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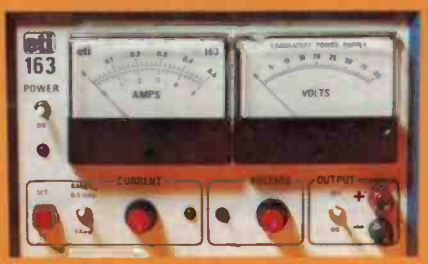

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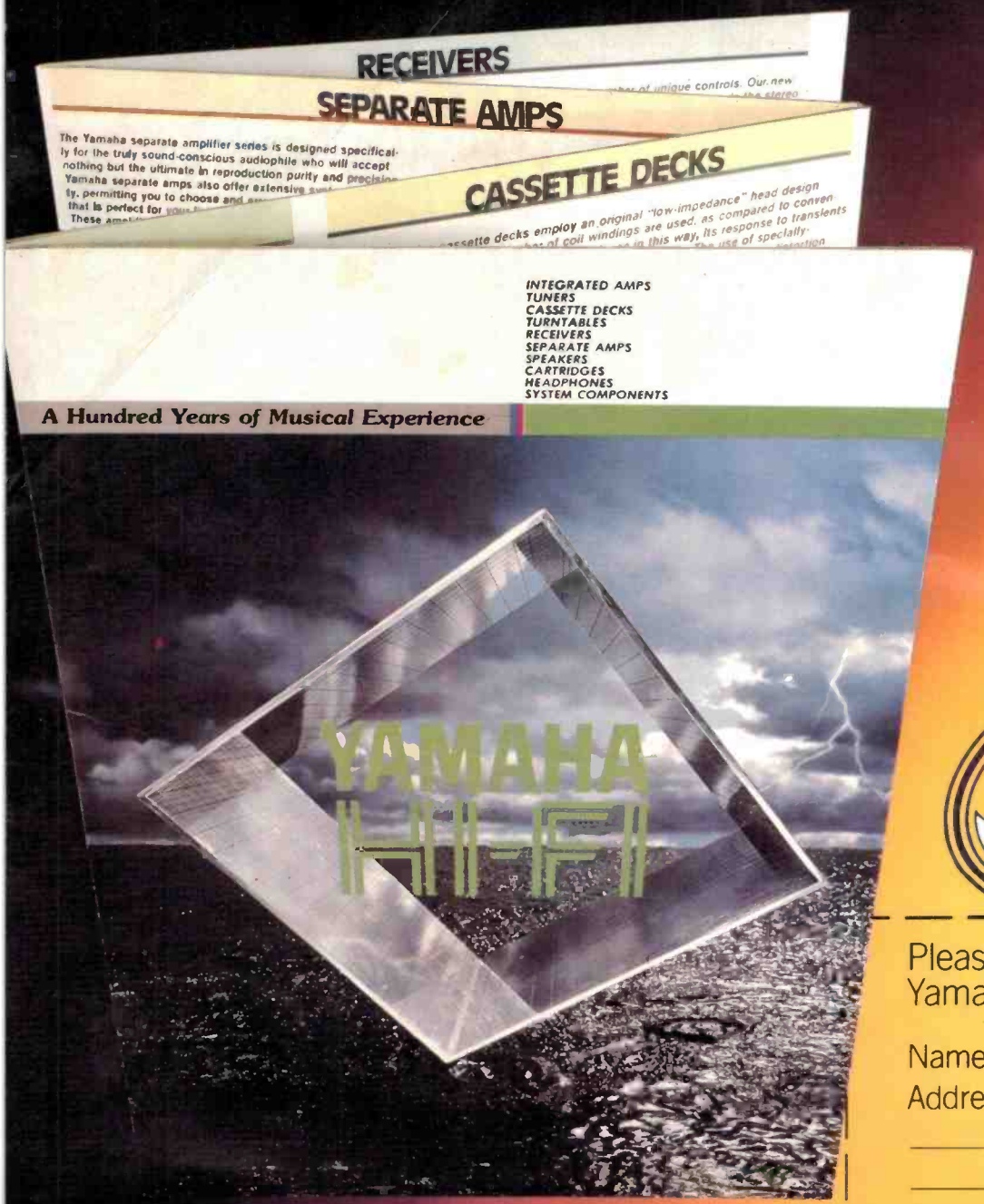

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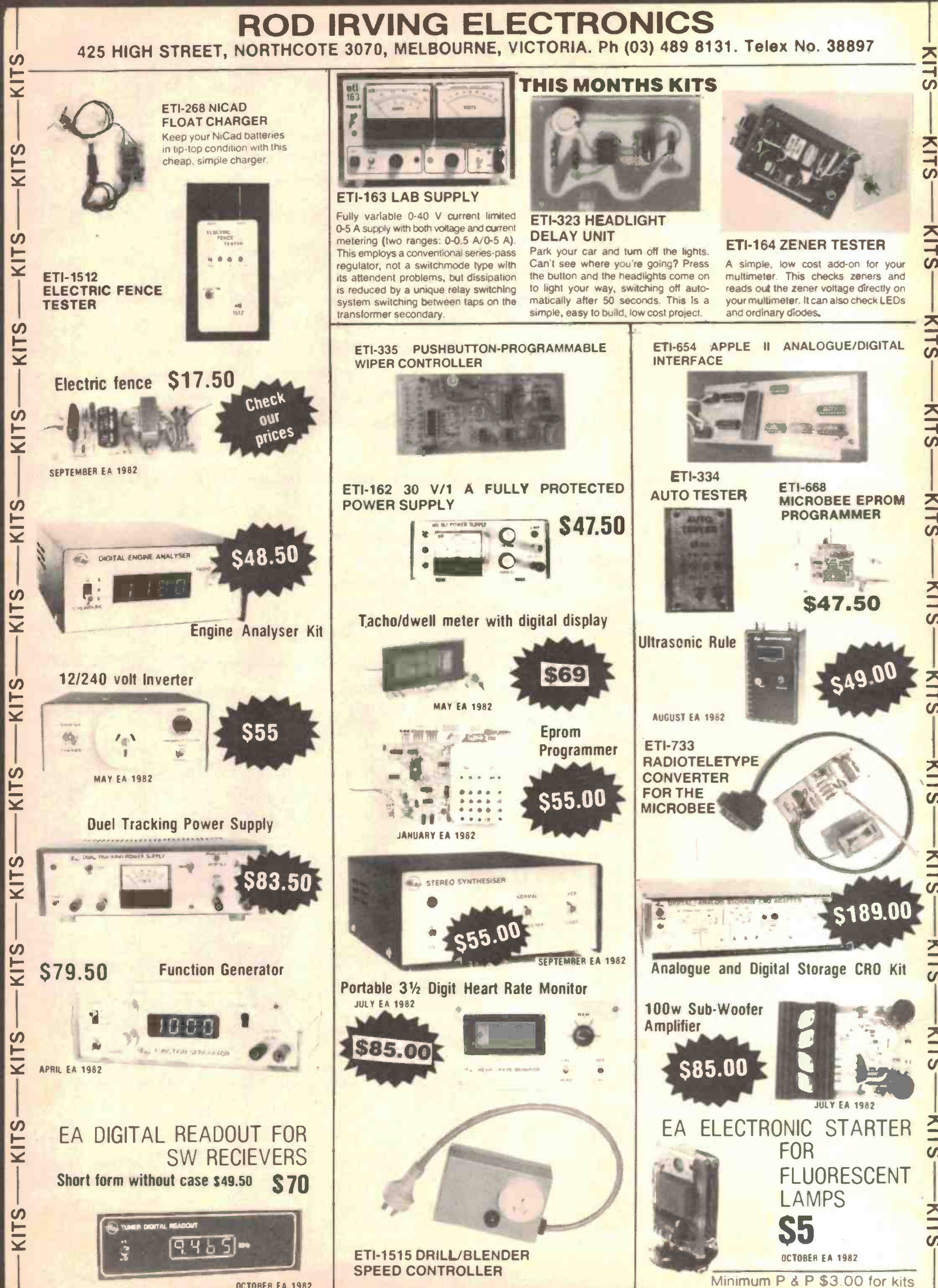
Our two big features this month are a review of the Microprofessor II, which features software compatibility with the Apple II, and our new lab. supply project, the ETI-163.

Microprofessor II picture courtesy of Emona. power supply picture by staff photographer. John Knight.

Cover design by Ali White.



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New Zealand: Steve Edgar, Circulation Marketing Manager, c/- Collector Publications, Box 7118, Auckland. Ph: 546-380; Tlx Archcol NZ 21217.

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

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

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

Electronics Today International is published by The Federal Publishing Company Proprietary Limited, 140 Joynton Avenue, Waterloo NSW 2017. (02)663-9999. Telex AA74488 'FEDPUB'. This issue was printed by ESN, The Litho Centre of 140 Joynton Avenue, Waterloo NSW 2017. (02)662-8888. Distributed by Network Distribution Company.

Recommended retail price only

SINCE MOVING PREMISES in February, our telephone technical enquiry service has not been what it was in the past as we had no suitable telephone facilities for over two months. However, our new technical enquiry telephone has been installed and been in use for some weeks by the time you read this. If you are having difficulties with one of our projects or technical features, you can phone technical staff **after 4.30 pm (eastern standard time) Mondays to Thursdays** on the following number:

ETI Technical Enquiries 662-4267

If you find it engaged, keep trying until the line is free. Unfortunately, we cannot take technical enquiries prior to that time as, otherwise, the staff would have little time to develop the projects you enjoy

New artwork service

With this issue we introduce a new service for printed circuit and front panel artwork for readers wishing to make their own pc boards and panels. In the past, we have printed the artwork in the magazine, where possible, with a page in blue behind so that readers could make their own negative 'phototool' from Scotchcal 8007 film. Where this was not possible we either published the artwork with the article or made prints available to readers who sent a stamped addressed envelope.

From this issue, we can offer readers negative or positive film transparencies of pc board and panel artwork for all projects, except those where copyright is retained, for a cost between $1 minimum and $20 maximum. The charge is worked out on an *area* basis. For artwork that totals less than about 100 square centimetres (pc board and panels combined) — this covers the greater number of our projects — the charge is 4 cents/cm^2. For artwork that totals above this area, the charge is 2½ cents/cm^2. Artwork will be sent post free. At present, we can only offer this service for projects from this issue onwards. A note with each project will advise the availability of artwork and the cost. We may be able to offer this service for some past projects at a later date.

This service in no way supercedes the availability of pc boards and panels from those suppliers who choose to stock them. The service is provided for those readers who, for the satisfaction of it, wish to make their own pc boards and Scotchcal panels. The provisions of the Copyright Act, published below, still apply. Note that breach of the Copyright Act is a criminal offence.

Roger Harrison
Editor

services

Technical enquiries: We can only answer readers' technical enquiries by **telephone after 4:30 pm Mondays to Thursdays.** The technical enquiry number is **(02)662-4267.** Technical enquiries by **mail** must be accompanied by a stamped, self-addressed envelope. There is no charge. We can only answer queries relating to projects and articles as published. We cannot advise on modifications, other than errata or addenda. We try to answer letters as soon as possible. Difficult questions may take some time to answer.

General enquiries: For enquiries about back issues, photostats of articles, artwork or submitting articles, call **(02)663-9999** or write to the address on this page.

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

next month

THE 'SURE START' MODEL ENGINE IGNITION SYSTEM

The tiny combustion engines used in model aeroplanes, cars and boats employ a 'glow plug' to ignite the fuel. This is simply a tiny, screw-in plug with a resistive heater element that sits inside the top of the combustion chamber of the engine. When a dc source (usually a battery) is applied to it, the element glows, the heat aiding ignition of the fuel when the motor is turned over.

Problem is, they tend to burn out with regularity. Expensive, and a nuisance. This project regulates the 'juice' applied and the temperature of the element, preventing burn-outs and ensuring proper ignition.

ADD-ON TEMPERATURE SENSOR FOR MULTIMETERS

Another simple add-on project for your multimeter, particularly suited to digital multimeters. This unit is simple to build and can be arranged to read directly in degrees Celsius, degrees Kelvin, or degrees Fahrenheit.

BIPOLAR PROM PROGRAMMER

Have you ever been designing a project and wished you had a custom decoder or simple programmable logic array to reduce the chip count and circuit complexity? How about using a 7-segment LED display to show more than the usual 0-9 digit information?

All these applications and many more can be addressed by one versatile IC known as the Schottky Bipolar Programmable Read-Only Memory. They are produced by many manufacturers in pin-compatible forms and are widely available through normal suppliers. This project can be used to program types: 74S188/288, 77S188/288, 27S18/19, 6330-1 and 6331-1, 82S23 and 82S123.

USING OPTOCOUPLER DEVICES

Next month's Lab Notes covers a range of applications and gives data for commonly available optocoupler devices, including: 4N26, 4N28, MCT2, MCT6, 4N23, 6N139 and MOC3020. Such versatile, useful devices — not to be missed!

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.

TAX TIME SELLOUT

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

Jack O'Donnell

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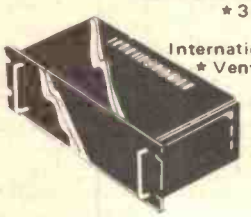

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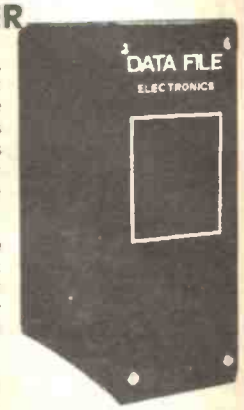

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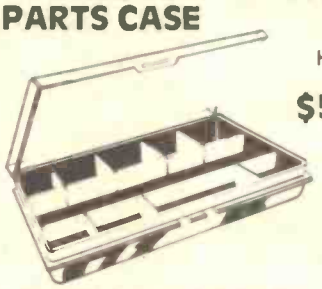

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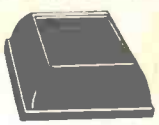

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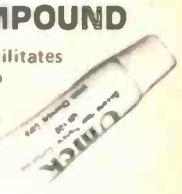

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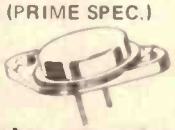

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Innovation Centre to aid inventors

Amid a fanfare of publicity and political promotion, the Innovation Centre of NSW was opened at the University of NSW on April 8th by the NSW Premier, Neville Wran.

Considerable political push for the launching was provided by the new Federal Minister for Science and Technology, Barry Jones, who spoke on the critical role which innovative technology must play in industry if Australia is to progress in a post-industrial society. He pointed out that Australia ranks 23rd out of 24 amongst technology-producing nations. New Zealand ranks much higher.

The Kirby Report, compiled by the Committee to Review Productivity and Innovation Programs, chaired by Mr. Raymond Kirby, tabled in the Federal Parliament in April '82, recommended the establishment of innovation centres which would bring industry and inventors together.

The Victorian Chamber of Manufacturers set up a pilot innovation centre in 1979 which is reported to be operating with some success. The Innovation Council of NSW, set up in March this year, has set up the centre with the objective of facilitating the commercialisation of innovations in NSW by:

- providing private and corporate inventors with access to information, expertise, services and facilities;
- promoting greater interaction between private and corporate inventors, manufacturers, educational institution, government and financial organisations;
- seeking partners to assist in the production, marketing and financing of new ventures; and
- developing educational and promotional activities designed to encourage innovation in local industry.

The underlying objective is the promotion of Australian inventiveness and hopefully, the creation of new industries or branches of industry and the opening up of employment opportunities.

Both the Council and the Innovation Centre are supported by the State and Commonwealth governments, the University of NSW and a number of other organisations.

The centre will service both high technology and low technology development from:
• individual inventors, • corporate inventors and companies, • educational institutions.

Basic services will cover: preliminary technical and commercial assessments using academic, industrial and supplementary resources as required; advice on patents and a patent search if necessary; referral to potential industrial partners and referral to appropriate avenues for government and other sources of financial assistance.

For selected projects the centre could negotiate a royalty or equity position and provide: laboratory space and access to some administrative support; engineering development support; assistance in market assessments; development of business plans and proposals for raising venture capital; creation of a management team; assistance in locating venture capital; assistance in relocating the business outside the centre.

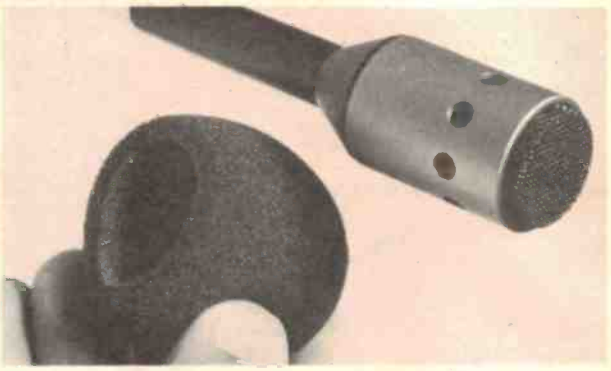
An important supporting function of the Centre will be the provision of educational courses in innovation, entrepreneurship and related topics through the running of workshops, seminars and lectures; the provision of courses generally on new product development, marketing, finance, patents, government funding and services, plus legal and other aspects of managing innovation.

The Centre will promote its own services and create public awareness of the role of technology in the business community.

The Premier of NSW and the Federal Minister for Science and Technology both presented cheques (meagre, but something), representing the State and Commonwealth contributions to the Centre. These were received by Mr. Colin Bull, from the Innovation Council.

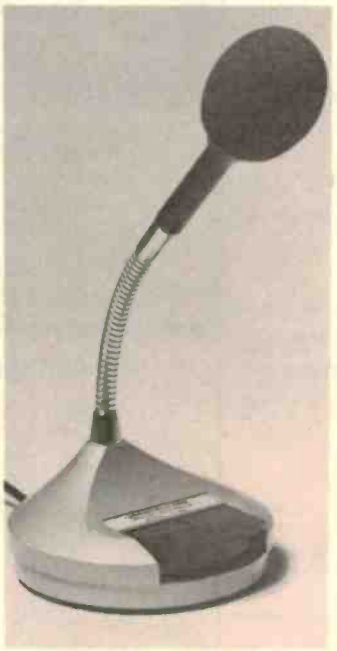
The Executive Director of the Innovation Centre is Dr. Neville Stephenson. The Centre's board of directors comprises a dozen people from industry, the University of NSW, the NSW State Department of Industrial Development and Decentralisation and the Department of Science and Technology.

It remains to be seen whether getting this disparate group into bed together will produce lusty offspring or strangulated abortions.



This mic stands up for itself

A new desk-top microphone from Benelec Pty Ltd, designed for PA and transceiver applications, features a 200 mm tall gooseneck for easy positioning of the mic.



Designated the Model 7-801, it comes with a heavy diecast body to ensure stability. A push-to-talk switch with lock is mounted in the base and the mic has a pop filter to minimise noise pickup when out of doors or when close-talking.

The microphone has reduced rear pickup to avoid 'howl round' in PA applications and unwanted background noise pickup in communications installations.

The sensitivity is quoted as -70 dB at 1 kHz, impedance as 10k at 1 kHz and frequency range as 200 Hz to 10 kHz.

The 7-801 stands 215 mm tall and the base is 100 mm diameter. It is supplied with a 4 mm diameter shielded three-core cable three metres long.

Further information from the distributors, **Benelec Pty Ltd, P.O. Box 21, Bondi Beach NSW 2026. (02) 665-8211.**

Magna 87 liquid flux

Researchers of Magna Industrial Company have produced Magna 87, a liquid flux whose acidity aids soldering.

Magna 87 gradually converts to a neutral salt, irrespective of the type of metal being soldered, eliminating the persistant problem of corrosion at soldering points.

Magna 87 liquid flux contains no ammonium chlorides, no resins, no zinc chlorides or other strong acids or acid forming substances. While in the container the flux is mildly acidic, however this mild acid is converted into a neutral salt through heating during the soldering operation. The heat of the soldering regardless of the method, will be sufficient to cause the chemical change.

National competition for electronics students to aid oceanographic studies

A low-cost reliable temperature sensor and recorder is needed for seasonal studies of the Australian Continental Shelf and, in particular, in the Great Barrier Reef Marine Park.

With the hope of an innovative solution, a competition for students has been organised jointly by the Great Barrier Reef Marine Park Authority and the Marine Studies Centre, University of Sydney.

The competition, for the electrical design and construction of a prototype of a marine temperature sensor and recorder, is open to students who are residents of Australia, including all full and part-time engineering students. Either individual students or groups can enter.

The competition is being sponsored by Neil Brown Instrument Systems of Massachusetts US, the Great Barrier Reef Marine Park Authority and the Marine Studies Centre, University of Sydney.

Neil Brown Instrument Systems has put up the substantial prize and funds for component costs. The prize is a three month work-study program at Neil Brown Instrument Systems, including travel, accommodation and a modest salary.

To assist students the first ten suitable entries, in the opinion of the judges, received after June 1 1983, will be considered for a reimbursement of costs of components, on the basis of receipts, up to a value of $300 per entry.

