single 25 mm dome tweeter is used to cover the decade extending from 2 kHz to 20 kHz. This tweeter is mounted in an equally unusual configuration, in that it sits on top of the main cabinet mounted in a small baffle with chamfered edges (to reduce diffraction effects) and a sloping ramp-like panel immediately below the driver cone. This ramp provides a hard reflecting surface to direct the high frequency energy forwards, whilst simultaneously reducing unwanted reflections from the top of the cabinet.

The tweeter baffle is mounted on a separate sub-plate, which screws down on a large air-cored crossover network. This is arranged as much for its 'high technology' visual effect as for the mounting convenience and possible ease of adjustment. The main air-cored inductors of this crossover are wound on two large-diameter moulded plastic bobbins mounted side by side on the top of the main cabinet. These inductors are used to support a printed circuit card, onto which a series of smaller inductors, capacitors and resistors are mounted. The whole crossover assembly is screw-fixed to the top of the cabinet, which is then covered by a small rectangular cloth-covered frame that matches the main speaker grille on the front of the enclosure. The two tweeters and their crossover networks come packaged in a third box. These have to be assembled by bolting them onto the top of the enclosure with thumb screws. The interconnection between the two assemblies is made by means of a plug which latches into a socket on top of the main cabinet.

The cabinet is well finished with plastic veneer. Electrical connections are made by means of pairs of universal terminals, colour coded and set into moulded recesses on the back panels.

The crossover network and tweeter come as a single unit which mounts to the top of the bass enclosure and connects via a plug.

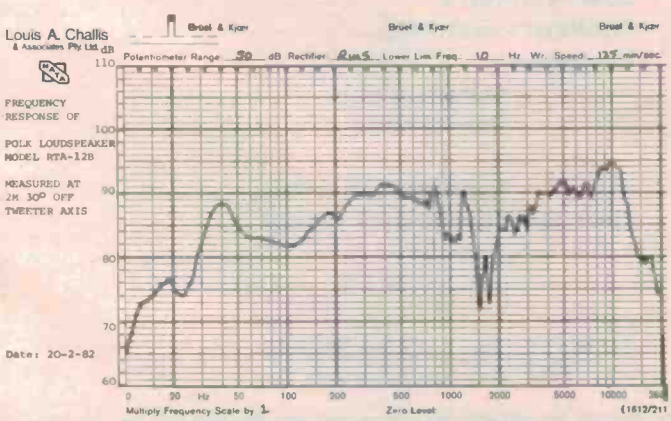
The tweeter and the main drivers are located approximately 900 mm above the floor, which I have found to be an excellent position for good stereo imaging and good listening comfort.

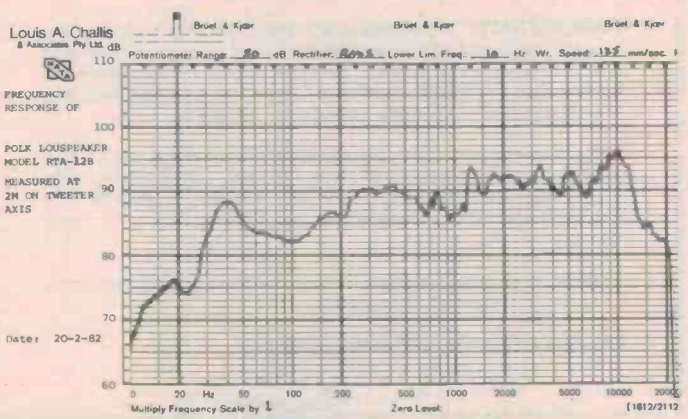
The manufacturers carefully label the back of each of the speakers to indicate which is left and which is right. They also recommend placing the speakers approximately 1.2 metres from the wall to achieve the best and smoothest frequency response. This recommendation ties in neatly with the results of the objective testing.

## On test

The objective testing proved to be something of an eye opener. The bottom end of the frequency response in the anechoic room was reasonable and confirmed that the speakers can provide a good response when the reflective components from the rear wall and floor are arranged to supplement the direct sound. The rest of the spectrum is not as smooth as I would expect from a loudspeaker sold as a 'reference monitor'. It is the other objective performance results that highlighted the unusual aspects of the design.