The instrument must be able to sense temperature between 5°C and 30°C and be able to operate at depths of up to 100 metres.

More information on the required specifications for the sensor and recorder may be obtained by writing to Mr. Bruce Hamon, Marine Studies Centre, University of Sydney NSW 2006.

The final data for acceptance of entries is Friday, January 13 1984.

High-efficiency, low cost film-type solar cells

National Panasonic's parent company in Japan, Matsushita Electric, has developed a film-type solar cell which will cut the cost of existing solar cell prices by more than half.

The cell, called 'Sunceram II', uses a screen printing method which results in an extremely high energy conversion efficiency as well as the lowest production cost per unit power output of all existing type of solar cells, claim Matsushita.

Matsushita is a participant in the Japanese government's 'Sunshine Project' which aims at mass producing cheap solar cells for power generation.

Hopefully our new Australian government will set up a similar project, financing and encouraging research in solar cells. In this 'land of sunshine' using solar cells for the generation of power would seem to be quite logical. But perhaps this form of power is not profitable for the government. So once again we'll have to rely on the Japanese.

The newly developed solar cell can be either 4.6 cm x 0.17 cm or a 30 cm-square large cell. The small cell energy conversion rate is 12.8% compared with a conventional efficiency of 10.5% in existing cells. The large cell conversion efficiency is 8.5%.

Due to the simple screen printing method for all the film forming processes, the production cost of the Sunceram II is relatively low. When mass production begins the production cost per watt (power output) for the cell will be less than $4.35, cheaper than any solar cell ever developed, claim Matsushita. A single crystal type silicon solar cell, which is most commonly used at present, costs approximately $10.90 per watt.

More information can be obtained from **National Panasonic, 95-99 Epping Rd, Nth Ryde NSW 2113. (02)887-5333.**

A snappy new pushbutton switch catalogue

The latest catalogue from Dialight, a North American Philips company, consists of twenty pages of specification details about snap-action pushbutton switches.

The catalogue covers models that are panel mounted (581 Series), snap-in mounted (582 Series), pc mounted with support brackets (587 Series) and pc right angle mounted (583 Series). It also includes a wide range of round and square push-button caps (586 Series).

The catalogue provides complete mechanical, electrical and materials specifications for each switch series. It also includes a handy guide cross-referencing Dialight part numbers with those of other manufacturers.

The new snap-action push-button switch catalogue is available by contacting **Philips Electronic Components & Materials, P.O. Box 50, Lane Cove NSW 2066. (02)427-0888.**

Switching off Halley

Radio astronomers at Britain's Jodrell Bank radio telescope in Cheshire are planning to 'switch off' the radio waves emitted by Halley's comet when it approaches the sun in 1986.

Radio waves beamed at the comet from the large telescope may turn off the comet's natural maser.

The maser action results from the evaporation of parts of the core of the comet containing frozen water, ammonia and methane by the radiation from the sun. Some water molecules will lose a hydrogen atom to form a hydroxyl unit and the hydroxyls can radiate coherently (in unison) to form a natural maser. The maser emits radio waves of 180 mm wavelength and it has been estimated that the total power is only about 30 W.

The Jodrell Bank group feel that they can probably switch off the maser action by beaming a 10 kW pulse of 180 mm waves at the comet from their telescope. If successful, they expect to learn more about the comet and its maser by the time taken for the natural maser action to be resumed.

Although lasers and masers were both invented on earth, they have since been found elsewhere. A natural laser occurs on Mars.

B. Dance

NOTES & ERRATA

Project 268 NiCad Float Charger, March '83, page 31. The curve for 'Typical charging characteristics of NiCad cells' is for one particular type and may not be indicative of most currently on the market. While the shape is generally similar, the maximum terminal voltage reached is generally between 1.4 V and 1.5 V, not 1.7 V as shown.

Project 1515 Motor Speed Controller, April '83. If you find your speed potentiometer has a considerable 'dead band' at the 'top' (towards full speed) end, this indicates your drill has lower back-emf than that designed for. The cure is to increase R3. If all the speed control is crowded over about 60° of rotation, increase R3 to 330k. If you get 90° or 100° of rotation for zero to full speed, change R3 to 220k or 180k, etc. You may need to increase R4 from 27k to 56k or 68k, also. DISCONNECT THE UNIT FROM THE MAINS BEFORE MAKING ANY MODIFICATIONS.

The George Brown

PROTRONICS
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Ph. (08) 212 3111 Telex AA88261

George Brown & Co.
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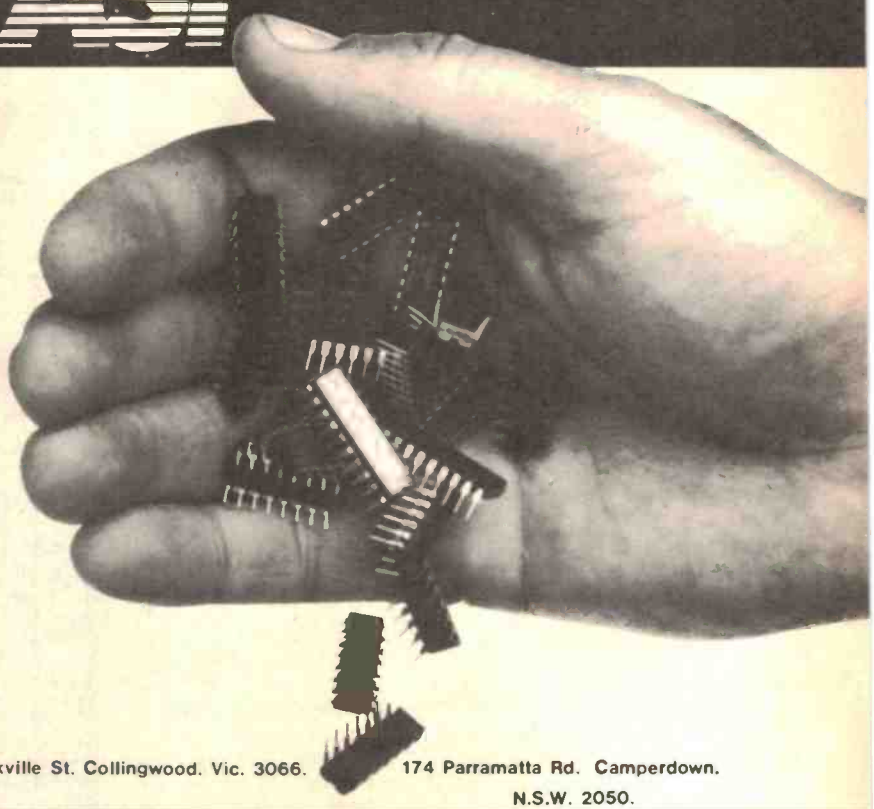

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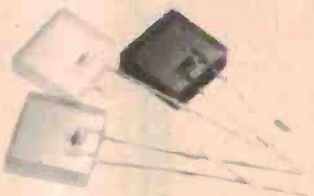

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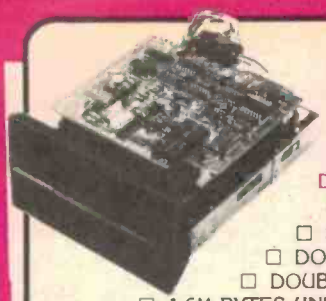

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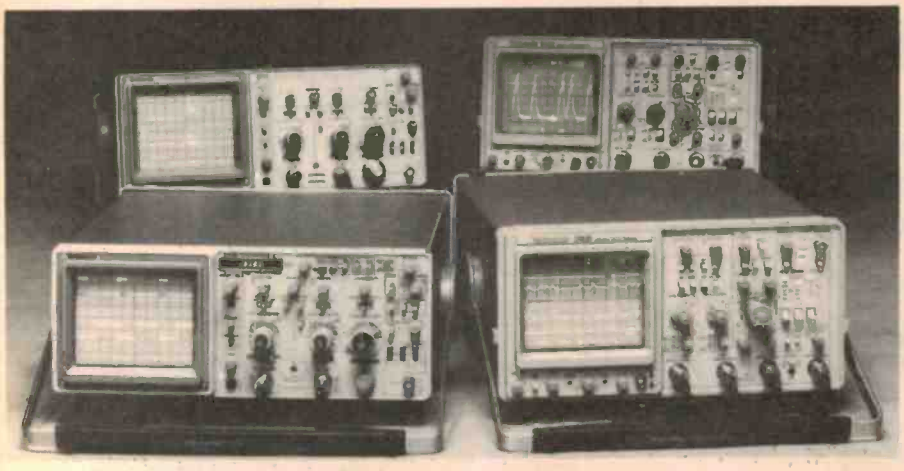


Tektronix keep a step ahead with new oscilloscopes

Tektronix has released two new top-of-the-range oscilloscopes, the 2445 and 2465, and two new general purpose scopes, the 2235 and 2236.

The 2445 and 2465, priced at $4700 and $6900 respectively, are analogue scopes with significant benefits for digital applications. They replace the 465B and 475 and have broader bandwidths, four channels, extensive CRT readouts, faster sweep speeds and increased timing accuracy.

The 2465 has a 300 MHz bandwidth, 500 ps per division sweep speed and auto-level trigger feature with trigger bandwidth greater than 500 MHz. The 2445 has a 150 MHz bandwidth, 1 ns per division sweep speed and the same triggering features with trigger bandwidth to 250 MHz. Another feature is the channel 1 and 2 propagation delay matching adjustment.

New developments have produced a meshless scan expansion lens to provide a shorter, more rugged CRT. The CRT readout generates cursors which the user can superimpose on the waveform to measure delta voltage, sweep delay and delta delay time, and vertical and horizontal scale factors. The readout also indicates variable vertical sensitivity, bandwidth limit, add mode and variable hold-off.

In both the 2445 and 2465 channels 1 and 2 feature full-range step attenuators from 2 mV to 5 V per division, variable attenuators, a choice of 1M or 50 ohms input impedance, ac and dc coupling and provision to invert channel 2.

Channels 3 and 4 are optimised for logic signals with 1M, dc coupled inputs and scale factors of 0.1 V and 0.5 V per division, and 1 V and 5 V per division with 10X probes.

The 2235 and 2236, priced at $2800 and $4400 respectively, have all the features of the earlier 2215 scope plus higher bandwidth, greater accuracy, trigger view, maximum sweep speed of 5 ns per division, 20 MHz bandwidth limit switch for reducing high frequency noise, single sweep mode for transient photography and separate A and B intensity controls.

A digital counter/timer/multimeter (CTM) is fully integrated into the vertical, horizontal and triggering systems of the 2236, allowing measurements that previously haven't been possible with only one portable instrument, claim Tektronix. In the

The auto-ranging ohmmeter features an unusually wide range, from 10 milliohms to 2000M, and automatically senses and evaluates diode junctions.

More information on the 2000 series of oscilloscopes can be obtained from **Tektronix Australia Pty Ltd, 80 Waterloo Rd, Nth Ryde NSW 2113. (02) 888-7066.**

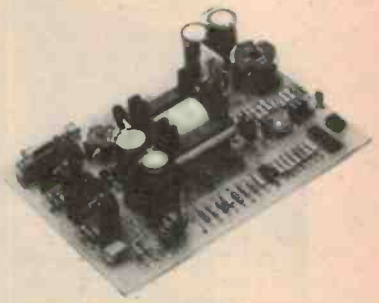
Australian made switch mode power supplies

Australian power supply designer and manufacturer, Scientific Electronics, has released details of switch mode power supplies which are aimed at micro users and system designers.

In the single rail series are the SM50A1/5 5 V 8 A, SM50A1/12 12 V 3.3 A, SM50A1/15 15 V 2.7 A, SM50A1/24 24 V 2 A and SM50A1/48 48 V 1 A. The output is short circuit protected and has overvoltage protection. Output rails to customer specifications are also available.

The SM65AC1 has three output rails from which a total of 65 watts can be drawn.

Standard output voltages are +5.2 V at 8 A, +12 V at 1 A and −12 V at 1 A. Outputs to customer specifications are also available.



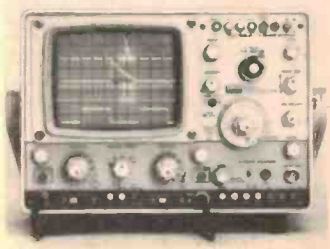
The features of the SM65AC1 are the same as those of the SM50A1 series.

All these power supplies are fully supported with a five year guarantee and complete technical back up.

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

BWD's go-anywhere oscilloscope

The BWD 835 is a new, dual trace oscilloscope for digital or analogue applications.



It is lightweight, compact and rugged and with a power supply that operates from 95 to 264 volts at 48 to 440 Hz without external switching, you can take it anywhere.

The vertical amplifiers provide a full 60 MHz bandwidth from 5 mV to 20 V per div and 50 MHz at 2 mV per div. For noisy waveforms or operation in noisy environments a 20 MHz bandwidth limit button is provided.

Sweep speeds range from one second per div to 50 nano seconds per div and a 10X magnification increases the maximum speed to five nano seconds per div for both A and B time bases.

A high sensitivity trigger system for both time bases operates to beyond 100 MHz and in the alternate mode triggers to unrelated signals. Other features include TV line and frame lock, low or high frequency reject, power line trigger and external trigger from both A and B time bases.

The dual time base permits either delayed sweep or delayed trigger operation and the alt A-B presentation simultaneously displays both the intensified A trace and the delayed B trace with variable offset.

For more information contact **BWD Instruments Pty Ltd, Miles St, Mulgrave Vic. 3170. (03)561-2888.**

80 watt voltage regulator IC

Motorola now has on the market a single-chip five volt voltage regulator, the MPC100, which combines the decision making capabilities of integrated circuits with the output capability of an 80 watt power transistor.

The new voltage regulator, capable of delivering up to 10 A, is expected to find wide spread usage in MPU related applications.

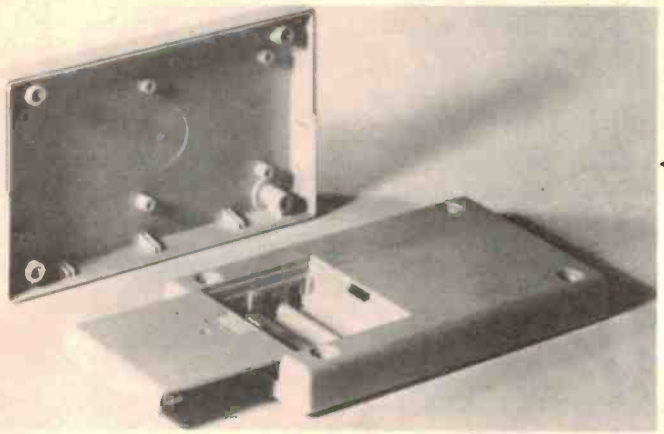
The MPC100 regulator can withstand an input voltage up to 25 V. The typical output resistance is in the order of two milliohms which results in good load regulation. The output is capable of handling large capacitive loads.

The low saturation voltages of the output transistors allows the regulator to operate with differential voltages as low as 1.5 V (typical), with a load current of 10 A. Motorola claim that this results in improved efficiency and makes the MPC100 regulator ideal as post-regulators in conjunction with a switching regulator for remote applications.

Other features of the MPC100 include internal thermal protection, internal short circuit protection and overcurrent limiting.

The MPC100 regulator is fabricated on a 150 x 250 mm chip and uses a standard TO-204AA package. The chip requires only a die attached to the header and three wire bonds for complete assembly.

More information about Motorola products can be obtained from **Motorola Semiconductor Products, 250 Pacific Hwy, Crows Nest NSW 2065. (02) 438-1955.**



PWM switching regulator

Fairchild's uA494 voltage regulator contains all of the building blocks for designing a pulse width 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 sourcing or sinking 200 mA 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 and military temperature range versions, the PWM switching regulator is packaged in a 16-pin DIP.

More information from **Fairchild Australia Pty Ltd, 366 Whitehorse Rd, Nunawading Vic. 3131. (03)877-5444.**

◂Adjustable shell-type cases

Mayer Krieg have released a new series of shell-type cases which, by combining various panels, can produce cases of different sizes in one of three heights.

A tongue and groove arrangement on all sides makes the combinations very stable and properly seals the two case sections. The cover and base are screwed together by four screws.

Optional panels, front and rear, are held in grooves and can be easily removed for punching and lettering. Guide rails are provided for vertical mounting of partitions and pc boards. Fastening studs are provided for horizontal assembly.

Cases can also be supplied with a battery compartment suitable for nine volt batteries, or four penlight batteries, and which is accessible from the outside.

More information can be obtained about these cases, manufactured in high-impact polystyrene or noryl, by contacting **Mayer Krieg and Co, 248 Angas St, Adelaide SA 5001. (08)223-6766.**

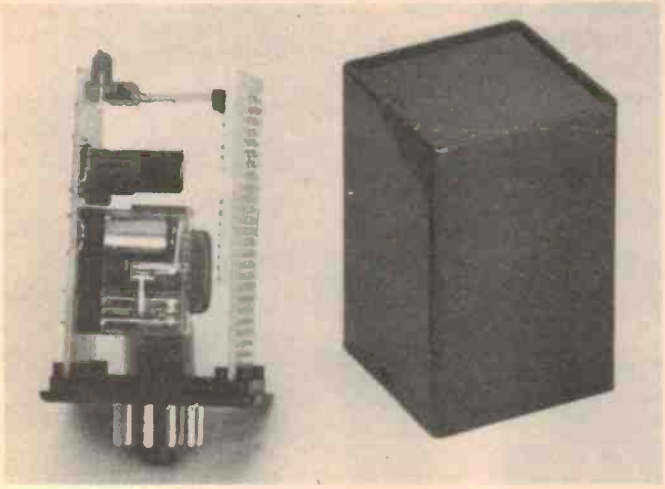
Digital noise source IC

National Semiconductor has a new monolithic metal-gate NMOS integrated circuit that can be used as a digital noise source or an internal pseudorandom number generator.

The MM5437 has been designed to produce a broadband white noise signal with uniform noise quality and output amplitude. It features an internal selfcontained oscillator, a single-supply voltage range of 4.5 V to 11 V, one-minute cycle time and automatic reset for an all-zeros state.

National claims that the MM5437 is ideal for use in rhythm instrument sound generators, white and pink noise generators and room acoustics testing/equalisation.

The device is available now, in an eight-pin plastic dual-in-line package, from **National Semiconductor, cnr Stud Rd and Mountain Hwy, Bayswater Vic. 3153. (03)729-6333.**



Plug-in case

A handy little case for plug-in module applications is available from Minitool Australia Pty Ltd.

Known as the '4A Series Enclosure', it measures 50 mm square by 80 mm high and can be supplied with either an 8-pin or 11-pin plug base.

To suit the enclosure, Minitool have available a number of general purpose pc boards, including a standard power supply and relay output layout.

They can also supply a 240 V to 24 V ac output transformer and a changeover relay with 6 A contacts, plus various hardware bits, connectors, etc.

Further details from **Minitool Australia Pty Ltd, 134A Ayr St, Doncaster Vic. 3108. (03) 850-9887.**

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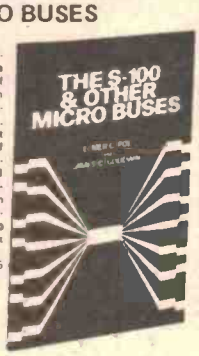

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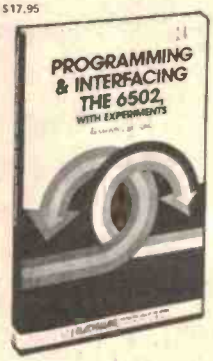

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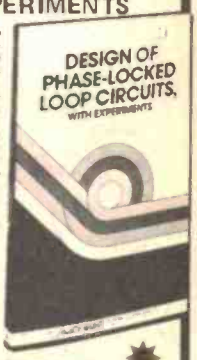

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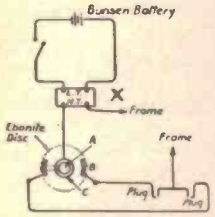
CAR COMPUTER CONTEST WINNERS

Five lucky contestants each receive a Sparkrite Voyager car computer.

The contest, featured in last November's issue, certainly set many readers hunting through their history books! There were five questions on which answers were sought and a sixth asking contestants' how they would use one of the car computer's alarm functions. Here are the answers to the five curly questions:

Q1) What is this circuit?



A) It is the very first coil-ignition system.

Q2) Who designed the circuit in question 1?
A) Although commonly known as the 'Kettering' system, it was in fact developed by the Frenchman Lenoir way back in 1860 — decades before Kettering was even born!

Q3) Which mechanician designed the coil marked X in the circuit?
A) The coil used in the circuit of question 1 was designed by the mechanician Ruhmkorff.

Q4) How does this quotation end?
"A traveller without knowledge is . . .
A) a bird without wings".

Q5 Who said the above?
A) The quotation is from the Persian poet Mushaiff-uddin, written in 1258! Mushaiff-uddin used the pen-name Sa'di.