The impedance curve really caught my attention. The low threshold of 4 ohms shows that the speaker is capable of extracting more power from your amplifier than you would expect or may even want, as many new Japanese amplifiers are not designed for 4 ohm loads. ▶



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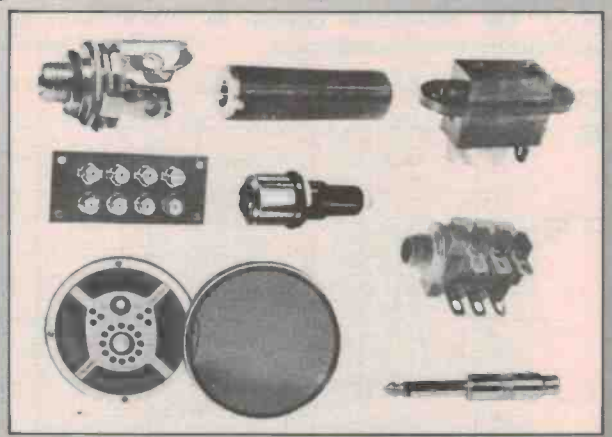

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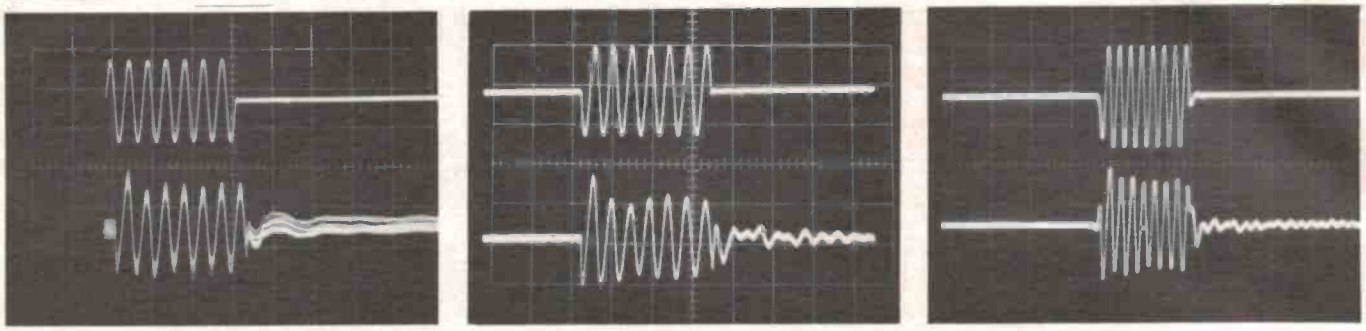


100 Hz (20 ms/div.) 1 kHz (2 ms/div.) 6.3 kHz (0.5 ms/div.)

**Tone burst response of Polk RTA-12B loudspeaker system (for 90 dB steady state SPL at 2 m on axis). Upper trace is electrical input; lower trace is loudspeaker output.**

The impedance curve exhibits dominant peaks at 20 Hz, 55 Hz and 3.25 kHz, and a rising impedance curve response all the way up to 20 kHz. A wide trough occurs between 200 Hz and 1200 Hz, with the lowest impedance level being approximately 4.4 ohms at 1 kHz. Under these conditions the system should be designated as a 4 ohm loudspeaker system, and it would be definitely unwise to try to parallel it with a second set of speakers on any normal amplifier.

The 20 Hz resonance is unusual, and is caused by the passive radiator, which resonates at that frequency. The output of this passive radiator clearly shows up in the frequency response curve with a notch at just below 30 Hz, but with a relatively smooth output response in the low frequency end down to a nominal 45 Hz cut-off frequency. Fortunately the amplifiers we use for both the lab testing and for our subjective testing are quite happy with 4 ohm loads, and each is also capable of delivering up to 400 watts per channel of power without complaint. However, not all amplifiers are designed for 4 ohm outputs and it would be unwise to parallel this speaker system with another without carefully checking the protection circuit or manufacturer's recommendations.

Considering the size of the main driver, the distortion characteristics in the speaker are reasonable. A sound level of 90 dB at 2 m results in 13% distortion at 100 Hz, 1.6% at 1 kHz and 4% at 3 kHz. The 13% distortion figure at 100 Hz is rather high on the left hand unit, but was slightly lower on the right hand unit at 9.5%.