As for question six, most contestants liked the speed alarm facility on the Voyager, with the aim of not getting caught speeding! The next most popular alarm facillty was the 'lights left on' reminder. Flat batteries can be awfully inconvenient.

Well, the first five questions sorted out the best researchers, and four contestants managed to get them all correct. Choosing a fifth winner proved difficult! However, with some careful sifting of answers to question six, we managed to choose one.

We apologise for the delay in publishing the results, but our move in Februry disrupted many things — the contest judging being one among many.

No doubt the five following readers will get much enjoyment out of their Sparkrite Voyagers. The winners, in alphabetical order:

THE WINNERS

B.W. Anderson, Keiraville NSW
W.K. Irish, Castle Hill NSW
Michael Reich, East Kew Vic.
Andrew Taylor, Glen Forrest W.A.
Ruth Taylor, Lawson NSW

Scanner antennas

There's an old maxim about antennas that says ". . . the bigger it is and the higher you put it, the better it'll be . . .". And it's correct. But there are a few other considerations when it comes to such a specialised application as scanning. Here's a practical guide on buying, building and erecting an antenna system for your scanner, no matter what your budget.

Roger Harrison

MOST SCANNERS are supplied with some form of plug-in whip when you purchase them. These, in general, are just a simple telescopic whip with a connector on the end for desk top/mobile scanners, or a 'rubber ducky' type short flexible whip for pocket or handheld scanners. While, in the main, they do work they are inefficient at gathering in the signals you may want to hear. You can be deceived by the apparent strength and clarity of the signals you can hear on your scanner using one of these whips, but there are likely to be myriads more you're missing out on. The one major saving grace of such antennas is *convenience*. You can just plug in your scanner, plug in the whip and be on the air.

You often hear that VHF and UHF signals travel only by 'line of sight' — from the antenna to the horizon; if you can't see the antenna of the station transmitting you can't hear it. To a certain extent this is true, but not strictly so. The 'radio horizon' is actually a little further than the visual horizon — as if the earth were 4/3 the size it is, as a rough rule. However, large landforms — hills, mountains — can get in the way, but also, bending or scattering over the top of these can extend the 'horizon' somewhat. Buildings large and small will reflect VHF and UHF signals, scattering them into places you would not expect to hear them.

As mentioned in my previous article on scanning, the lower atmosphere will occasionally 'duct' VHF and UHF signals way beyond the normal horizon, some hundreds to thousands of miles. Also, the ionosphere — the electrified layers lying from 100 km to 800 km or so above the Earth — will bounce VHF signals beyond the horizon under the right conditions, sometimes halfway round the Earth.

The 'Sporadic E' layer, which forms at about 100 km above the ground at unpredictable times (hence the name) will reflect signals for distances from 500 km out to 2000 km in a single 'hop', very occasionally 3000-4000 km on multiple hops. Sporadic E propagation is most prevalent during the summer months, with a smaller seasonal activity 'peak' during mid-winter.

Around the equinoxes (21 March, 21 September), 'transequatorial propagation' conducts VHF signals across the equator for distances of 3000 km to 10 000 km or more, bouncing the signals via two dense regions in the F layer (200 — 800 km high) lying either side of the equator.

If you're interested in the unusual, or fascinated by the vagaries of propagation, then a scanner is a useful 'tool'. More information on Sporadic E may be found in ETI, May 1978, p.82, and on transequatorial propagation (TEP) in ETI, July 1978, p.112.

Polarisation

Most services using the VHF and UHF spectrum for communications want coverage in all directions over a particular area, between a base station and a number of mobiles. The simplest antenna type for this application, for both the base and the mobile stations, is a vertical whip. Such an antenna will radiate and receive in all directions in the horizontal plane.

As the current-carrying portion of the antenna is in the vertical plane, by convention the antenna will be vertically polarised because the electric field of the antenna will be vertical. Hence, the majority of signals you hear will be vertically polarised. (Well, not after they have travelled some distance, as atmospheric effects and the effects of multiple reflections confuses the polarisation of the signal so that it will be a combination of vertical and horizontal polarisation — or elliptical.)

Antenna types

For scanning applications, the first major requirements for an antenna are that it be able to receive vertically polarised signals and that it can receive more or less equally from all directions. i.e: have omnidirectional coverage. Now, because scanners cover such a wide frequency range, typically from about 40 MHz to 500 MHz or so, the antenna needs to cover a wide frequency range with more or less equal results anywhere in the range of interest. i.e: it should have a broad bandwidth.

Now that's a pretty tall order for an antenna!

Probably the most well-known, and certainly one of the best suited, types is the *discone*, the general arrangement of which is shown in Figure 1. Quite simply, it consists of a horizontal disc sitting atop a vertical cone. The connection to the elements is via a coaxial cable, the braid (or 'outer') of the cable being connected to the apex of the cone and the inner conductor to the disc, which is insulated from the cone.

The disc and cone elements can be made of solid metal, or in 'skeletal' form from metal rods or tubing. Figure 2 shows one of the popular commercially available types, the GDX-1.

The dimensions of the cone and disc are arranged in a particular way, the length of the cone side being around half a wavelenth at the lowest frequency and the diameter of the disc being 70% of that length. The included angle of the cone is generally 60°.

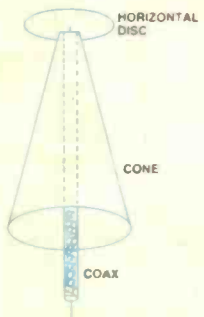


Figure 1. General arrangement of the discone antenna.

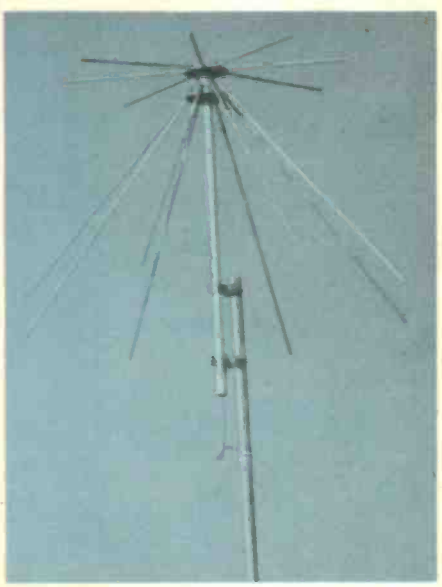


Figure 2. A popular, commercially-made 'discone', the Hoxin GDX-1. (Picture courtesy of G.F.S. Electronic Imports, Melbourne.)

Some types of discone are really stripped down to the bare essentials, the cone and disc simply consisting of three rods each, spaced 60° apart. This results in less expensive construction and a lower cost antenna. The 'Scan-X' is a widely available model featuring this form of construction (see Figure 3).

A popular form of omnidirectional, vertically polarised antenna is the *groundplane*. This consists of a single vertical element, about a quarterwavelength high, situated at the hub of four horizontal, orthogonally arranged elements, as shown in Figure 4. The four horizontal elements form a 'virtual ground', or groundplane, for the vertical element. A coaxial feedline is used, the outer (braid) connecting to the hub of the groundplane, the inner conductor to the vertical element.

The groundplane however, has a limited bandwidth, generally only +/− 5% of the designed centre frequency. However, with the addition of several shorter vertical elements alongside the original, higher frequency ranges can be covered. Tandy, for example, market such an antenna (cat. no. 20-014, 'VHF Hi/Lo, UHF Hi/Lo Ground Plane Base Antenna'). I'll show you how to build a multi-band groundplane later in the article.

The groundplane may come with a minimum of three horizontal elements, but four is more usual. Sometimes you'll see them with multiple groundplane radials, as the groundplane portion is simply a skeleton version of a solid groundplane just over half a wavelength in diameter.

If you're interested in signals from a particular area or getting improved performance over long distances, a beam antenna is required. This concentrates the area of reception of the antenna over a restricted 'window' in a particular direction, reducing the strength of signals coming from other directions. Because a beam concentratres the energy from a particular direction, it will have 'gain' compared to an omnidirectional antenna. The biggest application of beam antennas is in TV reception.

The requirement of broad bandwidth still applies and there are several types of antenna which can be used. Probably the best known, though, is the *log-periodic* antenna. The derivation of the name is quite involved, so I won't attempt to explain it here. However, a log-periodic antenna looks something like that in Figure 5.

A beam antenna will have a 'radiation pattern' or 'reception pattern' looking typically like that shown in Figure 6. If you think of it in terms of reception sensitivity, the greatest sensitivity is in the direction of the arrow, which points in the direction of the 'main lobe'.

Stations at directions off to the side of the main lobe will be received at lower strength than those toward the front. The directions either side of the main lobe peak where the signal strength falls to a half defines the 'beamwidth'. A very large beam, with many elements, may have a beamwidth of 20°, a smaller model, perhaps 80°.

Well to the side of the antenna there may be some minor 'side lobes', with very deep 'nulls' between them and the main lobe. Signals in the direction of the nulls will be severely attenuated.

A further lobe will be found to the rear of the antenna, but sensitivity will be well down compared to the main lobe, as it will be with the side lobes.

Naturally, if the antenna is directional, you'll need to be able to point it in any desired direction, unless you're interested in signals from one general direction only. That's what an antenna rotator is for.

In general, omnidirectional antennas for scanning cost $50 to $100, whereas a beam antenna will cost upwards of $100.

There are many makes and models of antenna rotators on the market, for TV antenna systems and for ham or commercial antenna applications. They cost from around $150 upwards. In general, an antenna rotator will consist of a motor assembly which mounts on a mast and a remote control unit which contains the control switches and a direction indicator. (See Figure 11, later.) ▶

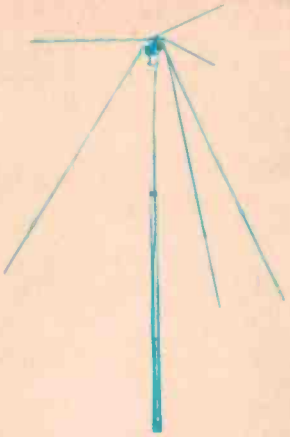


Figure 3. The Hoxin 'Scan X', a truly 'skeletal' form of the discone antenna. This one is sold by many scanner equipment suppliers.

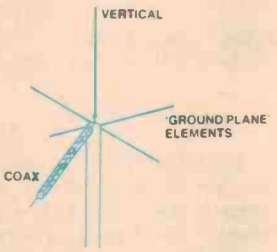


Figure 4. General arrangement of the 'groundplane' antenna.

Figure 5. A typical log-periodic beam antenna (horizontally polarised here). All the elements are split in the centre and 'cross-connected' to the next in line.

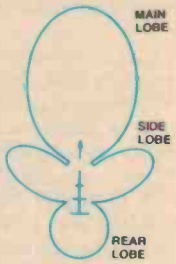
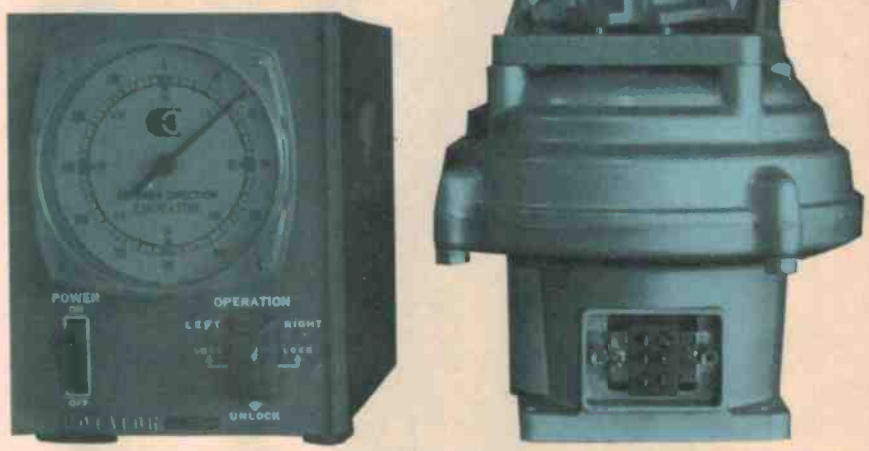


Figure 6. The 'radiation pattern' of a typical beam antenna, showing how the sensitivity varies to signals from different directions. To pick up a signal from a particular direction, the antenna is rotated so that the main lobe points in the desired direction (where the signal will be strongest).



Beam rotator. A typical beam rotator comprises a motor housed in a weatherproof enclosure (to which the beam is attached) — on the right — and a remote control and indicator unit — on the left — sited at your operating position. This is the Emotator 103SAX, available from G.F.S. Electronic Imports, Melbourne.

Build your own scanner antenna

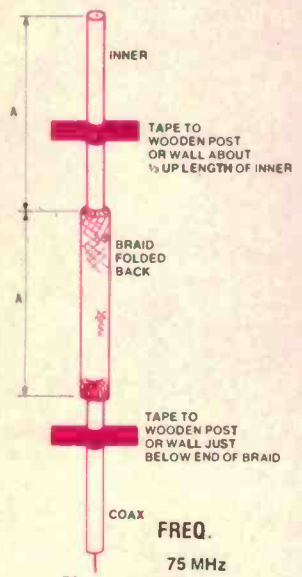
For a simple, quick, cheap and effective antenna that will cover a single band of interest, it's hard to beat the 'coax dipole' shown in Figure 7. There is an antenna type known as the *coaxial dipole*, and this is a version constructed on the end of a piece of coaxial cable.

To make it, cut the end of a length of coax square then measure back along the sheath the distance 'A' indicated in the accompanying table. Using a penknife or modellers' scalpel, carefully cut around the cable through the outer sheath, to the braid. Take care not to nick the braid. Slit the sheath from the cut to the end of the cable and remove it, exposing the braid. Starting at the end of the cable, gently push the braid back toward the end of the sheath, bunching it up, then work the braid loose along its length toward the end of the sheath. Carefully undo a little of the braid at the end and roll it back on itself, then roll back the braid, pulling it down over the sheath to form the antenna as illustrated in Figure 7.

If you're going to mount the antenna outdoors, seal the cable at the turnover of the braid using a silicone compound such as Silastic.

The antenna may be taped high on a wall or taped to a pole mounted outside and as high as you can conveniently get it. Use electrical insulation tape. It doesn't matter too much if the inner droops a bit at the top.

If you're taping it to a wall inside, position the antenna as high as possible; keep it vertical and away from large masses of metal. You could suspend it using nylon fishing line, if you wish.



FREQ.	A
75 MHz	935 mm
120 MHz	585 mm
146 MHz	480 mm
160 MHz	440 mm
470 MHz	150 mm

Figure 7. The 'quickie' coaxial dipole. It's simple, but only covers one band (and three times that frequency band, but not as well).

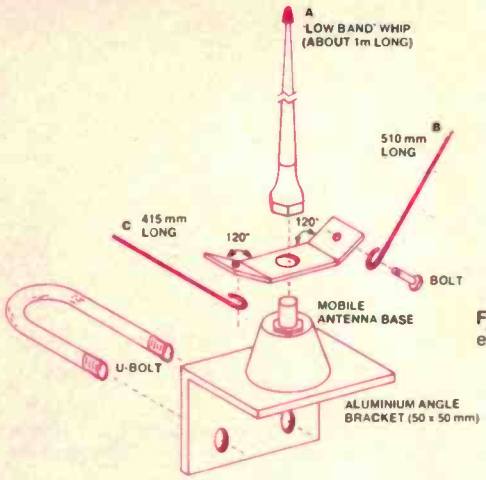


Figure 8(a). Exploded view of the whip radiator assembly for the three-band groundplane.

This 'quickie' antenna will work well over a range of 5% or so either side of the frequencies quoted in the table with Figure 7, and also at three times those frequencies.

Figure 8 shows the construction details for a multi-band groundplane for base station or mobile use. The principal element is a commercially available 'low band' VHF mobile whip about one metre long. This mounts to a standard VHF antenna base mounted on a piece of aluminium angle bracket. A small piece of aluminium plate about 20 mm wide by 40 mm long is drilled and bent as shown in Figure 8a. This holds the two side antennas, B and C, at an acute angle to the main whip (about 30°). These can be fashioned out of heavy gauge (e.g: 16g or 18g) bare copper or steel wire. Each has a small loop at the end so that it can be bolted to the bracket secured under the low band whip.

A dual groundplane system is used for base station applications. These are fashioned out of 9 mm (3/8 inch) aluminium tube bolted to a 50 mm (or larger) diameter aluminium mast which can be as long as you please. Figures 8b and 8c show the dimensions and general construction, 8d shows the completed antenna.

The angle bracket holding the vertical element is secured to the mast just above the groundplane elements using a U-bolt.

Attach a length of coax to the antenna base, seal it with a silicone compound such as Silastic and you're ready to go on the air!

For mobile operation, dispense with the groundplane elements and mount the angle bracket to a roof-rack bar using two small U-bolts positioned vertically, side by side. Alternatively, if you have a VHF mobile antenna base already mounted on your vehicle, the three elements could be mounted to it in the same fashion as shown in Figure 8a.

This antenna will cover channels within quite a few MHz of 70 MHz, 140 MHz and 170 MHz — which covers some of the more popular bands. It will also work on the UHF band, but perhaps not as well as a good UHF antenna.

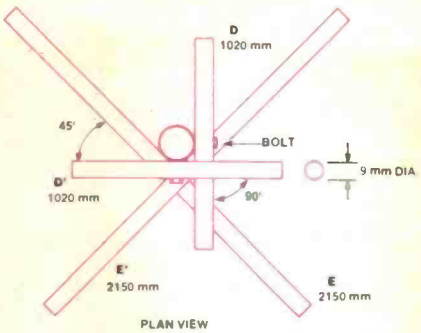


Figure 8(b). Plan view of the two sets of groundplane elements.

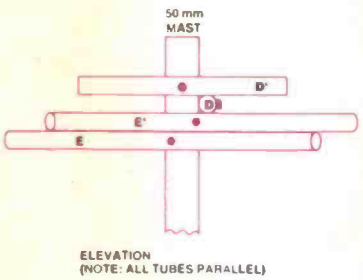


Figure 8(c). Elevation view of the two sets of groundplane elements.

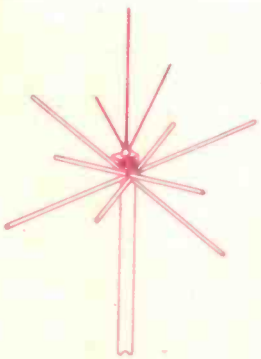


Figure 8(d). Overall view of the finished three-band groundplane.

Erections

"The higher you put it, the better it'll be . . .", says the old maxim, but there's no need to go to extremes. Really good results can be obtained simply mounting the antenna on the roof of your house. A 30 metre high tower is hardly in keeping with the cost of your scanner!

No matter what sort of antenna you're using, mount it in a conveniently high position and as clear of nearby objects or structures as you can. If you're mounting it somewhere on your house, then simple, low cost TV antenna type fittings can be used, as illustrated in Figures 9 and 10.

When contemplating where to mount the antenna, you'll need to keep in mind that the shorter the run of coax feedline you can get, the better off you'll be. Any sort of feedline has losses — that is, it will attenuate the incoming signals to some extent, and the loss increases with increasing frequency. Thus, the shorter the length of feedline, the less the loss incurred.

The sort of feedline commonly used is known as 'RG58' or 'RG58C/U'. Buy a good quality make — it will have less loss than that made for CB applications. RG58 is about 6.5 mm

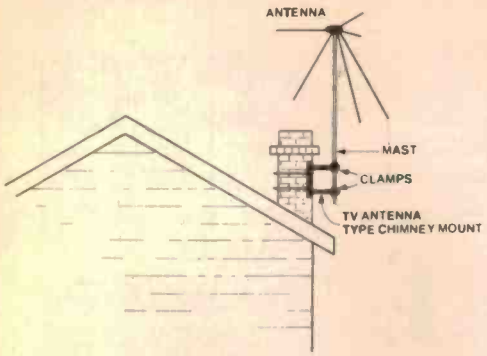


Figure 9. Mounting a scanner antenna on your chimney, using TV antenna type fittings. The mast should be no taller than two or three metres.

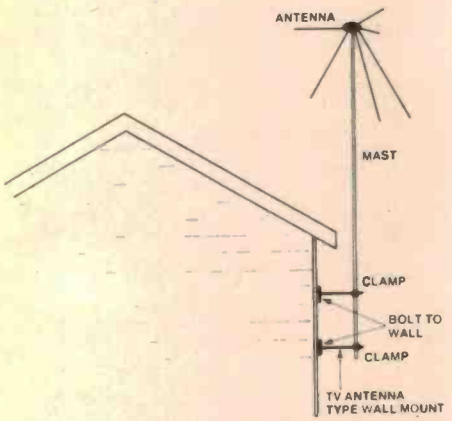


Figure 10. Mounting a scanner antenna from a wall, again using TV antenna type fittings. The mast could be up to 4m tall but, if so, keep the wall mounts about a metre apart.

in diameter and has a loss of around 16 dB per 100 metres at 100 MHz, 24 dB/100 m at 200 MHz.