The most interesting objective test result was that for the phase response. This shows the most complex set of phase interactions I have yet seen from any speaker system at the low frequency end of the spectrum. The number of reversals is really to be expected, and although not audible, is nonetheless a direct result of the choice to use two low frequency drivers working in parallel, with an even more unusual crossover network. The manufacturer's claims for exceptional phase linearity in this speaker in the low frequency region are not borne out, although the phase response in the 1 kHz to 20 kHz region is somewhat better.

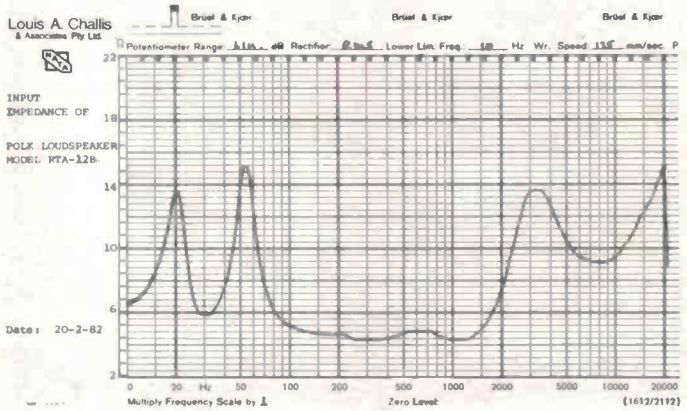
Even the tone burst response test, which normally gives similar information to the decay response spectrum, provided useful information about the characteristics of this system. The 100 Hz tone burst shows a remarkable degree of instability, which comes as a result of the passive radiator inducing a low frequency modulation component on the top of the 100 Hz sinewave. This made it difficult to photograph a steady tone burst response. The higher frequency tone burst exhibited a different set of responses, with obvious resonances apparent.

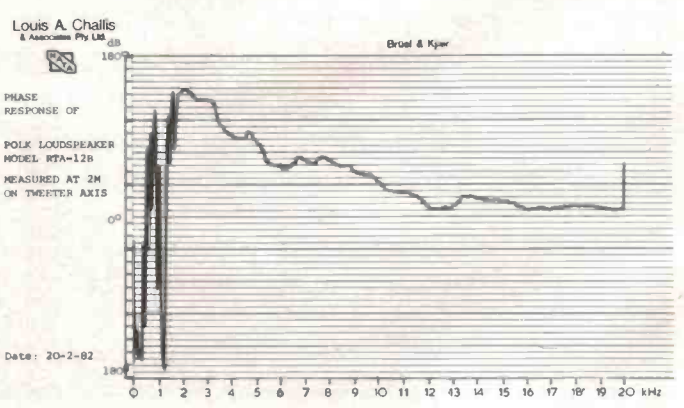
The decay response spectrum shows significant peaks at 1500 Hz, 2.5 kHz, 5 kHz and a series of pronounced peaks in the 10 kHz region and 16 kHz region.

## Subjectively

The objective testing did not provide the sort of confidence I would like, and would worry most purists even without listening to the speaker. The subjective response of the speaker was unusual in that we expected a higher level of audible distortion to be apparent than we actually found.

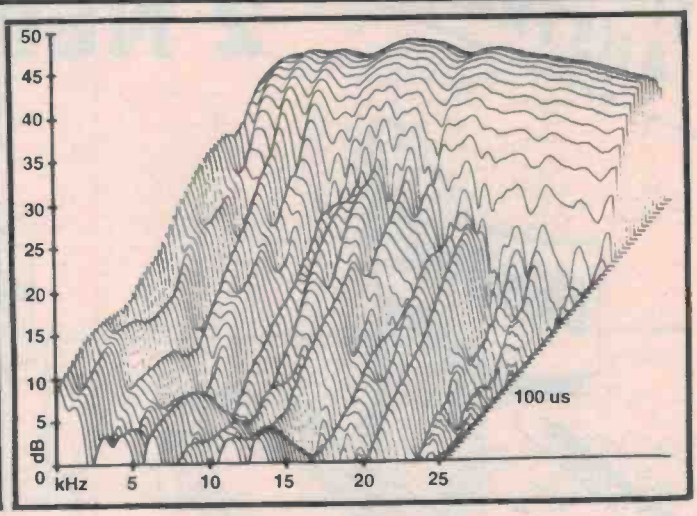
The first thing you notice with the Polk speakers is that they are unusually 'bright', with a presence that was typical of the JBL, Altec Lansing and AR speakers in the early 70s. Most people like that sort of presence, some people don't. The best test of colouration is to use our standard voice record test, which still seems to be one of the easiest subjective ways of picking speaker