However, the larger diameter coax cables have lower loss figures. These are generally 10 mm in diameter and two common types are RG8 and RG213 (sometimes with the /U or C/U suffix). These have losses of around 6 dB/100 m at 100 MHz, 9 dB/100 m at 200 MHz. As you can appreciate, despite the extra cost, the larger diameter coax is a better proposition when long feedline runs are involved.

If you intend using a beam antenna, the mounting configuration shown in Figure 11 is recommended. The mast can be mounted using the techniques shows in Figures 9 and 10, but make sure the total mast length is no longer than about three metres, otherwise it may not take the wind loading that the beam antenna will exert on it.

When mounting a beam antenna, ensure that it can rotate freely and that the beam is mounted to the mast at the point of balance. The short section of mast between the beam and the rotator must not be metal, otherwise it will interfere with the operation of the beam. It should be at least as long as the longest element, or slightly longer. You can use ABS pipe, as suggested, or a wooden mast here (suitably treated against the effects of the weather. i.e: paint it with an exterior epoxy lacquer, such as Estapol).

The feedline should have enough slack in it so that it is not strained by the operation of the rotator, yet not too much that it flaps violently in the wind, which will prematurely wear it. Tape it securely to the mast sections above and below the rotator.

Well, that concludes this short guide to scanner antennas; good listening!

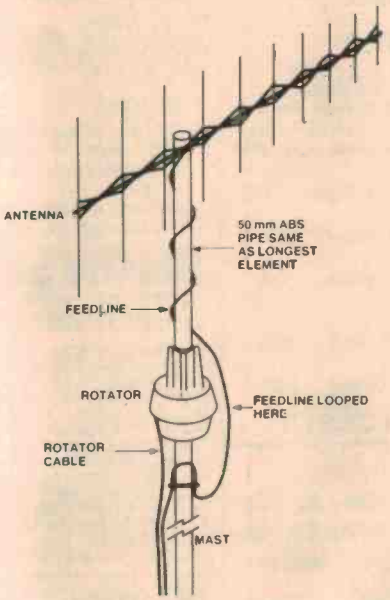


Figure 11. General arrangement for mounting a beam antenna and rotator. The mast should be supported no further than 1½m below the rotator.

Another rotator. This beam rotator is a medium duty type, by Alinco, model EMR-400. It is available from Imark Pty Ltd, Melbourne.

Some references

Here are a few books which contain useful further reading on the general subject of antennas. They are not listed in any preference order.

The ARRL Antenna Book, *The American Radio Relay League, 1982.*

Vertical Antenna Handbook, Capt. Paul H. Lee, USNR, K6TS, *Cowan Publishing Corporation, 1974.*

The Radio Amateur's VHF Manual, *The American Radio Relay League, 1982.*

VHF-UHF Manual, Fourth Edition, *G.R. Jessop, G6JP, RSGB Publications, 1983.* ●

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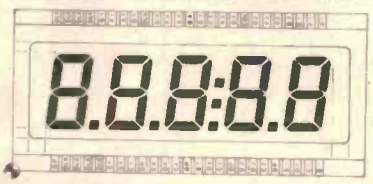

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We don't have a great deal of space to list the dozens of features here but hurry if you want to join the hundreds of Australians who are SAVING MONEY DAILY with the Voyager Car Computer. (Note professional drivers could recoup the cost of the unit within a year after adopting more economical driving habits as shown by the computer).
THIS OFFER IS STRICTLY LIMITED TO THIS MONTH ONLY! REMEMBER! THE VOYAGER GIVES INSTANT FUEL CONSUMPTION AS YOU DRIVE ALONG – IN L/100 Km OR MPG!
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What to do? Well they are STILL a great FM antenna for home use, but at this new price you would be silly if you did not grab one for better FM reception. (For more info see our ads around NOV-DEC 1982). The Jabber Grabber sold for $29.50, well, sort of sold anyway. It was probably too expensive. But at $19.50 – another story.
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JABBER GRABBER – Cat. AA2002 $19.95
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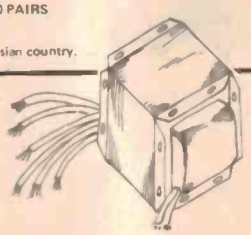

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This component has a 0.1" pitch 72 way (2 x 36) configuration. Each contact is heavily gold plated and bifurcated for lower contact resistance. The 0.025 square terminations will PC mount or take one level of wire-wrap. The body is moulded in high quality Diallyl Phalate with integrally moulded mounting feet on the ends. Outstanding quality for the price.

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Edge Connector No.2 — Cat. HE-8656
This component has a 0.156" pitch 86 way (2 x 43) configuration. Once again each contact is heavily gold plated and bifurcated. The termination is of the solder-lug type. The body is identical in fashion to the HE-8655

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The Micro-Grasp robot arm

Part 2

This part covers construction of the interface electronics board, which completes the project.

Richard Becker
Powertran, Andover, Hants U.K.

ALL THAT REMAINS to complete the Micro-Grasp project is the assembly of the interface board, wiring it to the mechanical assembly and arranging the interface connections.

ELECTRONIC ASSEMBLY

Many of the components on the interface board are closely spaced and you'll find assembly easiest if you follow the order detailed here.

Sockets are used for all the dual-in-line (DIL) ICs. These should be soldered in place first. Identify which is required for each IC position and solder them in place one by one taking care to orientate them correctly.

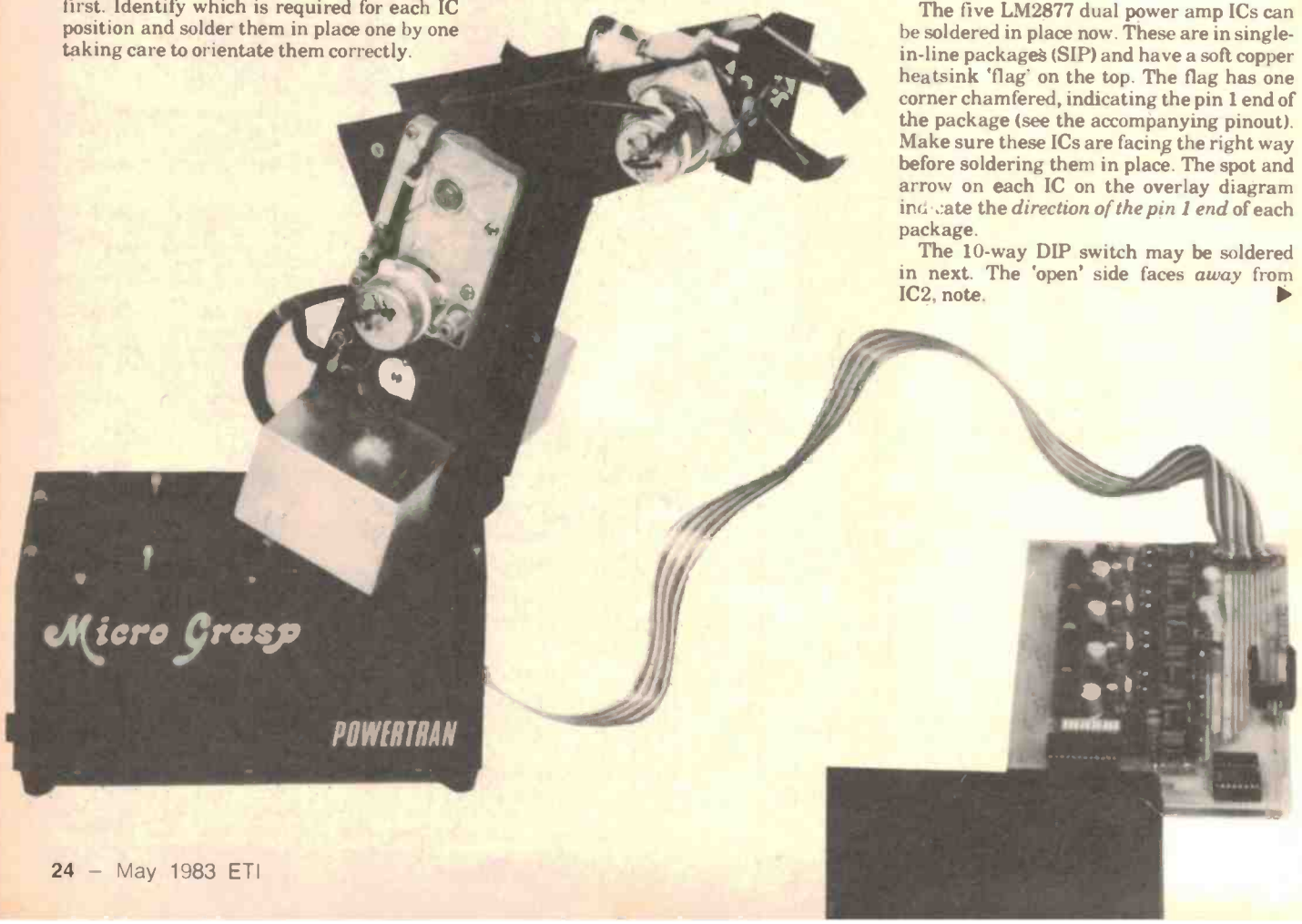
The single-in-line resistor pack, R3-R10, should be soldered in place next, making sure you place the end marked with a spot towards the outer edge of the board, as indicated on the component overlay.

All the resistors should be soldered in place next. Note that four are stood vertically from the board: R26, R27, R29 and R30. Solder the disc ceramic capacitors in place next, then the polyester capacitors (the colour-coded ones). The four 47n capacitors are located between the row of trimpots and the row of IC6s (A, B, C, D). The 100n capacitors are all located between the row of trimpots and the line of LM2877s (ICs 8A-D and 10). Finish off this stage of the construction by soldering the electrolytic and tantalum capacitors in place. Take care they are each orientated correctly.

Now you can mount the eight trimpots. Follow by assembling the 7805 regulator, IC1, and its heatsink to the board, carefully bending the leads to fit into the holes provided. Solder the leads *after* tightening the securing bolt.

The five LM2877 dual power amp ICs can be soldered in place now. These are in single-in-line packages (SIP) and have a soft copper heatsink 'flag' on the top. The flag has one corner chamfered, indicating the pin 1 end of the package (see the accompanying pinout). Make sure these ICs are facing the right way before soldering them in place. The spot and arrow on each IC on the overlay diagram indicate the *direction of the pin 1 end* of each package.

The 10-way DIP switch may be soldered in next. The 'open' side faces *away* from IC2, note. ▶



INTERFACE BOARD

Resistors ..... all ½W, 5%

R1, 2, 15A-D, 16A-D, 31, 33	4k7 (12 off)
R3-10	4k7 8-up SIP network
R11	82R
R12	68R
R13A-D, 18A-D, 19A-D, 21A-D, 27, 30	1k (18 off)
R14A-D	3k9 (4 off)
R17A-D	470R (4 off)
R20A-D, 22A-D, 25, 28, 32, 34	100k (12 off)
R23A-D, 24A-D, 35, 36	3R3 (10 off)
R26, R29	10k (2 off)
RV1A-D, RV2A-D	22k trim pots (8 off)

Capacitors

C1, C2	220u/16 V RB electro. (2 off)
C3, C4	1u/16 V tant. (2 off)
C5A-D	47n ceramic (4 off)
C6A-D	100u/10 V RB electro. (4 off)
C7A-D	100p ceramic (4 off)
C8A-D	47u/10 V RB electro. (4 off)
C9A-D	47n polyester (4 off)
C10A-D, 11A-D, 12A-D, 13A-D, 16, 19	100n polyester (20 off)
C14, C15	47u/6V3 tant. (2 off)

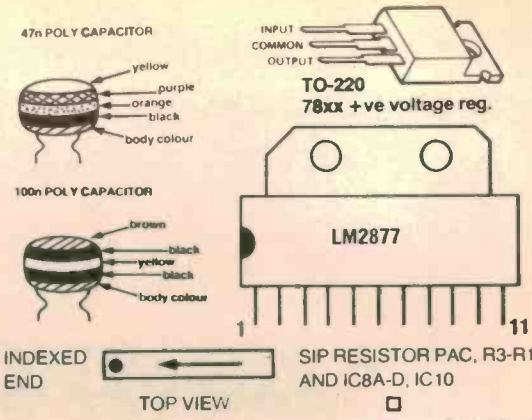
Semiconductors

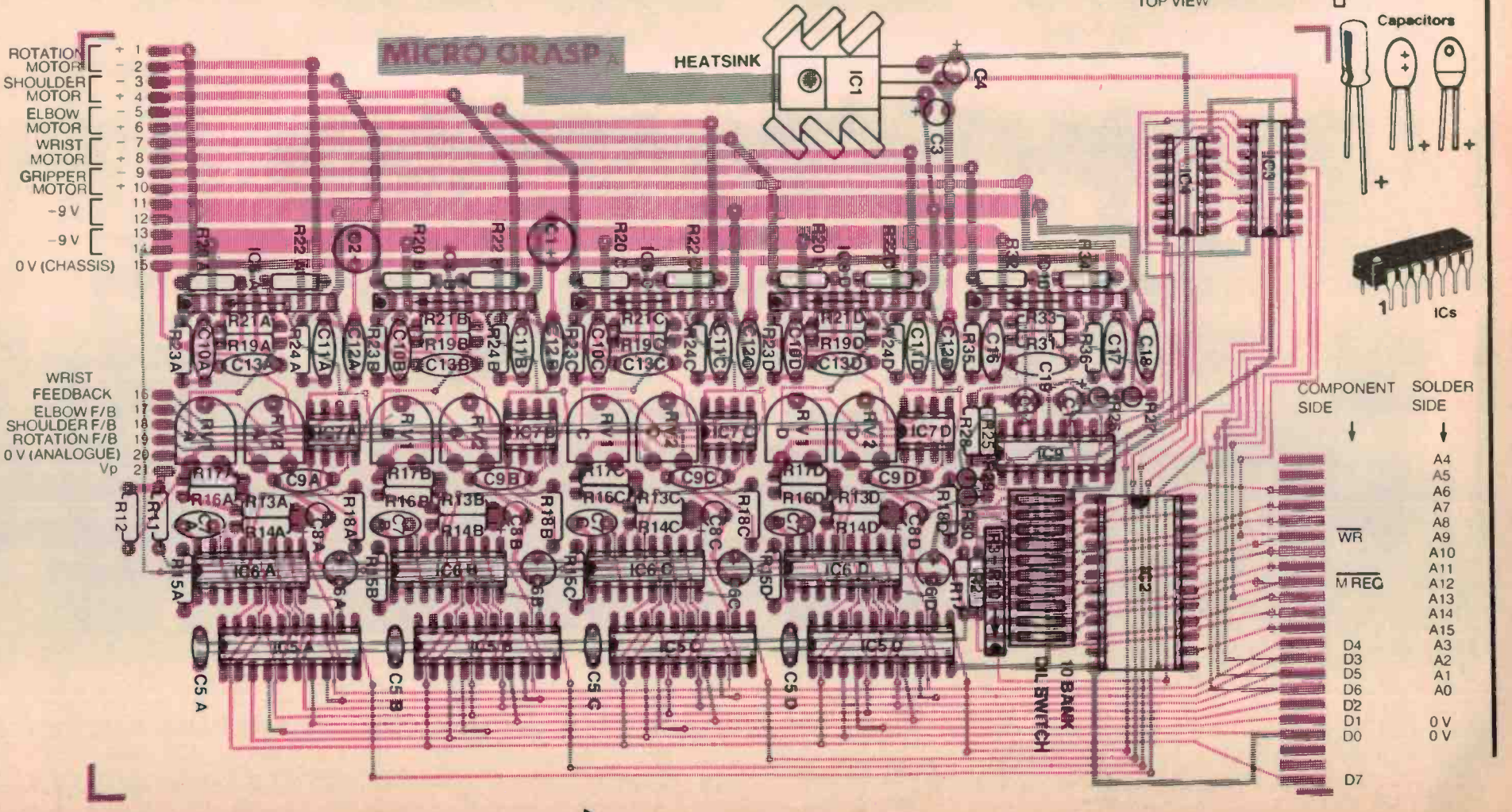
IC1	7805
IC2	DM8130
IC3	74LS138
IC4	74LS04
IC5A-D	74LS373 (4 off)
IC6A-D	DAC0808 (4 off)
IC7A-D	1458 (4 off)
IC8A-D, IC10	LM2877 (5 off)
IC9	74LS123

Miscellaneous

S1-S10 ..... SPST 10-band DIL switch

Printed circuit board; flatpack heatsink; 4 x 8-pin IC sockets; 1 x 14-pin IC socket; 6 x 16-pin IC sockets; 4x20-pin IC sockets; 1x24-pin IC sockets.





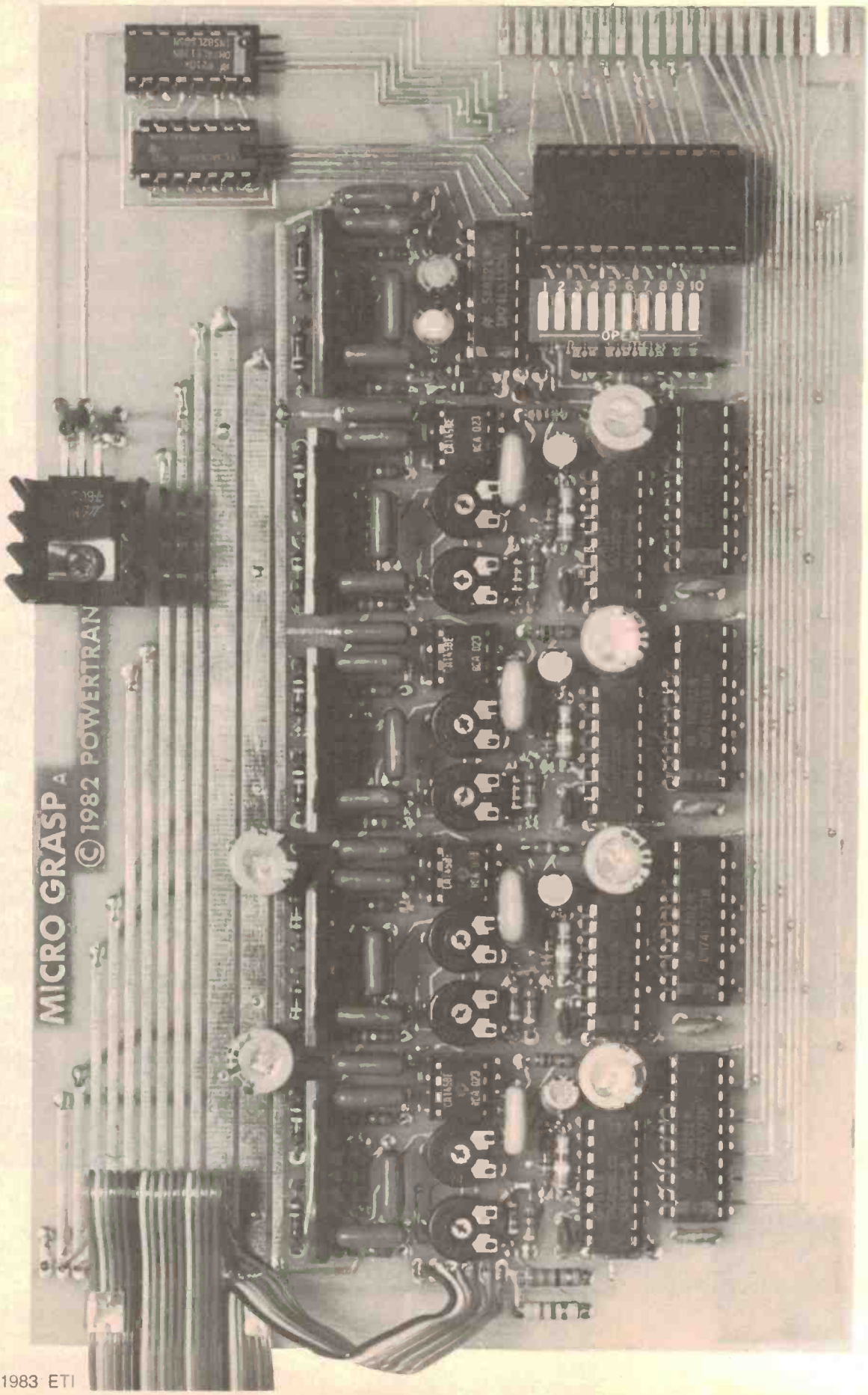

MICRO GRASP A
©1982 POWERTRAN

TABLE 2.

PC BOARD CONNECTION POINT	TERMINAL BLOCK	DESTINATION
1	1	rotation motor +ve
2	2	rotation motor −ve
3	3	shoulder motor −ve
4	4	shoulder motor +ve
5	5	elbow motor −ve
6	6	elbow motor +ve
7	7	wrist motor −ve
8	8	wrist motor +ve
9	9	gripper motor −ve
10	10	gripper motor +ve
11, 12	11	+9 V
13, 14	12	−9 V
15	tag	0 V (solder tag on chassis)
16	13	wrist feedback (RV101D, tag B)
17	14	elbow feedback (RV101C, tag B)
18	15	shoulder feedback (RV101B, tag B)
19	16	rotation feedback (RV101A, tag B)
20	17	0 V, analogue
21	18	Vp

That completes the component assembly. A careful check at this stage may obviate problems later on.

The 21-wire flat ribbon cable can now be prepared for connecting between the interface board and the arm assembly. Separate the wires at one end and strip and tin the wires. A group of six on one side is pared back from the rest to go to connection points 16-21 (see the overlay and photograph).

The other end of the ribbon cable connects to the terminal blocks on the end plate of the arm assembly according to Table 2 (which is related to Table 1). Temporarily leave off the wires to terminals 2, 4, 6, 8 and 10.

Check everything, once again.

Don't plug in the remaining ICs yet.

All that remains now is to arrange the interface connections according to your computer's expansion socket pinout.

The edge connector at the right hand end of the board plugs into a 44-way keyed socket. This is British-made, UECL part CS 1692F 1585 8237, and suits the Sinclair ZX81 expansion connector. To interface the board to your computer, you'll need one of these sockets, a short length of 28-way ribbon cable and a plug or socket to suit your computer's expansion connector.

Testing and calibration

Power up the robot and interface board without the computer connected and with all the ICs unplugged and check the power rails for ±9 V approximately and ±5 V from the regulator. Assuming all is well, switch off and plug in the ICs. Check again and switch off.

Connect the computer, switch on the robot followed by the computer and check the computer's operation is unaffected by the interface board. If it is, then there is probably a short across the address or data lines on the board.

Set all the DIL switches to open, rotate RV1 A-B-C-D fully anticlockwise and enter POKE 65472,0. Each output of IC5a will now be low and IC7a pin 1 will be close to 0 V. Enter POKE 65472,255 and each output will change to high and IC7a pin 1 will change to close to +1 V. Enter POKE 65472,128 and IC7a pin 1 will change to 0.5 V.

Similar results will be obtained on servo circuits B, C, D using addresses 65473, 65474, 65475 respectively.

Address the monostables with POKE 65477,0 and POKE 65478,0 and IC9 pins 13 and 5 respectively will go high for about two seconds and then return to low.

Connect the rotation motor (terminal block 2) whilst the robot is switched off, turn each preset to its midway position and switch on. The arm will move to some extent and come to rest peaceably i.e: without being held back by its cables.

Turning RV1A will result in the arm changing its position.

Return RV1A to its midway position, successively enter data of 0 and 255 (i.e: minimum) and maximum codes and adjust RV1A-RV2A for 180° of movement symmetrical about the forward facing position.

Repeat this procedure one axis at a time for the other three servo-controlled axes, adjusting for the shoulder to move between almost touching the end stop and about 10° below horizontal and for the elbow and wrist joints to have 180° movement.

Finally, connect and check the gripper motor circuit and after fitting the end panels the robot is ready for use.

We hope to follow up this project description with some general software details plus interfacing to some popular micros and a few programs. ●

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BRAND NEW B&W pix tubes: 1x 27ZP4, 18x 25RTP4, 5x A65-12W, 1x A65-11W, 1x 21DJP4, 2x 17BJP4, 1x AW43-80, 1x A31-120W, 1x21CBP4. What offer for the lot. Ex Hobart. E. Searle, GPO Box 578F, Hobart Tas. 7001.

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WANTED: 6299, 7554, 6442, 6884, 7077 and 6205 valves. K901 110 Vac delay relays (similar in size to 6V6 GT). (03)583-1638.

COMPUTERS

FOR SALE: DISK DRIVES, 8" 30M Micropolis Winchester and Intelligent controller, 8" Shugart floppy $3000 ono. Alan Millett (066)52-4077 bh.

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WANTED TO BUY: SYM-1 single board computer. Geoff (02)638-0177 ext 341 bh.

VIC 20 COMPUTER, cassette recorder, Super Expander, 16K RAM, $400 of software, joystick. Worth over $1000, sell for $500. Adrian (03)850-3113.

SELL: ONE HHP-16K ROM emulator, for use with HP-41C/CVs. Use EPROMs. As featured in ETI March '83 page 78. $250. Stephen (03)366-6502.

SELL: Z80 S100 microcomputer. Includes DGZ80 CPU, MW640 VDU, motherboard, keyboard, cassette interface, power supply and manuals. All working, $320 ono. Con (02)709-6393.

TRS-80 MODEL I program exchange. Send four on cassette and receive four new ones. $2 P&P. G. Egel, 18 Sturt St, Loxton SA 5333.

WE'RE STUCK!

FOR ROOM TO MAKE MORE KITS, OUT THESE GO AT
NEVER-TO-BE-REPEATED PRICES

MICROSYNTH

COMPACT MUSIC SYNTHESIZER **Kit**

For details on this fantastic Synthesiser see our ads last month in EA and ETI.
We have slashed $50 off this unit for the month of MAY ONLY. When stocks sell out it will be a LONG TIME before more arrive!
If you want one HURRY!!
Cat. KJ6002

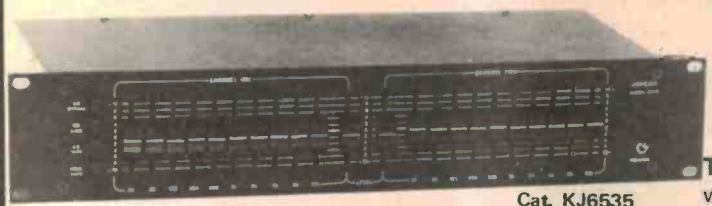
NORMALLY $399
THIS MONTH ONLY $349

BAND-BOX Kit

Again for more info see our ads last month. This has to be seen and heard to be believed! It is basically a 3 "MAN" backing trio! Bass, Chords and Percussion! By far the most sophisticated muso-kit we have ever seen.
And we are SACRIFICING them this month ONLY.
Strictly limited. Cat. KJ6604

NORMALLY $699 including Master Rhythm
THIS MONTH $100 OFF
THAT'S RIGHT ONLY $599

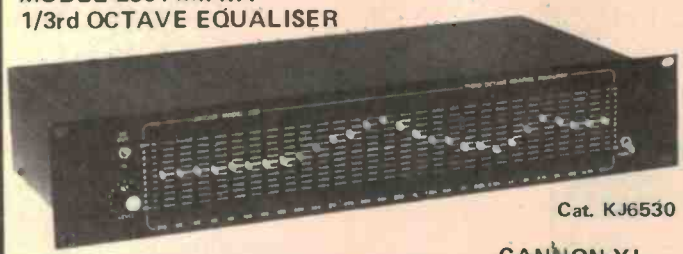
JAYCAR 2010 EQUALISER



Cat. KJ6535

Fantastic value for the month of May on the Jaycar 2010 Mk IIA Octave (10 band) Equaliser – this superb unit will be cut by 5% making it superb value – add one to your system today – Stereo unit with one slider per octave – 3½" high cabinet.
NORMALLY $139 – NOW LESS 5% MAY ONLY

MODEL 2801 Mk IIA
1/3rd OCTAVE EQUALISER



Cat. KJ6530

240 VOLT AC POWERED

CANNON XL
IN/OUT

A full road quality 1/3rd Octave Equaliser – the Jaycar 2801 Mk IIA – don't pay up to $1000 when the Jaycar unit can do the job for you – two units are required for stereo use
NORMALLY $225 IN KIT FORM
LESS 5% FOR THE MONTH OF MAY ONLY

WOT! *PIANOS AS WELL*

That's right. We are slashing the price of our piano kits because we are overstocked. Unfortunately at this price we cannot afford to add such goodies as a soldering iron and IC sockets – BUT everything else is there, including the stand!!

73 NOTE 6 OCTAVE PIANO (COMPLETE KIT)
NORMALLY $475 - THIS MONTH $425 – SAVE $50!!
88 NOTE 7¼ OCTAVE PIANO (COMPLETE KIT)
NORMALLY $589 – THIS MONTH $489 – SAVE $100!!
BE EARLY TO AVOID DISAPPOINTMENT!!
6 Octave Cat. KA1350 : 7¼ Octave Cat. KA1360

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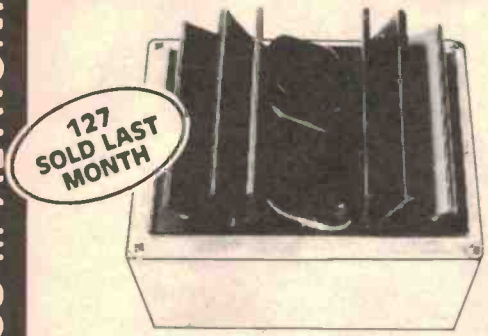


The Altronics Kit includes all components for the modifications, detailed by Electronics Australia Feb. 1983.

Yes, it's bad enough paying $2.00 a gallon for petrol without wasting a fortune on an out of tune engine. Fit this transistor assisted ignition kit in minutes and start saving money from the very next petrol stop. Easy to build!

K 4010 . . . . . $35.00

THE EVER POPULAR MUSICOLOUR IV EA PROJECT

Combination Colour Organ and Light Chaser. Four channel colour organ. Internal microphone or connect to speakers for colour organ operation. (The lights connected to each channel pulse in beat to the music proportional to portion of frequency spectrum concerned.) Four chaser modes forward and reverse. Output lamp load capacity a massive 2400 watts — that's 100 party globes. Full instructions and every last nut and bolt included. Great for parties, shop signs, display windows etc.

K5800. . . . . $89.50

ELECTRONIC FLUORO STARTER

(SEE EA OCT. 1982)

Save a fortune on Flouro Tubes.

- Extends the life of your flouro tubes by 1,000's of hours.
- Instant "ON" — no more flickering at switch on.

K6300 . . . . . $4.95

HIGH FIDELITY AM

Sounds every bit as good as FM
With this absolutely brilliant
EA Project

Project 82 AR12 — See December EA

Frankly, we felt AM was dead and buried for the serious audio buff — when EA told us their new wide band AM tuner had 16KHz bandwidth and made AM sound like as never before — we were still not convinced. But on hearing the New EA AM Tuner, I for one was astonished — AM Broadcasts now sound incredible, there is no other word for it. And the 9KHz whistle filter really works! The result is clear smooth sound reproduction that will be a joy to every constructor of this fantastic tuner project.

The ALTRONICS Kit includes rack box and every last nut and bolt — even solder. Full instructions included.

K 5200 . . . . . $249.00

THE INCREDIBLE SERIES 5000 FROM ETI
SERIES 5000 1/3 OCTAVE GRAPHIC EQUALIZER

Another brilliant DAVID TILBROOK no compromise design

SPECIFICATIONS:
Noise — at zero gain and 20 KHZ Bandwidth — 102 db. Distortion 1 KHZ — typically .007%. Bandwidth — 12HZ — 105 KHZ + 0 — 1 db. Boost/Cut + and — 14 db.

ALTRONICS EXCLUSIVES:
* All IC sockets provided * Quality series Racking Case supplied * Genuine Philips Sygnetics Low Noise 5534 IC op amps supplied * Specially imported high accuracy linear slide potentiometers employed for precision control adjustment.
(**NOTE:** Not compromise "Null Centre" types that some suppliers offer.)

K 5025 . . . . . See ETI Magazine November 1982 . . . . . $199.50

STUDIO FORMAT
ETI 5000 STEREO CONTROL PREAMPLIFIER

There have been countless accolades exclaiming this brilliant design by Australia's top audio design engineer David Tilbrook — and with good reason!

As a demonstration of our faith in this classic designed preamplifier we proudly release the **STUDIO FORMAT 5000 PREAMP** which includes some very worthwhile refinements as detailed here:—
* Gold plated RCA Jacks on all phono inputs * 1 x pair gold plated RCA Line Plugs, supplied * Military spec. National Semiconductor LM 394's employed * Low capacitance screened cable, supplied; IC sockets provided throughout; Multicoloured led display * Metal film 1% resistors used throughout all audio circuitry * Pretinned PCB's * Satin Black brush finished, aluminium control knobs

DELUXE STUDIO FORMAT 5000 PREAMP KIT Complete kit
Includes all ETI specified parts plus the Studio Format Package. Full instruction booklet included. SEE ETI MAG. JULY '81—OCT. '81 FOR FULL DETAILS.

K 5001 . . . . . $275.00

ETI 5000 STEREO MOSFET AMPLIFIER

See ETI magazine Jan. '81—April '81. New generation mosfet power semis facilitate David Tilbrook's classic power amplifier. Listening tests prove it surpasses even the best in conventional amplifiers in low fatique, high definition audio. Completely uncoloured crisp sound purity.

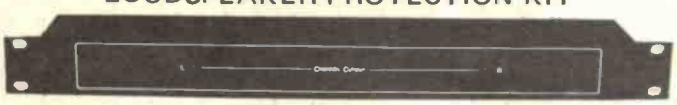
EVEN BETTER: This beautifully engineered amp design is based principally on two identical printed circuit boards with a minimum of other wiring, thus enabling even a relative "beginner" to accomplish building this project as long as the step by step instructions are followed.

The ALTRONICS Kit includes the DELUXE FINISH FRONT PANEL HEATSINK
* Original specified chassis bar design case * All metal work finished satin black * Flux shorting strap transformers used to minimise hum * Low leakage power supply electrolytics

SPECIFICATIONS: Power Output: 100 watts into 8 ohms x 2. **Frequency Response:** 8 HZ - 20 KHZ + 0 db — .4 db. **Noise:** 116 db below full output. **Input sensitivity:** 1V RMS for 100 W output. **Distortion:** Less than .001% at 1 KHZ and full output. **Stability:** Unconditional stable.

COMPLETE MOSFET AMP KIT K 5005 . . . . . $299.00

LOUDSPEAKER PROTECTION KIT



Protect your valuable loudspeaker system with this easy to build, professional appearance kit. This easy to construct kit, based on the latest ETI design (Oct. '82), provides both DC and overpower protection for your valuable Hi-Fi speakers.

Self-powered unit disconnects the speakers within 1/10th of a second of a fault occuring yet in no way effects the sound quality.

The ALTRONICS Kit comes in a superb 1 unit rack box including quality silk screened front panel.

EXCLUSIVES: * LED Monitoring of channel cutout * Fujitsu 10 amp relays * ALTRONICS Kit, stereo unit complete to last nut bolt and washer * Input/Output speaker cable terminals supplied.

Install it in minutes — no AC or DC connections required — simply connects into the left and right channel speaker lines.

K 5050 Stereo Rack Version $79.50

Headlight delay unit

With this simple project you can use your car headlights to illuminate your pathway for about 50 seconds; safe on a dark night from the horrors of stumbling into bushes or slipping on those nasty smelly things lying on the footpath. The unit is easy to build and install and switches off automatically.

Jennie Whyte

THIS IS a simple circuit which lets you use your car headlights to light your way. It saves you from falling over rubbish bins or walking into fences on a dark night.

After you have parked your car and turned the delay unit on, the headlights will come on for a pre-set period of about 50 seconds. At the end of this period the unit turns the headlights off automatically. So if you haven't manoeuvred the obstacle course by this stage then you're out of luck.

THE 555 AND HOW IT WORKS

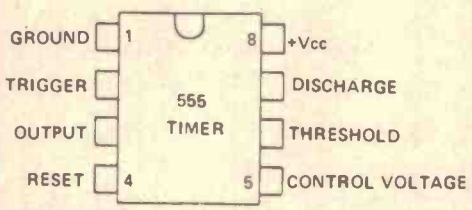


Figure 1.

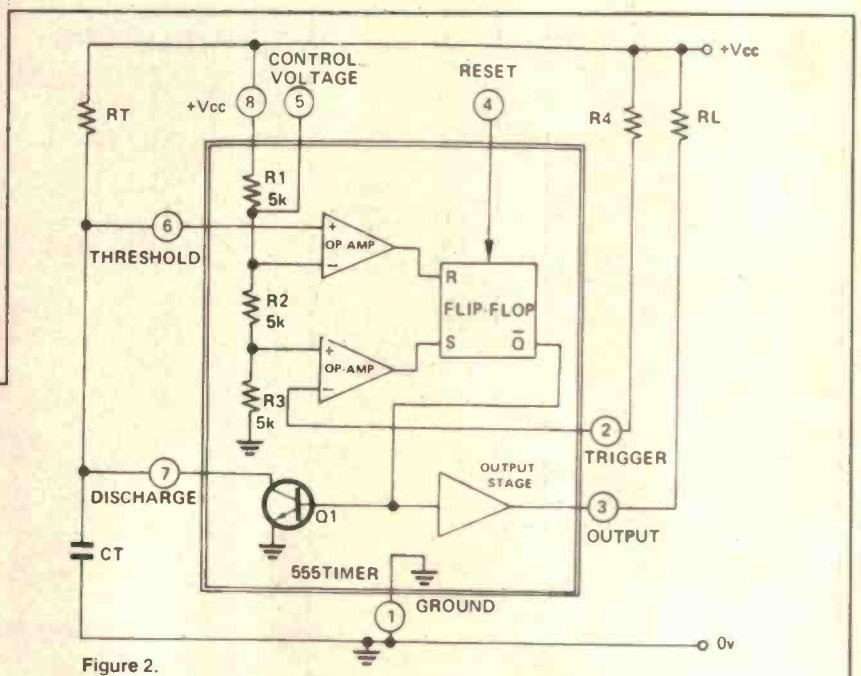


Figure 2.

The 555 timer is a very versatile IC designed specifically for precision timing applications.

It can operate from 4.5 V to 16 V and its output can source (supply) or sink (absorb) any load current up to a maximum of 200 mA. It can directly drive loads such as relays, LEDs, low-power lamps and high impedance speakers.

When used in the 'timing' mode, the IC can produce accurate timing periods variable from a few microseconds to several hundred seconds, via a single resistor-capacitor (RC) network. Timing periods are virtually independent of supply rail voltage, can be started via a 'trigger' command signal and can be stopped by a 'reset' command signal.

The device is available in a number of packaging styles, including 8 and 14-pin dual-in-line (DIL) and 8-pin TO-99 types. Figure 1 shows the outline and pin notations of the standard 8-pin DIL version of the 555. Figure 2 shows the functional block diagram of the same device (within the double lines), together with the connections for using it as a basic monostable generator or timer.

The 555 houses two diodes, 15 resistors and 23 transistors. These components are arranged to form one voltage-reference potential divider, two voltage comparator op-amps, one 'reset-set' (RS) flip-flop, a low-power complementary output stage and a slave transistor.

The period timer, as it is used in the headlight delay unit, gives a direct voltage output at pin 3 which is normally low, but goes high for the duration of the timing period.

The timing action is initiated by momentarily shorting pin 2 to ground via the PB1 START switch. As this voltage is below the reference value of the built-in potential divider the output of the lower voltage comparator op-amp changes state and causes the RS flip-flop to switch over.

As the RS flip-flop switches over it cuts off Q1 and drives the pin 3 output of the 555 to the high state. As Q1 cuts off it removes the short from the timing capacitor connected to pin 7 and the capacitor starts to charge up. Then the RS flip-flop switches back to its original condition, Q1 turns on, the capacitor discharges and simultaneously the pin 3 output of the IC reverts to its low state.

PARTS LIST — ETI-323

Resistors ..... all ½W, 5%
- R1 ..... 22k
- R2 ..... 470k
- R3 ..... 1k

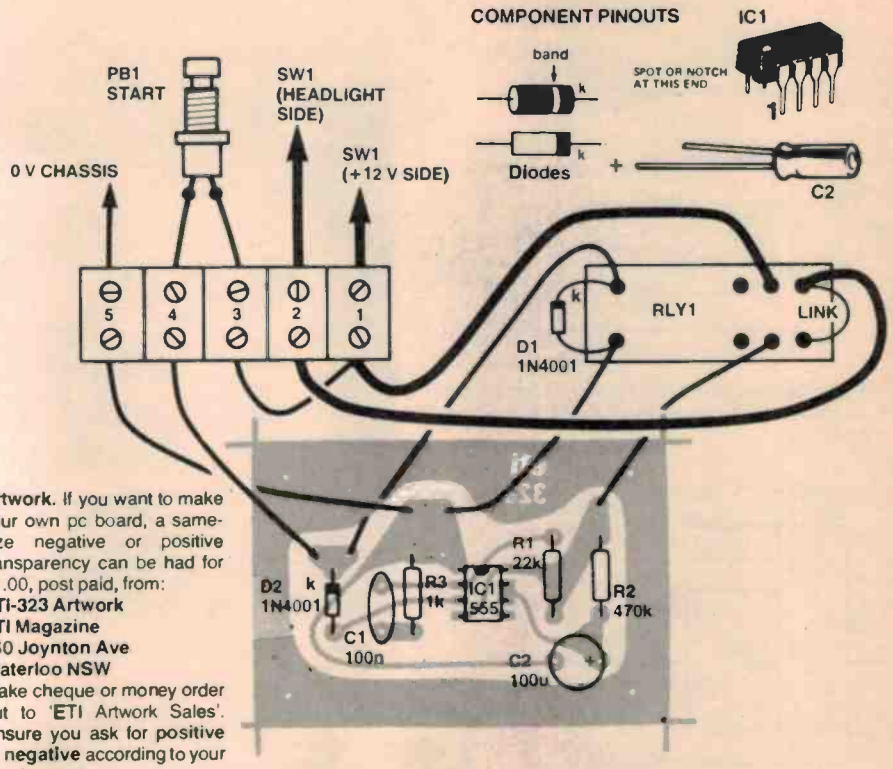
Capacitors
- C1 ..... 100n greencap
- C2 ..... 100u/25 V RB electro.