MEASURED PERFORMANCE OF POLK AUDIO MODEL 12B
SERIAL NO. 15623/22 - 10458

| | | | | |
|---|---|---|---|---|
| FREQUENCY RESPONSE: | | 30Hz - 16kHz | | |
| CROSSOVER FREQUENCIES: | | 600Hz - 2.2kHz | | |
| SENSITIVITY: | | | | |
| (for 90dB average at 2m) | | 7.0 VRMS = 12.2 Watts (nominal into 4Ω) | | |
| HARMONIC DISTORTION: | | (@ 84dB) | | |
| (for 90dB at 2m) | | 100Hz | 1kHz | 6.3kHz |
| | 2nd | -17.8 | -37.5 | -38.0 dB |
| | 3rd | -34.3 | -42.5 | -45.9 dB |
| | 4th | -47.5 | -50.0 | - dB |
| | 5th | -49.9 | -49.8 | - dB |
| | THD | 13.0% | 1.6% | 1.4% |
| INPUT IMPEDANCE: | | 100Hz | 5.2 Ω | |
| | | 1kHz | 4.4 Ω | |
| | | 6.3kHz | 9.3 Ω | |
| | | Minimum at 300 & 1kHz | 4.4 Ω | |




colouration. The RTA-12B does not come through this test particularly well.

Considering the small size of the drivers, the low frequency performance of these speakers is relatively good and they are able to handle the Swedish High Fidelity Institute test record with reasonable aplomb. At power levels exceeding 40 watts input there was a distinct speaker break-up, with a much higher level of distortion than normal. Playing the new Ultragroove record 'The Digital Fox' from Volume One of the late Virgil Fox's organ recitals, I was suitably impressed that the Polks could do reasonable credit to a record which is at its best when played through a system requiring sub-woofers. This particular record produces very high levels at frequencies as low as 25 Hz and consequently constitutes a rugged test for most speaker systems.

With the Telarc 10042 'Pictures at an Exhibition', the RTA-12B can handle 200 watts of power and produce reasonable outputs of in excess of 115 dB at 2 m on axis. Under these conditions the distortion is readily audible and I was tempted to turn the power level down out of deference for my ears rather than for the speakers themselves. With percussion, brass, and woodwind instruments the speakers take on a slightly strident characteristic, which is readily discernible and which leaves one with a feeling of roughness rather than the smooth performance I have grown to expect from this record. With Barbra Streisand singing 'Woman in Love' on a half-speed mastered CBS record (CBSH162), Barbra shows quite clearly with her voice the degree of colouration that the speakers produce.

The Polk Audio RTA-12B speakers are not exactly what they claim to be, and are most certainly not a reference speaker. Although Polk Audio may claim that much care and thought went into their design, it is my opinion that a little more thought and care would make them ever so much better. At a recommended retail selling price of $1450 they are relatively expensive.

The Polks are different and the Polks are impressive, and these characteristics could form the basis of what may yet develop into a monitor loudspeaker system. ●

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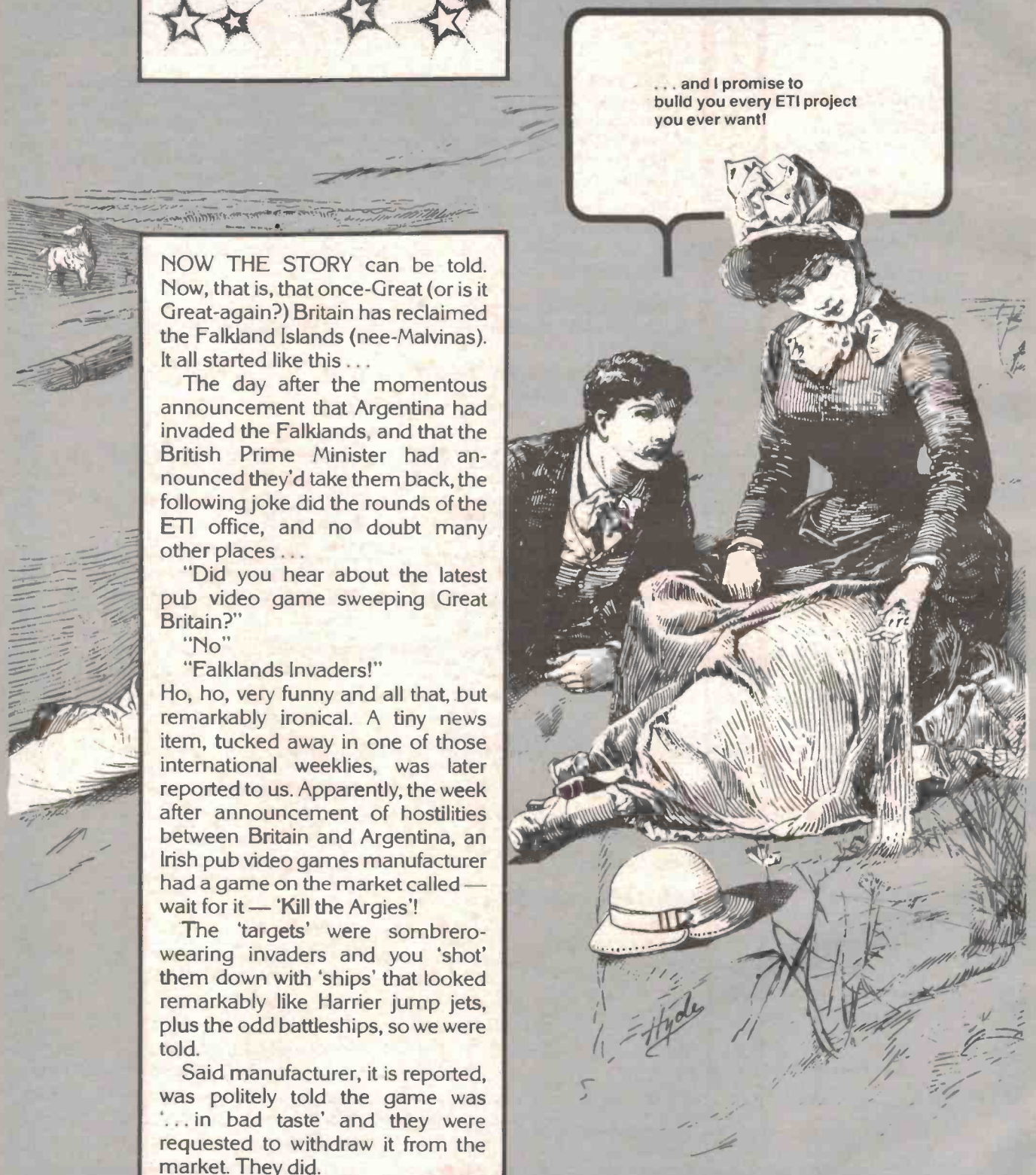
# ARGGS




NOW THE STORY can be told. Now, that is, that once-Great (or is it Great-again?) Britain has reclaimed the Falkland Islands (nee-Malvinas). It all started like this . . .

The day after the momentous announcement that Argentina had invaded the Falklands, and that the British Prime Minister had announced they'd take them back, the following joke did the rounds of the ETI office, and no doubt many other places . . .

"Did you hear about the latest pub video game sweeping Great Britain?"

"No"

"Falklands Invaders!"

Ho, ho, very funny and all that, but remarkably ironical. A tiny news item, tucked away in one of those international weeklies, was later reported to us. Apparently, the week after announcement of hostilities between Britain and Argentina, an Irish pub video games manufacturer had a game on the market called — wait for it — 'Kill the Argies'!

The 'targets' were sombrero-wearing invaders and you 'shot' them down with 'ships' that looked remarkably like Harrier jump jets, plus the odd battleships, so we were told.