Semiconductors
- D1, D2 ..... 1N4001, 1N4002, EM401, EM402, etc.
- IC1 ..... uA555, NE555, LM555, DS555, etc.

Miscellaneous
- RLY1 ..... DPST or DPDT relay, 5A-rated contacts with 12 V coil (120 ohms or greater).
- PB1 ..... momentary action pushbutton (e.g: D.S.E. S-1102, S-1199 types, or similar).

ETI-323 pc board; five-way plastic terminal block; box (if necessary); wire etc.

Price estimate
$14 — $16



Artwork. If you want to make your own pc board, a same-size negative or positive transparency can be had for $1.00, post paid, from:
ETI-323 Artwork
ETI Magazine
140 Joynton Ave
Waterloo NSW
Make cheque or money order out to 'ETI Artwork Sales'. Ensure you ask for positive or negative according to your requirements.

Component overlay and external wiring. How the parts are assembled onto the printed circuit board — watch which way around you assemble D2, IC1 and C2. Wiring to the external components is also shown. The pc board and relay may be housed in any suitable box, if you wish.

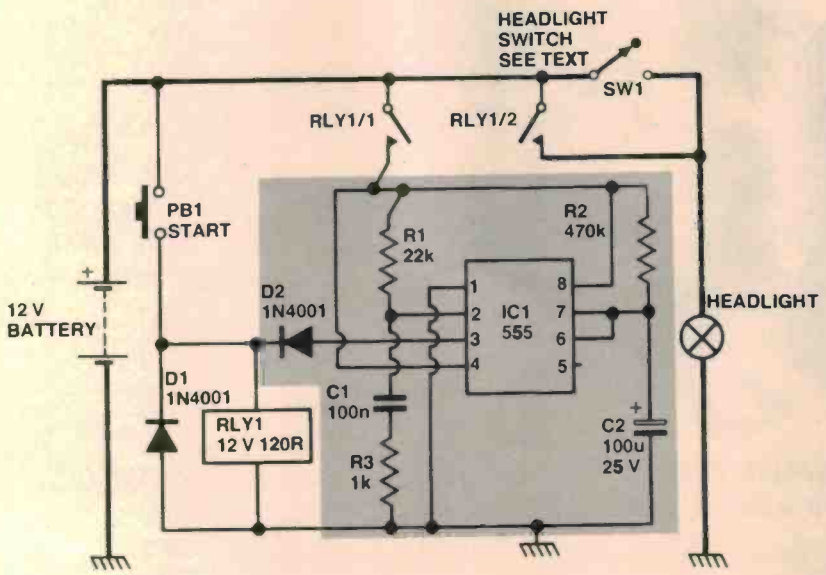
Construction

The unit is easy to build and install and works off the car's 12 V battery. The circuit does not interfere with normal headlight operation under actual driving conditions.

Construction is simple because there are only a few components and the layout on the pc board is clearly shown. Before you assemble the components on the board, check that the board has no track breaks or shorts between the tracks, particularly between the IC pins. Make sure you solder the diodes the correct way round.

The relay can be any 12 V DPDT (double-pole, double-throw) type with a coil resistance of 120 ohms or greater. The contacts should be rated to switch 5 A or greater at 12 Vdc. Note that the IC, a 555, is shown on the circuit diagram with all its connections in the standard manner. Look for the notch and make sure that it's positioned on the pc board correctly, soldering it in after the other components.

Kits and components. See 'Shoparound' in this issue to find suppliers stocking kits or components for this project.



Circuit diagram. The parts in the shaded area are located on the pc board.

HOW IT WORKS — ETI-323

This circuit has been designed around the 555 IC timer which has already been described.

The pin 3 output is connected to a relay which has two sets of normally open contacts. D2 is wired in series with the relay coil to counteract the slight residual voltage that appears at pin 3 of the IC under the OFF condition and this makes sure that the relay turns fully off. The START switch, PB1, is also normally open so there's no power going to the timer circuit and the lights are off. Capacitor C1 is discharged under this condition.

When PB1 is momentarily closed power is fed directly to the relay coil and the relay turns on. As the relay turns on, contacts RLY1/2 close and apply power to the vehicle lights and contacts RLY1/1 close and apply power to the timer circuit. At this moment pin 2 of the IC is briefly tied to ground via C1 and R3 so a negative trigger pulse is immediately fed to pin 2 and a timing cycle is initiated.

Consequently, pin 3 of the 555 switches high at the moment that the relay contacts close, and thus locks the relay into the ON condition irrespective of the subsequent state of the PB1 START switch so the lights remain on for the duration of the timing cycle.

The period of the timing cycle depends on the values of R2 and C2. With the component values shown, this period is roughly 50 seconds.

At the end of the timing cycle pin 3 of the IC switches to the low state, so the relay turns OFF and contacts RLY1/2 and RLY1/1 open, disconnecting power from the timing circuit and the lights. The operating sequence is then complete.

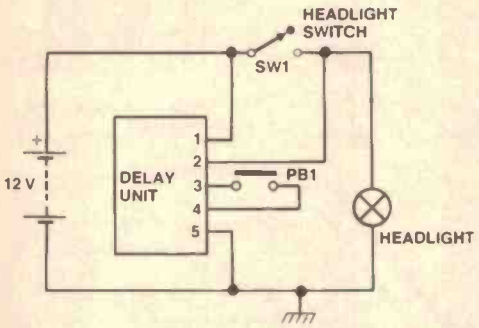


Figure 3. Connection of the delay unit to a car system where the headlights are independent of the ignition switch.

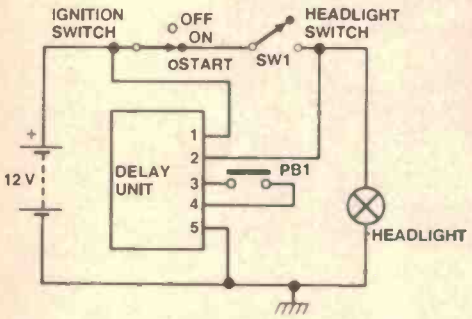
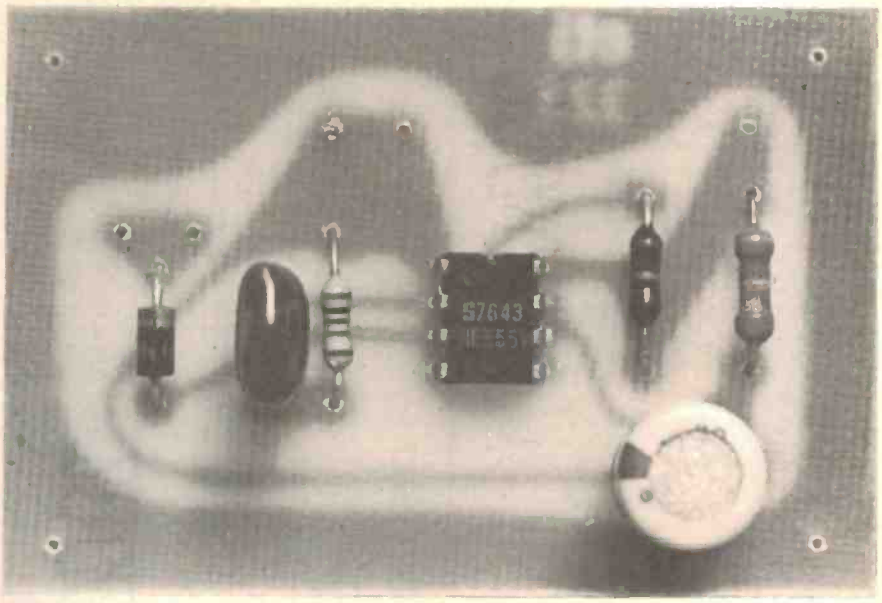


Figure 4. Connection to all other systems.



Closeup. View of the assembled printed circuit board, about four times life size!

When it comes to installing the unit, note that two methods of connection to the vehicle are possible. On some vehicles the headlight switch is connected directly to the battery so that the headlights operate even when the ignition is turned off (see Figure 3).

Many vehicle manufacturers are now adopting the practice of feeding the headlight switch via the ignition switch, so that the headlights operate only when the ignition is turned on. If your car uses this type of connection then you'll have to install the unit as shown in Figure 4. ●

ETI BOOK SALES

Save time and trouble with mail order. Just fill out the coupon on page 66

APOLOGY

Electronics Today International moved to new premises during January and February. This caused some disruption to our book sales department. If your order was late arriving please accept our apologies.

electronics textbooks

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Meters, resistance, capacitance and inductance, emitter followers, op amps, power supplies and electronic filters.

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Complete, accurate, up-to-date guide to direct substitutes for receiving and picture tubes. Contains over 6000 receiving tube substitutes, over 4000 monochrome and colour picture tube substitutes, and 600 communications substitutes. Also includes pinouts for quick operational checks.

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Contains full interchangeability data on more than 9500 ICs with possible alternatives and equivalents shown. Covers many types of digital and linear ICs.

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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.

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

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This guide covers many thousands of transistors showing possible alternatives and equivalents. Covers transistors made in UK, Japan, USA, Germany, France, Europe, Hong Kong and includes types produced by more than 120 different manufacturers.

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BP27 $1.92
Identify those symbols at a glance. A must for beginners and advanced enthusiasts alike. Professionals can always hide it in their desks!

RESISTOR SELECTION HANDBOOK
BP28 $2.24
Shows how to combine two preferred values of resistor to obtain virtually any required value of resistance. Includes information about fixed resistors, standard ranges, colour codes and markings, power ratings and resistor calculations.

ELECTRONIC CALCULATOR USERS' HANDBOOK
BP33 $5.12
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, hyperbolic functions, logarithms, square roots and powers.

LINEAR EQUIVALENTS AND PIN CONNECTIONS
BP41 $9.12
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, Sescocrem, SGS-ATES, Siemens, AEG-Telefunken, Teledyne, Texas Instruments.

PRACTICAL ELECTRONIC CALCULATIONS & FORMULAE
BP53 $9.76
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.

INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE
BP85 $9.76
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.

HOW TO IDENTIFY UNMARKED ICS
BP101 $2.46
This chart shows the reader how, with just a test-meter, to go about recording the particular 'signature' of an unmarked IC which should enable the IC to be identified with reference to manufacturers or other data.

electronics for beginners

BEGINNERS HANDBOOK OF IC PROJECTS
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The novice is guided in mastering the fundamentals of building, troubleshooting and testing electronic projects. In addition to many elementary projects, more advanced ones are included concerning bipolar integrated circuits and medium and large-scale integrated circuits.

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219B $3.04
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.

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

ESSENTIAL THEORY FOR THE ELECTRONICS HOBBYIST
228B $4.32
This book supplies the electronics hobbyist with the background knowledge which will exactly suit their specific requirements. Minimum maths.

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

FIRST BOOK OF PRACTICAL ELECTRONIC PROJECTS
BP23 $2.72
Full constructional data, circuits, components lists for many practical projects including audio distortion meter, superFET receiver, guitar amp, metronome, etc.

RESISTOR SELECTION HANDBOOK
BP28 $2.24
Shows how to combine two preferred values of resistor to obtain virtually any required value of resistance. Includes information about fixed resistors, standard ranges, colour codes and markings, power ratings and resistor calculations.

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

ELECTRONIC PROJECTS FOR BEGINNERS
BP48 $4.64
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.

POPULAR ELECTRONIC PROJECTS
BP49 $4.96
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.

BEGINNERS GUIDE TO DIGITAL ELECTRONICS
BP61 $3.36
Covers all essential areas including number systems, codes, constructional and sequential logic, analogue/digital/analogue conversion.

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

RADIO CONTROL FOR BEGINNERS
BP79 $5.92
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. Section dealing with licensing etc. not applicable to Australia.

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

IC PROJECTS FOR BEGINNERS
BP97 $6.56
Especially written for the less experienced hobbyist, and offers a range of fairly simple projects based around a number of popular and inexpensive linear and digital ICs. Complete layout and point-to-point wiring diagrams included.

ELECTRONICS — IT'S EASY VOL. 1 $5.95
Meters, resistance, capacitance and inductance, emitter followers, op amps, power supplies and electronic filters.

ELECTRONICS — IT'S EASY VOL. 1 $12.95
Same content in a hard-cover form.

ELECTRONICS — IT'S EASY VOL. 2 $5.95
Digital sub-systems counters and shift registers, A-D and D-A conversion, digital instruments and test equipment, computers, transmission links and oscilloscopes.

ELECTRONICS — IT'S EASY VOL. 2 $12.95
Same content in a hard-cover form.

HOBBY ELECTRONICS PROJECT BOOK $4.95
Fifty projects ranging from very simple ones for complete beginners to more elaborate ones for those with more experience. There's a complete guide to soldering and instructions on how to make your own pc boards.

HOW TO BUILD ELECTRONIC GAMES $3.95
Alien Invaders, electronic die, sound effects, two slot car controllers, electronic poker machine, the family ferry and lots more.

HOW TO BUILD GOLD AND TREASURE DETECTORS $3.95
Tells you how metal detectors work and how to construct the different types of detectors: discriminating, BFO, induction balance and a professional deep-seeking unit. How to build a geiger counter.

constructional projects general

DESIGN OF TRANSISTOR CIRCUITS WITH EXPERIMENTS
21626P $20.75
A self-teaching course in transistor circuits — seven chapters explore the fundamentals of active semiconductors and their operating principles and procedures. Experiments in design and semiconductor testing provide hands-on experience.

UNIQUE ELECTRONIC WEATHER PROJECTS
21484P $13.25
Fun and easy-to-build projects include an IC barometer to serve as a tornado warning and a 'thermostat with a brain' to help conserve energy.

BUILD YOUR OWN HI-FI & AUDIO ACCESSORIES
220B $3.04
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 limiter, loudspeaker protector, voice-operated relay, etc.

28 TESTED TRANSISTOR PROJECTS
221B $4.32
Some circuits are new, others are familiar designs. Projects can be split and/or combined for specialised needs.

50 CMOS PROJECTS
224B $4.64
Many interesting and useful projects — multivibrators, amplifiers and oscillators; trigger devices; special devices.

MAJOR SOLID STATE AUDIO HI-FI PROJECTS
BP29 $3.04
Three projects for the more experienced constructor: 12.5 W/ch stereo amplifier, eight input stereo/mono mixer and 4x14 W quadraphonic amplifier. Full constructional details provided.

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

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

PROJECTS IN OPTO-ELECTRONICS
BP45 $5.92
Included are simple circuits using ordinary LEDs as well as more sophisticated designs such as infra red transmitters and detectors, modulated light transmission and also photographic projects etc.

POPULAR ELECTRONIC PROJECTS
BP49 $4.96
Includes a collection of the most popular types of circuits and projects which cover radio, audio, household projects and test equipment.

SINGLE IC PROJECTS
BP65 $5.12
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.

ELECTRONIC GAMES
BP69 $5.92
A number of interesting electronic games projects using ICs for both the beginner and advanced enthusiast.

ELECTRONIC HOUSEHOLD PROJECTS
BP71 $5.92
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.

REMOTE CONTROL PROJECTS
BP73 $6.56
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.

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

POPULAR ELECTRONIC CIRCUITS — BOOK 1
BP80 $6.56
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.

ELECTRONIC PROJECTS USING SOLAR CELLS
BP82 $6.56
Includes 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.

DIGITAL IC PROJECTS
BP84 $6.56
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.

AUDIO PROJECTS
BP90 $6.56
Covers a wide range of audio projects including pre-amplifiers and mixers, power amplifiers, tone controls and matching etc. A number of board layouts and wiring diagrams are included.

LOOK! More books!

mail order coupon on page 66

ELECTRONIC TIMER PROJECTS
BP93 **$6.56**
These may have a high degree of accuracy with quartz control or they may be quite simple designs, using only a few components. A number of specialist timer projects are car windscreen wiper delay unit, darkroom timer, metronome etc.

ELECTRONIC PROJECTS FOR CARS AND BOATS
BP94 **$6.56**
Fifteen fairly simple projects designed for use with 12 V electrical systems but in some cases can also be employed with 6 V and/or positive earth systems as well.

MODEL RAILWAY PROJECTS
BP95 **$6.56**
Projects include such things as controllers, signals and sound effects units. Construction stripboard layouts are provided for each project.

CB PROJECTS
BP96 **$6.56**
A number of useful designs include a speech processor, interference filters and a simple CB radio receiver. Stripboard layouts, wiring diagrams and notes on construction are provided.

POPULAR ELECTRONICS CIRCUITS — BOOK 2
BP98 **$7.52**
A companion for BP80, this book provides a wide range of designs for electronics enthusiasts who are capable of producing working projects from just a circuit diagram without the aid of detailed constructional information.

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

MULTI-CIRCUIT BOARD PROJECTS
BP103 **$6.56**
All circuits are based on one specially designed pc board. Recommended to the less experienced hobbyist.

ELECTRONIC SCIENCE PROJECTS
BP104 **$7.52**
These projects range in complexity from a simple colour temperature meter to an infra-red laser. There is an electronic clock regulated by a resonating spring and an oscilloscope with a solid-state display. How to build them and use them is fully explained.

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

MODERN OP-AMP CIRCUITS
BP106 **$6.56**
A collection of widely varying circuits and projects based on the op-amp ICs.

HOW TO GET YOUR ELECTRONIC PROJECTS WORKING
BP110 **$6.56**
Helps you to overcome the problems of a circuit that doesn't work by indicating how and where to start looking for many of the common faults that can occur when building up a project.

circuit techniques and design

TTL COOKBOOK
21035P **$17.50**
A complete look at TTL logic circuits — what TTL is, how it works, and how to use it. Many kinds of practical TTL are included, such as digital counters, electronic stopwatches, digital voltmeters, etc.

ACTIVE-FILTER COOKBOOK
21168P **$21.95**
Learn how to construct filters of all kinds — highpass, lowpass, bandpass. The book is easy to understand — no advanced maths or obscure theory is used.

ELECTRONIC CIRCUITBOOK 1: PROJECT CONSTRUCTION
21241P **$7.50**
Your basic guide to project construction, covering component identification, power supplies, proper tool selection, troubleshooting techniques, oscilloscope use, custom-made enclosures, and more.

CMOS COOKBOOK
21398P **$19.25**
This book explains CMOS technology and its application to 'real world' circuitry. A mini-catalogue is included, which lists over 100 devices, giving their pinouts and application notes.

IC TIMER COOKBOOK
21416P **$15.95**
Gives you a look at the hundreds of ways IC timers are used in electronic instrumentation.

IC CONVERTER COOKBOOK
21527P **$20.75**
Written for the practising engineer, technician, hobbyist or student; this book will be an invaluable working guide to the understanding and use of IC analogue/digital and digital/analogue converters.

DESIGN OF OP-AMP CIRCUITS, WITH EXPERIMENTS
21537P **$16.50**
The design of the fundamental circuits that are the basic building blocks of more sophisticated systems. A series of 35 experiments illustrates the design and operation of linear amps, differentiators and integrators, voltage and current converters, active filters, and lots more.

555 TIMER APPLICATIONS SOURCE BOOK, WITH EXPERIMENTS
21538P **$11.25**
This book describes the construction of the 555 timer and gives numerous practical examples of its applications in all areas of electrical and computer engineering, including 17 simple experiments.

DESIGN OF ACTIVE FILTERS WITH EXPERIMENTS
21539P **$15.95**
Introduction to the theory, implementation and design of active filters using the 741 op-amp.

DESIGN OF PHASE-LOCKED LOOP CIRCUITS, WITH EXPERIMENTS
21545P **$15.95**
An excellent introduction to the theory, design and implementation of phase-locked loop circuits using various TTL and CMOS devices. Includes manufacturers' data sheets and describes the use of breadboarding aids in the wide range of laboratory-type experiments.

AUDIO IC OP-AMP APPLICATIONS
21558P **$13.25**
This book discusses IC op-amps and their application in audio systems, and describes the numerous advantages of using op-amps, including small spatial needs, low power consumption, reliable performance and low cost. Assumes a basic understanding of op-amp theory.

UNDERSTANDING CMOS INTEGRATED CIRCUITS
21598P **$9.95**
This book tells you what CMOS ICs are, how they work, and how they can be used in electronic circuit designs. Many practical circuits, complete with parts values, are included.

DESIGN OF TRANSISTOR CIRCUITS WITH EXPERIMENTS
21626P **$20.75**
A self-teaching course to provide the background and explanations necessary to teach the reader the art of designing transistor circuits.

GUIDE TO CMOS BASICS, CIRCUITS, AND EXPERIMENTS
21654P **$14.95**
If you are already familiar with TTL devices and are ready to examine the benefits of CMOS, this book is your complete source. It tells you what CMOS devices are, their characteristics and design rules. 22 experiments demonstrate the concepts discussed.

PRACTICAL TRANSFORMER DESIGN HANDBOOK
21657P **$35.50**
An easy to understand, illustration-filled guide to designing and constructing transformers. Reviews the fundamentals of electricity, magnetism and algebra needed to understand transformer theory, and covers general design considerations, transformer types, power losses and transformer use in converters and inverters.

Z80 MICROCOMPUTER DESIGN PROJECTS
21682P **$20.75**
This book provides a complete look at the internal architecture of the Z80, the heart of many microcomputers, and even shows how to build a microcomputer, the EX80, using this powerful chip.

DESIGN OF VMOS CIRCUITS, WITH EXPERIMENTS
21686P **$17.50**
The authors look at the technology which makes dramatic advancements possible with VMOS, and show how these components can easily and effectively be integrated into common circuit designs to enhance their responses.

IC OP-AMP COOKBOOK
21695P **$23.75**
Basic op-amp theory in detail, with 200 practical, illustrated circuit applications: JFET and MOSFET units are featured, plus manufacturers' data sheets and company addresses.

EXPERIMENTS IN ARTIFICIAL INTELLIGENCE FOR SMALL COMPUTERS
21785P **$13.25**
Artificial intelligence is the capability of a device to perform functions normally associated with human intelligence. With this book, a small computer with extended BASIC and some knowledge of BASIC language, you can conduct interesting and exciting experiments in artificial intelligence.

PRACTICAL SOLID-STATE CIRCUIT DESIGN
21787P **$14.95**
An introductory course in practical solid-state circuit design for the experimenter, designer or technician who is interested in constructing tailor-made circuits.

SCRS AND RELATED THYRISTOR DEVICES
21806P **$19.25**
Written for experimenters, technicians and engineers, this book is a practical and comprehensive guide to theory, operation, specifications and applications of silicon-controlled rectifiers (SCRs) and related thyristor devices.

REGULATED POWER SUPPLIES
21808P **$29.75**
Comprehensive discussion of the internal architecture and operation of the latest solid-state regulators. Explains when regulated supplies are needed and how to incorporate them in your projects, and discusses modern circuitry including linear and switching circuits and late ICs.

ANALOG INSTRUMENTATION FUNDAMENTALS
21835P **$29.75**
Numerous practical, hands-on lab experiments and solved problems are included, plus discussions of movements, dc ammeters, voltmeters, ohmmeters, bridges, filters and attenuators. No calculus is required.

RF CIRCUIT DESIGN
21868P **$33.95**
A practical approach to the design of RF amplifiers, impedance-matching networks and filters. Uses a minimum of complex maths.

SOLAR CELLS
22270P **$37.95**
In-depth description of the basic operating principles and design of solar cells. It also covers the techniques currently used to produce solar cells and reviews system applications.

ELECTRONIC DESIGN WITH OFF-THE-SHELF ICS
50274P **$14.70**
It contains virtually all the information you need to design and build electronic circuits, systems and subsystems with readily available ICs. Shows how to interface them into highly complex systems.

MODERN FILTER DESIGN
94663P **$49.95**
This book details the advances in active RC filters, both from a practical standpoint and from a state-of-the-art point of view. It is the first book that gives detailed analysis and design procedures for switched capacitor filters.

50 PROJECTS USING CA3130 ICS
223B **$4.32**
The CA3130 is an advanced operational amplifier capable of higher performance than many others: circuits often need fewer ancillary components. Audio projects. RF projects. Test equipment. Household projects. Misc. projects.

PRACTICAL INTRO TO DIGITAL ICS
225B **$4.32**
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.

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

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

50 FET PROJECTS
BP39 **$5.92**
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.

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

IC555 PROJECTS
BP44 **$6.56**
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.

PROJECTS IN OPTO-ELECTRONICS
BP45 **$5.92**
Included are simple circuits using ordinary LEDs as well as more sophisticated designs such as infra-red transmitters and detectors, modulated light transmission and also photographic projects etc.

LM 3900 IC PROJECTS
BP50 **$4.64**
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.

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

50 CMOS IC PROJECTS
224B **$4.64**
Projects include multivibrators, amplifiers and oscillators, trigger devices and other special devices.

SECOND BOOK OF CMOS IC PROJECTS
BP59 **$5.12**
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.

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

VMOS PROJECTS
BP83 **$6.56**
Though primarily concerned with VMOS power FETs and their applications, power MOSFETs are dealt with too, in a chapter on audio circuits. Projects include audio circuits, sound generator circuits, dc control circuits and signal circuits.

DIGITAL IC PROJECTS
BP84 **$6.56**
Helps the reader to develop a knowledge of the workings of digital circuits. Board layouts and wiring diagrams are included.

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

ELECTRONIC TIMER PROJECTS
BP93 **$6.56**
These may have a high degree of accuracy with quartz control or they may be quite simple designs, using only a few components. A number of specialist timer projects are car windscreen wiper delay unit, darkroom timer, metronome etc.

ETI CIRCUITS BOOKS 1/2/3 **$2.95 ea**
Many of these circuits have been published in the 'Ideas for Experimenters' section in ETI.

ETI CIRCUIT TECHNIQUES VOLS 1/2 **$4.75 ea**
The how, what, which, where, why and how much anthology of electronic components, circuits and techniques.

test equipment and fault finding

AUTOMOTIVE TUNE-UP AND EMISSION CONTROL SERVICE
21712P **$20.75**
Car owners who wish to save money and maintain their cars at peak performance will learn from this book how to adjust, repair and maintain the systems that ensure best operation.

TROUBLESHOOTING WITH THE OSCILLOSCOPE
21738P **$15.95**
Excellent for the professional service technician or the serious hobbyist, as it combines step-by-step procedures for using the scope with the specific nuts and bolts of TV receiver troubleshooting.

EFFECTIVELY USING THE OSCILLOSCOPE
21794P **$14.95**
Excellent for the professional service technician or the serious do-it-yourself, as it combines the correct step-by-step procedures for using a scope with the specific nuts and bolts of TV receiver troubleshooting.

MICROCOMPUTER DESIGN AND TROUBLESHOOTING
21819P **$26.75**
Tells you how to design microcomputer systems and make them work without an expensive commercial development system or the need for costly test instrumentation. The author also provides a complete description of two popular microprocessors — the 8085 and the 6502.

USE OF THE DUAL-TRACE OSCILLOSCOPE
40023P **$23.75**
This programmed text breaks down the process of operating a scope into a series of logical steps starting with the deflection of the electron beam and continuing through proper use of the triggering controls to measure the phase difference between two waveforms.

ELECTRONIC TROUBLESHOOTING HANDBOOK
52585P **$10.50**
This workbench guide shows you how to pinpoint transistor troubles in minutes, how to test almost everything electronic and how to get the most out of low cost test equipment.

PRACTICAL REPAIR AND RENOVATION OF COLOUR TVS
BP34 **$4.32**
This book shows how to obtain a working colour TV for very little outlay by repairing and renovating a set that has been 'written off' by a dealer. Includes practical details of how to construct your own CRT tester/rejuvenator and cross hatch generator.

TRANSISTOR RADIO FAULT-FINDING CHART
BP70 **$1.92**
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 the faults. Selecting the appropriate fault, the reader simply follows the arrows and carries out the suggested checks in sequence until the fault is cleared.

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

POWER SUPPLY PROJECTS
BP76 **$5.92**
Includes simple unstabilised types, fixed voltage regulator types and variable voltage stabilised designs. The designs are all low voltage types for semiconductor circuits.

HOW TO GET YOUR ELECTRONIC PROJECTS WORKING
BP110 **$6.56**
Helps you to overcome the problems of a circuit that doesn't work by indicating how and where to start looking for many of the common faults that can occur when building up a project.

TEST GEAR — METERING AND POWER SUPPLY PROJECTS **$3.00**
Includes many types of meters, audio noise and signal generators, simple CMOS tester, oscilloscope calibrator etc.

TEST GEAR — VOL. 2 **$3.95**
Projects include audio oscillator, transistor tester, true RMS voltmeter, RF signal generator, versatile logic test probe, microwave oven leak detector etc.

ELECTRONIC PROJECTS FOR YOUNG SCIENTISTS **$3.95**
PH meter, geiger counter, helium-neon laser, sound level meter, solar cells, negative ion generator and much more.

electronic music/audio/video

AUDIO CYCLOPEDIA
20675P **$66.00**
A complete in-depth look at the art of audio — from the basic principles of sound to solid-state and integrated circuits. Over 3000 entries and hundreds of illustrations and circuit diagrams cover acoustics, amplifiers, recording, reproduction, test equipment, audio measurements, and much more.

ELECTRONIC MUSIC CIRCUITS
21833P **$24.95**
How to build a custom electronic music synthesiser, outlines numerous other circuit designs and then shows you how to modify them to achieve particular responses. Many of the circuits can be used as special-effects boxes for guitars and other musical instruments.

INTRODUCTION TO ELECTRO-ACOUSTIC MUSIC
81515P **$15.95**
This book assumes no previous technical knowledge. It discusses the relationship between the technology and the composition of electro-acoustic music.

MODERN RECORDING TECHNIQUES
21037P **$19.25**
Explains the equipment controls and techniques found in a modern recording studio and how to use them creatively and correctly to produce a desired result. Numerous photographs, diagrams and charts.

SOUND SYSTEM ENGINEERING
21156P **$32.50**
Dealing with audio systems as a whole, it includes installing and equalising the sound system and interfacing the electrical and acoustic systems. Instrumentation, the acoustic environment and designing for acoustic gain are covered.

TUBE SUBSTITUTION HANDBOOK
21746P **$8.75**
Complete, accurate, up-to-date guide to direct substitutes for receiving and picture tubes. Contains over 6000 receiving tube substitutes, over 4000 monochrome and colour picture tube substitutes, and 600 communications substitutes. Also includes pinouts for quick operational checks.

HOW TO BUILD SPEAKER ENCLOSURES
20520P **$8.75**
A practical guide to the 'whys' and 'hows' of constructing high-quality top-performance loudspeaker enclosures.

ACTIVE-FILTER COOKBOOK
21168P **$21.95**
Learn how to construct filters of all kinds — highpass, lowpass, bandpass. The book is easy to understand — no advanced maths or obscure theory is used.

DESIGN OF ACTIVE FILTERS WITH EXPERIMENTS
21539P **$15.95**
Introduction to the theory, implementation and design of active filters using the 741 op-amp.

AUDIO IC OP-AMP APPLICATIONS
21558P **$13.25**
This book discusses IC op-amps and their application in audio systems, and describes the numerous advantages of using op-amps, including small spatial needs, low power consumption, reliable performance and low cost. Assumes a basic understanding of op-amp theory.

VIDEO TAPE RECORDERS
21521P **$17.50**
In this completely revised second edition, the author tells in simple language how helical VTRs work and how to operate and service them. Includes numerous examples of circuits and mechanical systems.

continued on page 63

0-40 V/5 A laboratory power supply Part 1.

Here's a laboratory standard power supply featuring truly regulated output from zero to 40 volts capable of delivering a massive 5 A across the whole voltage range, plus current limiting variable from zero to 5 A. Two meters monitor voltage and current and regulator dissipation is reduced by employing an automatic transformer switching circuit.

David Tilbrook

IN APRIL 1976 we published the ETI-131 General Purpose Power Supply. This project could be built in two versions — 0-20 V/2.5 A or 0-40 V/1.25 A. It featured variable current limiting and had pretty close to lab-standard specs. A great many have been built since then and are to be found in development laboratories, service workshops, technical college and university labs and hobbyist's workshops.

Since that time, electronic technology has made considerable strides and the sort of things now being investigated by hobbyists and in electronics labs of all descriptions range much wider than they did when the ETI-131 was in vogue. It came to our notice that a lab-standard supply having 'expanded' specifications was in demand so we set out to investigate what sort of project would best meet that demand.

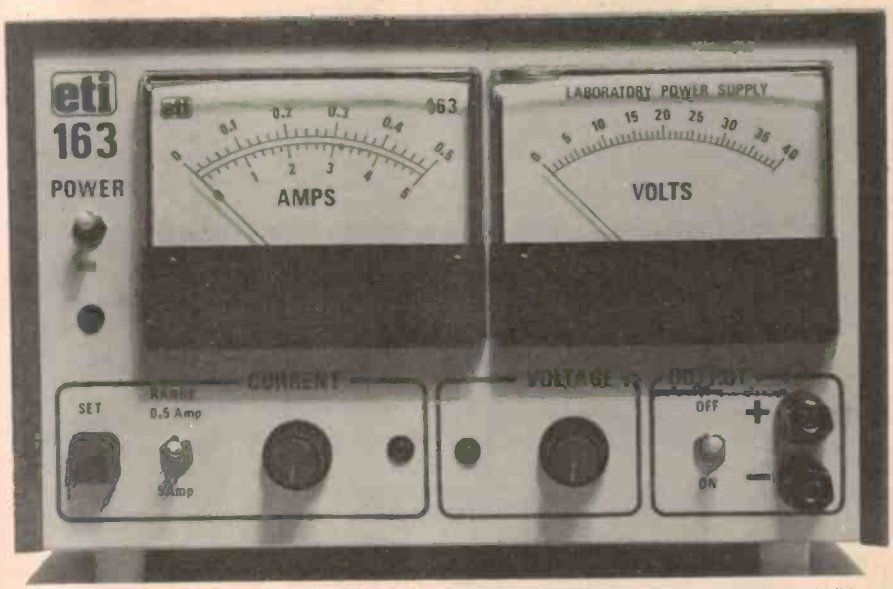
Following considerable discussion with both users and project suppliers, it was apparent that the most generally useful output voltage range would be about 0-40 V or 0-50 V and the required maximum current capability would be in the vicinity of 3-4 A or so. The next thing to do was to define 'lab-standard'.

Defining 'lab-standard'

An 'ideal' power source should provide the following: • a regulated voltage variable from zero to some chosen limit • no extraneous hum or noise on the output and none radiated from the supply • current-limit operation from zero to some chosen limit • simultaneous metering of current and voltage output • protection from short circuits on the output at any output setting.

In addition, handy 'operator features', such as indicators to show voltage and current mode operation, output and current-set switches, are desirable.

What sort of specifications would approach the 'ideal'? With sensitive high gain, dc control, audio or RF circuitry attached to the supply during circuit development or fault locating, you want to be sure that any problem experienced is not caused by some characteristic of the power supply. Hence, hum and noise are an important consideration. ▶



Power and performance. The completed supply looks smart, performs well and is economical to build — at around $150-$160.

SPECIFICATIONS — ETI-163 LAB. SUPPLY TABLE 1

Output voltage	0-40 V, variable
Output current	0-0.5 A, variable limiting
	0-5 A, variable limiting
Output regulation	<50 mV at up to 2.5 A
	<100 mV up to 5 A
Ripple and noise	
voltage mode	<3 mV RMS
current mode	<10 mV RMS
Maximum output power	200 watts
Metering	
Voltage	0-40 V in 1 V divisions
Current	0-0.5 A in 20 mA divisions
	0-5 A in 200 mA divisions

- **LED to indicate voltage mode operation**
- **LED to indicate current mode (limiting) operation**
- **Current-set switch provided for setting current limit value**
- **Output switch provided to isolate supply output**
- **Output terminals isolated from chassis**
- **Full output current available right up to 40 V**

A figure under 10 mV is a desirable goal, preferably less than 5 mV. Performance in the current-limit mode should be similar, but is not as critical a parameter.

As supply voltage variations can adversely affect some circuits, regulation of the output voltage over the whole variation range is paramount. It should remain virtually constant despite relatively large mains input voltage excursions and despite large variations in current drawn (up to the maximum). Regulation can be expressed as a percentage (with respect to full output) or as a voltage variation. The latter is preferred as it shows performance over the whole output variation range.

A regulation figure of 0.1% (100 mV in 100 V) is common for low current output supplies (up to 1 A), but 0.5% is more usual for high current supplies. That would be 250 mV for a 50 V supply.

Regulator techniques

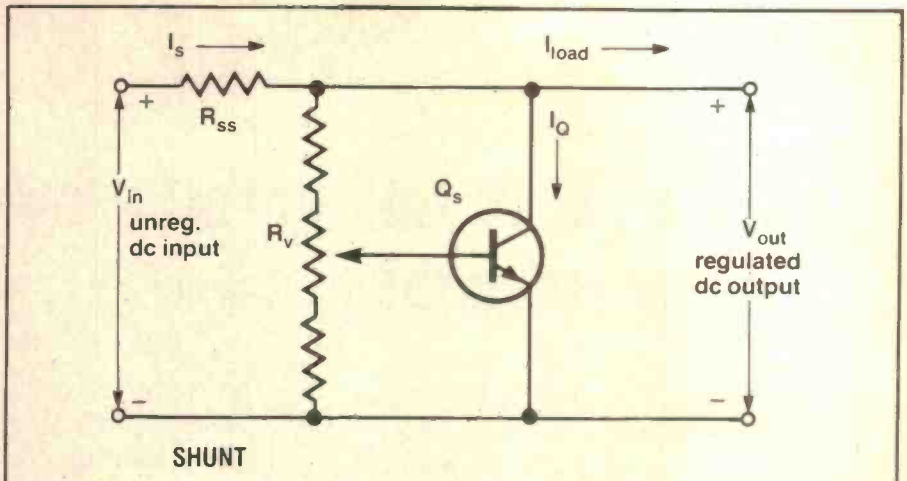
There are a number of basic techniques used to provide a regulated supply voltage. Choice depends on the application. The respective methods and their characteristics may be summarised as follows:

• **The shunt regulator.** This design is suitable mainly for low-power supplies — 15 to 20 watts. It has good regulation and is inherently short circuit proof. However, it dissipates the full amount of power it is capable of handling under no-load conditions.

Current-limit operation is not so easy to incorporate, but cost is low.

• **The series regulator.** Probably the most widely used technique. It is suitable for power supplies capable of delivering up to 200 watts.

Regulation, hum and noise performance is good, it's easy to arrange current-limit operation and cost is relatively low.



The shunt regulator. Fundamental circuit of a shunt regulator. As the load current (I_{load}) increases, the output voltage (V_{out}) tends to fall, reducing base current to Q_s. This, in turn, reduces the collector current (I_Q) of the shunt regulator, Q_s. The voltage drop across R_{ss} then decreases, maintaining the output voltage. As load current decreases, the opposite happens.

If the input voltage (V_{in}) increases, V_{out} tends to rise, increasing the base current to Q_s. This increases I_Q and the voltage drop across R_{ss} increases, maintaining the output voltage. If V_{in} decreases, the opposite happens.

Varying the wiper of R_v varies the collector current of Q_s, thus varying the voltage dropped across R_{ss}, setting the output voltage. Resistor, R_{ss} dissipates considerable power and Q_s dissipates the maximum output power under no load.

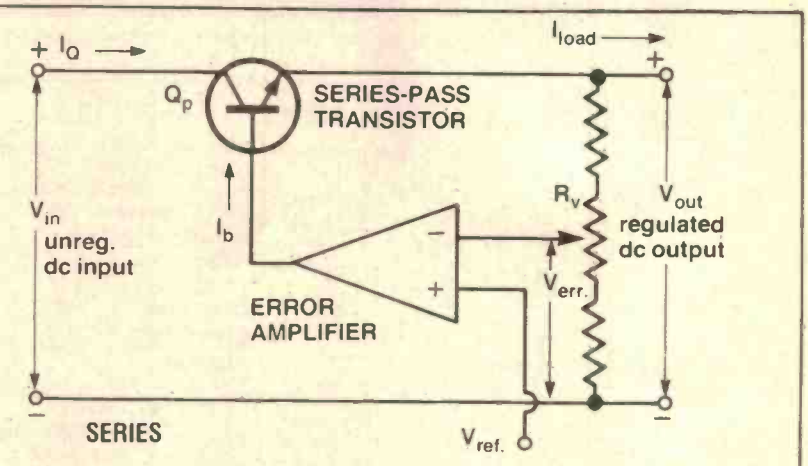
• **SCR regulator.** This technique is mainly suited for medium to very high power applications. The regulator has low dissipation and good regulation, but output noise and ripple are worse than for the series regulator and radiated switching 'hash' requires extensive shielding.

• **SCR pre-regulator and series regulator.** This combines the best features of the previous two and is best suited to medium to high power applications (say to several hundred watts).

An SCR pre-regulator provides a roughly regulated supply about five volts above the required output voltage, followed by a conventional series regulator. This keeps dissipation in the series regulator low. Cost is relatively high.

• **Switchmode regulator.** This technique is also used in medium to very high power applications. A series switching element stores energy in an inductor or capacitor, the on-time of the switching element being controlled to provide the required regulated output.