Said manufacturer, it is reported, was politely told the game was '. . . in bad taste' and they were requested to withdraw it from the market. They did.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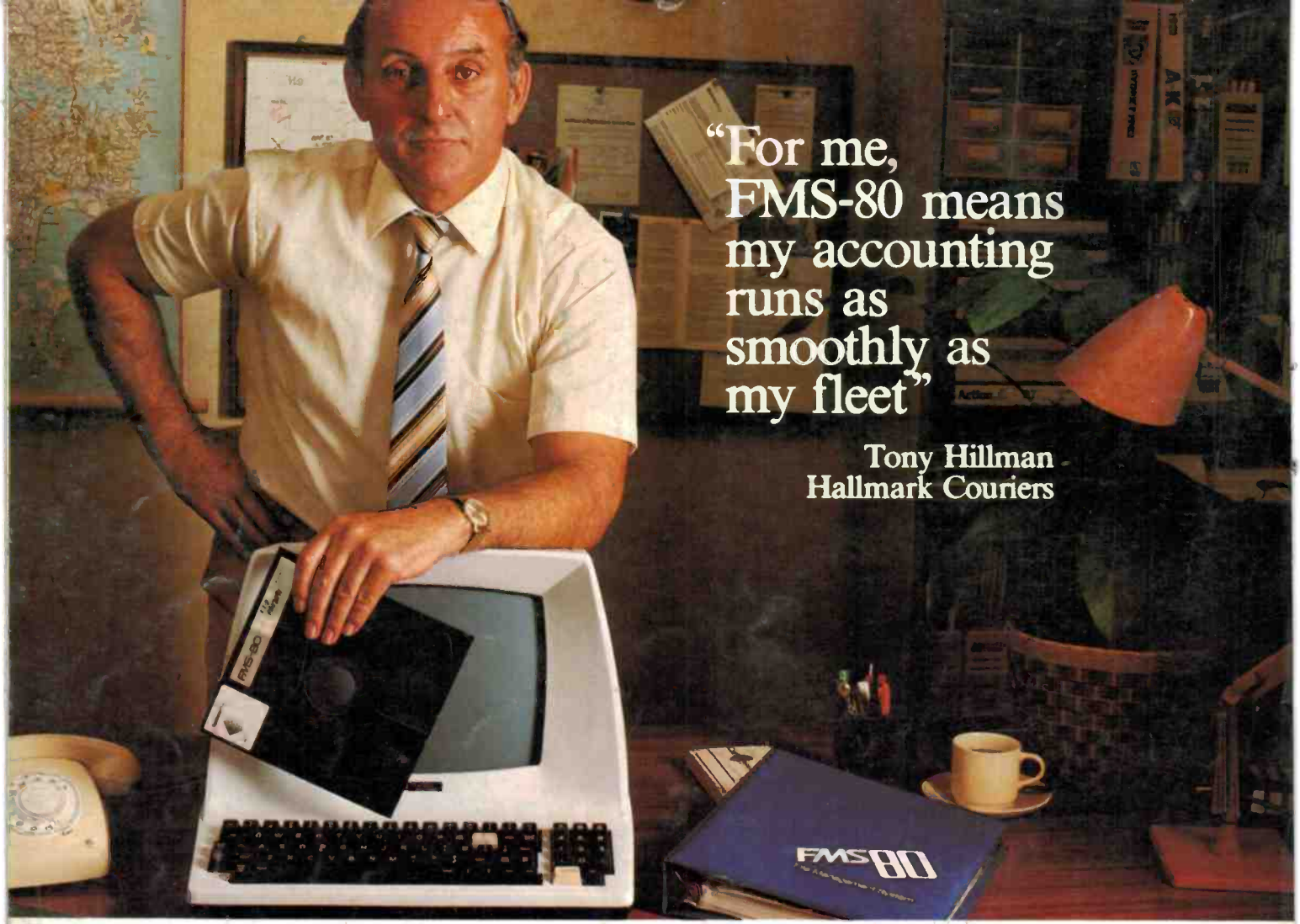


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FMS80 was the answer for Tony.

The FMS80 data management system gives him total integration of his day to day transactions and his accounts. With no costly tracking down of errors. FMS80 finds possible errors before they cost him time and money. FMS80's advanced report generator helps Tony look ahead. If there's going to be a cash flow problem in two weeks time, he knows now. Expandability and flexibilty are the keys to FMS80's power. For Tony this has meant that when he needs an individual driver's report, his FMS80 can provide it. Now he's looking at incorporating trial balance and creditor's reports.

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