This technique keeps regulator dissipation low and regulation performance is good. With modern ICs purpose-built for the application, cost is about the same as a series regulator. However, noise and ripple on the output can be difficult to suppress and considerable wideband RF energy is radiated by the circuitry, necessitating careful and extensive shielding.



The series regulator. Fundamental circuit of a series regulator. As the load current (I_{load}) increases, the output voltage (V_{out}) tends to fall. This causes $V_{err.}$ to fall (the 'error voltage'). The error amplifier is operated as an inverting amplifier and thus, as $V_{err.}$ falls, the base current (I_b) to the series-pass transistor (Q_p) will rise. This causes the collector current (I_Q) of Q_p to rise, maintaining the output voltage. If I_{load} decreases, the opposite occurs.

If the input voltage (V_{in}) rises, the output will tend to rise, as will $V_{err.}$. This will produce a decrease in base current to Q_p, reducing I_Q, thus maintaining the output voltage. If V_{in} falls, the opposite will occur.

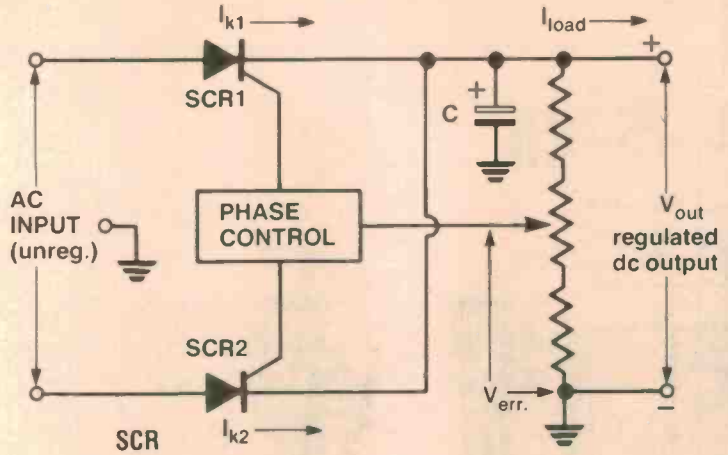
Varying the wiper of R_v varies $V_{err.}$, setting the output voltage.

Design features of this supply

I settled on an output voltage range of 0-40 V as this seemed to cover the great majority of supply requirements for circuit testing, development and fault locating. A maximum output current of 5 A was settled on for similar reasons. This results in an output rating of 200 watts, hence choice of an appropriate regulator technique was of paramount importance.

Two techniques were obvious contenders — series regulator and switchmode regulator. Previous experience with switchmode regulators made me wary that I could use one in a 'lab-standard' supply. The ETI-142 0-30 V/15 A supply (Feb. '79) employed a switchmode pre-regulator and a series regulator. Despite elaborate precautions, noise from the switchmode pre-regulator made it impossible to use this supply in the vicinity of, let alone connected to, sensitive circuitry. Pity, but a fact of life.

The inherent attractiveness of high efficiency — low dissipation is generally outweighed in this application. The necessity of elaborate screening and filtering brings problems of its own for constructors and increases costs.



The SCR regulator. Fundamental circuit of an SCR regulator. As the load current (I_{load}) increases, the output voltage (V_{out}) tends to decrease causing the 'error voltage' ($V_{err.}$) to drop. The phase control circuit then advances the triggering of the SCRs so that I_{k1} and I_{k2} and the average rectified voltage increases, maintaining the output voltage. If load current decreases, the opposite occurs.

If the ac input voltage rises, V_{out} tends to rise, causing $V_{err.}$ to rise also. The phase control circuit then retards the triggering of the SCRs, reducing the average rectified voltage, and maintaining V_{out}. The opposite happens if the ac input falls.

Varying the potentiometer varies $V_{err.}$, setting the output voltage.

I looked at the series regulator — and how to reduce the dissipation. For a 40 V output, dc input to the regulator would have to be around 50 V. At 5 A output into a short circuit, worst case dissipation would be around 250 watts! That requires *big* transistors and *lots* of heatsink.

As pre-regulators increased the cost and the noise problems, I had to find another way to reduce regulator dissipation and I hit on the idea of switching the transformer secondary.

Using several cheap ICs as comparators and a couple of relays, I could switch the rectifier across different transformer taps as the regulator output voltage was varied.

However, this technique had the drawback that a 'special' transformer would be required. If I could choose the output taps so that they were at generally 'useful' voltages, the transformer stood a good chance of becoming a 'stock' item. With this in mind, I chose the secondary taps to be 12 V, 24 V and 36 V.

The prototype transformer was wound up for us by Permatran of Melbourne. It is rated at 250 VA.

Astute readers will notice that basically, only two output taps are really required as the 12 V output could be selected by switching between the 24 and 36 volt terminations. However, using relay switching, it is possible under some circumstances to short part of the secondary with consequent disastrous results. The 'switching' tree employed avoids this possibility.

A separate low voltage and current dc supply is necessary to power the op-amps in the regulator and to provide a 5 V reference. In the prototype, I used a small 12 V/150 mA transformer — a stock item from most electronics suppliers — but a 15 V/200 mA winding may be available on the transformers obtained by suppliers of this project.

Worst case regulator dissipation for this supply is around 120 watts, a much more manageable figure than 250 watts. It occurs when the output current is 5 A at a voltage setting near 25 volts. At maximum dissipation, the heatsinks stabilise at a temperature of around 65°C.

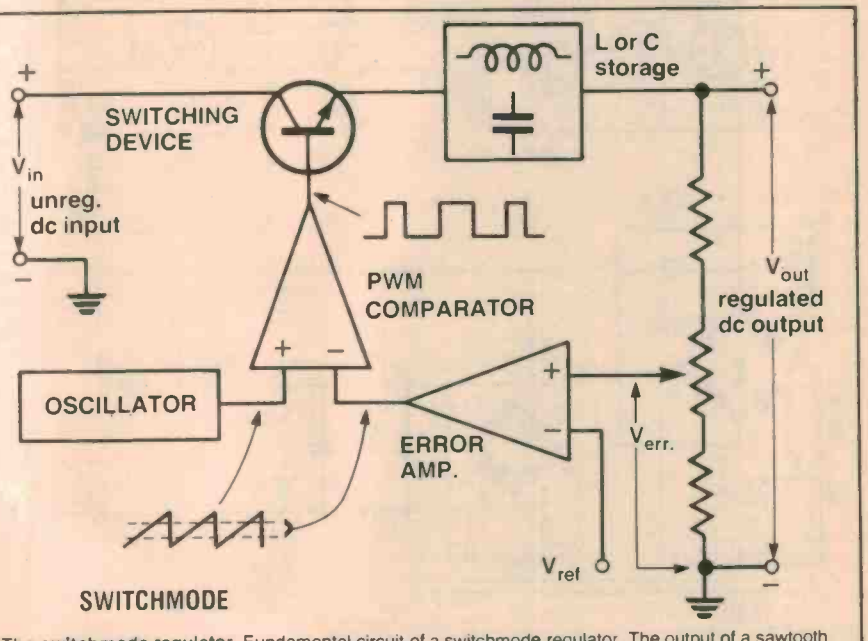
The regulator circuit is similar to the ETI-131 and employs two CA3130s for the voltage-mode and current-mode error amplifiers. A pair of MJ15003 high power NPN transistors connected in parallel are used for the series-pass element.

Another pair of CA3130s are used as comparators for the transformer secondary relay switching circuitry. These were chosen because their output can go right down to 0 V, ensuring the relay driver transistors turn off. The transformer taps are switched as the output voltage passes through about 12 V and about 25 V (these are adjustable over a few volts range). About a volt of hysteresis is added to the switching points so that the relays won't chatter when the output control is set on the switching point.

Separate meters are provided for indicating output voltage and current. There are two current-limit ranges — zero to 0.5 A and zero to 5 A. The point at which the supply switches from constant-voltage to current-limited (constant-current) output is fully variable across the two ranges.

A current-set pushbutton, which shorts the output terminals, is provided on the front panel and two LEDs indicate in which mode the supply is operating. A switch in series with the output allows you to isolate the supply from the load, without having to disconnect the supply or turn it off if you want the supply removed.

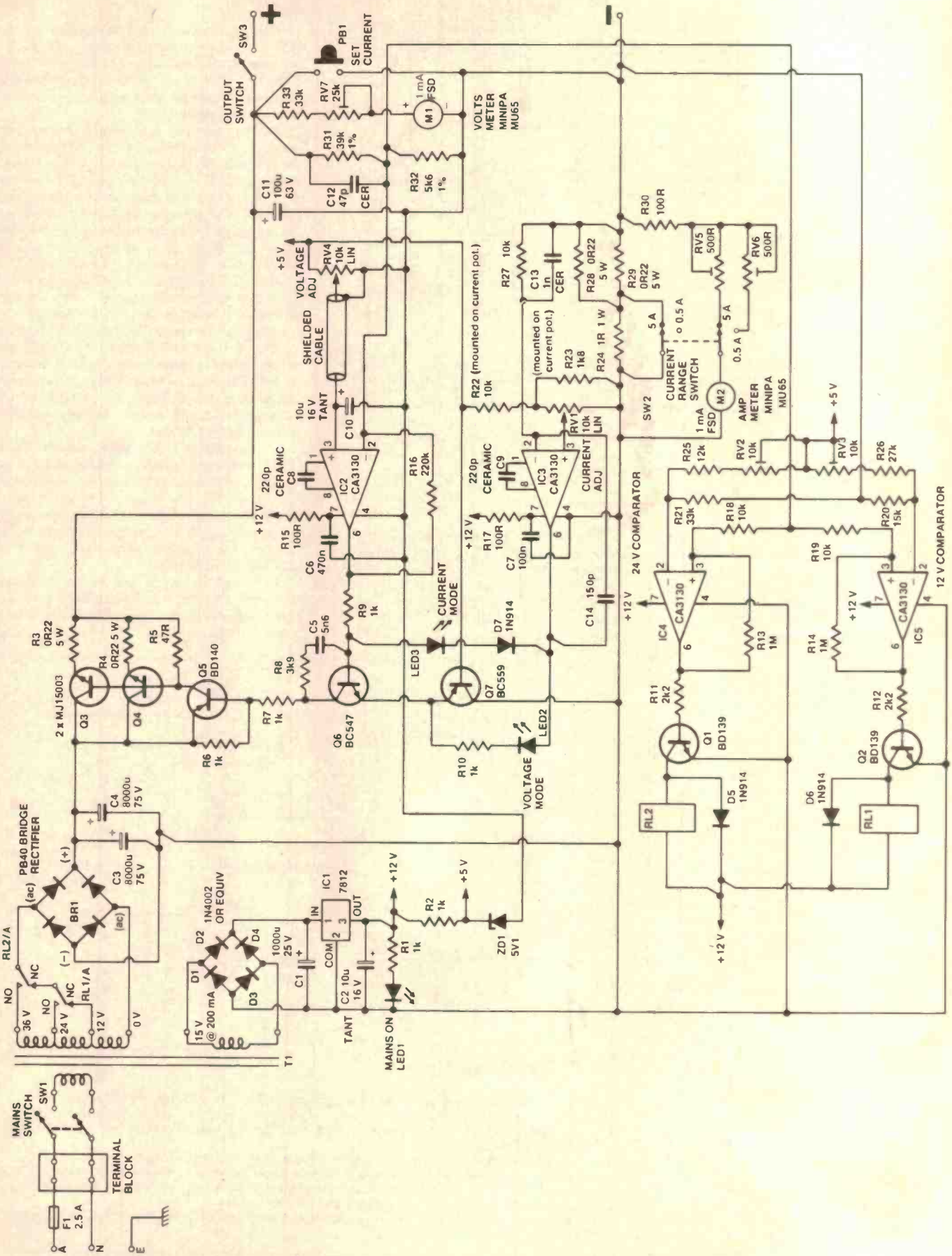
Performance turns out to be generally better than what was discussed as desirable for a lab-standard supply. See Table 1 for a complete run-down. ▶



The switchmode regulator. Fundamental circuit of a switchmode regulator. The output of a sawtooth oscillator and the output level of the 'error amplifier' are compared by the 'pwm comparator' which drives a switching device. The switching device turns on and off, storing energy from the unregulated input in a capacitor or inductor.

As the load current increases, the output voltage (V_{out}) will tend to fall as will the error voltage ($V_{err.}$). The output of the pwm comparator will turn on for a longer period for each cycle of the sawtooth. The switching device then conducts for a longer period, storing more energy in the L or C, maintaining the output voltage. As the output current decreases, the opposite occurs.

As the switching device is either hard on or fully off, it dissipates little power. Varying the potentiometer varies $V_{err.}$, setting the output voltage.


MAINS SWITCH
SW1
TERMINAL BLOCK
F1 2.5 A
A
N
E
T1
MAINS ON LED1
TANT
C2 10u 16 V
IC1 7812
IN
COM
OUT
1000u 25 V
C1
D1
D2
D3
D4
1N4002 OR EQUIV
15 V @ 200 mA
BR1
PB40 BRIDGE RECTIFIER
C3 8000u 75 V
C4 8000u 75 V
RL2/A
RL1/A
NO
NC
36 V
24 V
12 V
0 V
R1 1k
R2 1k
ZD1 5V1
+12 V
+5 V
D5 1N914
D6 1N914
RL2
RL1
Q1 BD139
Q2 BD139
R11 2k2
R12 2k2
R13 1M
R14 1M
IC4 CA3130
IC5 CA3130
24 V COMPARATOR
12 V COMPARATOR
R18 10k
R19 10k
R20 15k
R21 33k
R25 12k
RV2 10k
RV3 10k
R26 27k
R10 1k
VOLTAGE MODE
LED2
Q7 BC559
Q6 BC547
R7 1k
R8 3k9
C5 5n6
R9 1k
CURRENT MODE
LED3
D7 1N914
C14 150p
R6 1k
Q5 BD140
Q4
Q3
2 x MJ15003
R3 0R22 5 W
R4 0R22 5 W
R5 47R
R15 100R
R17 100R
C6 470n
C7 100n
C8 220p CERAMIC
C9 220p CERAMIC
IC2 CA3130
IC3 CA3130
R16 220k
C10 10u 16 V TANT
SHIELDED CABLE
VOLTAGE ADJ
RV4 10k LIN
CURRENT ADJ
RV1 10k LIN
R22 (mounted on current pot.) 10k
R23 1k8
R24 1R 1 W
R27 10k
C13 1n CER
R28 0R22 5 W
R29 0R22 5 W
R30 100R
RV5 500R
RV6 500R
CURRENT RANGE SWITCH
SW2
5 A
0.5 A
M2 1 mA FSD
AMP METER MINIPA MU65
VOLTS METER MINIPA MU65
M1 1 mA FSD
R31 39k 1%
R32 5k6 1%
R33 33k
RV7 25k
C11 100u 63 V
C12 47p CER
OUTPUT SWITCH
SW3
PB1 SET CURRENT
+
-

HOW IT WORKS — ETI-163

The power supply employs a series regulator circuit with current limiting operation added. The 36 V secondary of the power transformer has taps which are switched in automatically by relays as the output voltage is adjusted so that power dissipation in the series-pass transistors is minimised.

An auxilliary 15 V secondary (or an auxilliary transformer) provides a supply for the reference voltage, the relays, relay drive circuitry and voltage and current feedback op-amps (IC2 and IC3).

The main power transformer (T1) secondary of 36 volts is rated to deliver 5 A and is tapped at 12 and 24 volts. The appropriate tapping is selected by the contacts of relays RL1 and RL2.

These relays are controlled by Q1 and Q2, which are driven by a pair of comparators formed by IC4 and IC5 and associated resistors — R13, 14, 18 and 19. These resistors give the comparators some hysteresis which ensures that the relays do not chatter when the output voltage is set exactly equal to one of the trip voltages.

Resistors R21, 25, 20 and 26 and the two preset pots RV2 and RV3 form adjustable potential dividers, driven from the +5 V reference line. These potential dividers set the trip voltages for the two comparators. The presets allow the actual trip voltage to be adjusted over a small range.

Relay RL1 will trip when the voltage is around 12 V, while RL2 will trip when it is around 25 V. In this way the series-pass transistors, Q3 and Q4, are supplied with enough voltage to ensure good regulation but not excess voltage which would cause unneccessary power dissipation.

The main voltage regulator error amplifier is formed by IC2, a CA3130 FET-input op-amp. This compares the voltage on its non-inverting input (pin 3) with that on its inverting input (pin 2) which measures the output voltage via the potential divider formed by R31 and R32. The non-inverting input is connected to the wiper of RV4 which allows the reference voltage at this point to be varied from 0 to 5 V.

The output of IC2 is connected via resistor R9 to the base of Q6 which, in conjunction with Q5, provides the necessary current to drive the bases of the paralleled series-pass transistors, Q3 and Q4.

The RC network R8-C5 serves to provide negative feedback around Q6 and helps to ensure stability by reducing the gain of the circuit at high frequencies.

The tantalum capacitor C10 serves to filter the reference voltage. This is important since the error amplifier uses this voltage to establish the output voltage. Any ripple at the non-inverting input of IC2 will be amplified and appear at the output of the power supply. Capacitor C12 serves a similar purpose as C5 and controls the high frequency phase shift in the negative feedback loop to prevent oscillation. C8 provides compensation for IC2.

The current-limit error amplifier is formed by IC3 and associated components — C14, C9, R17 and C7. Resistor R17 and capacitor C7 simply form a low pass filter to ensure a reasonably clean supply to the op-amp. C9 compensates the op-amp and C14 provides feedback to decrease overall gain of the feedback loop at high frequencies, thereby ensuring stability when the supply is operating in the current-limit mode.

The non-inverting input to IC3 is connected to an adjustable voltage reference formed by RV1, R22 and R23. The inverting input is connected via R27 to the negative output terminal of the supply.

This op-amp is, in effect, measuring the voltage drop across the series resistance of R24, R28 and R29. This voltage is proportional to the current drawn from the supply. The amount of series resistance is switchable by the current range switch, SW2.

In the 5 A range, R24 is shorted by the switch providing a series resistance of 0.11 ohms. If for example, a 5 A current limit was desired, the current adjust pot. (RV1) would be adjusted, after depressing the current-set pushbutton (PB1) to give 5 A, and this would result in a 0.55 V reference voltage appearing at pin 3 of IC3. This op-amp then compares the reference voltage to the voltage developed across the series resistance.

IC3 will provide the appropriate output to bring its two inputs to the same voltage and, since 5 A will cause a 0.55 V drop across the series resistance, the load current will be limited to 5 A.

This assumes that the output voltage has been set high enough to force more than the desired current through the load. If this is not the case, it is impossible for the current error amp. to correct what it sees as a gross error in the current. The reference voltage at pin 3 of IC3 will be greater than the voltage at pin 2 so that the output of the op-amp is forced hard against its positive supply rail, i.e: around 12 V. This forward biases LED2, which indicates that the supply is in voltage mode. I.e: the output is controlled by the voltage pot.

If, however, the reference voltage has been set high enough so that the current flowing in the load approaches that set by the current limit potentiometer, then the current error amp takes over control of the feedback loop and maintains the output so that only the required current flows in the load.

The voltage error amp (IC2) is then incapable of correcting the output voltage and its output swings hard against its positive supply rail (12 V) in an attempt to do so. This forward biases LED3 which indicates that the supply is in current mode. I.e: the output is controlled by the current adjust pot., RV1.

The voltage meter, M1, is a straightforward milliameter arranged to measure voltage via series dropping resistors R33 and the preset RV7 — the latter being for the purpose of calibration.

The current meter, M2, is effectively a voltmeter, measuring the voltage developed across the series resistance in the negative output line of the supply. Independent presets RV5 and RV6 are provided to allow calibration of the two output current ranges.

A bridge rectifier (BR1) and two 8000u/75 V capacitors (C3, C4) provide the main supply for the regulator.

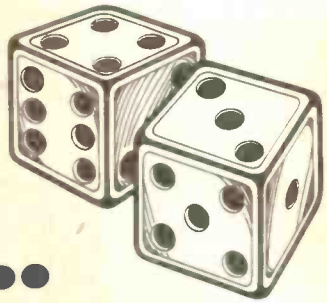
The voltage and current error amplifiers must be supplied with a 12 V rail obtained independently of the main tapped secondary winding of the transformer. This can be supplied from an auxilliary winding on the main transformer or from a second small transformer. It should be rated, at a minimum, to deliver 12 V at 150 mA, but a rating of 15 V at 200 mA provides a greater margin.

Diodes D1 to D4 rectify this supply, C1 providing smoothing. This is then regulated by IC1 to 12 V. A 5V1 zener diode connected across this supply provides the 5 V reference used by the reference inputs of the voltage and current error op-amps, IC2 and IC3.

The 'mains on' LED indicator, LED1, is powered from the +12 V rail by the series dropping resistor, R1. The output switch, SW1 permits 'turning off ' the supply output without turning off the mains. ●

Next month The interesting bits come next month — putting it together, setting it up and using it. Don't miss the next exciting episode! . . . .

AFTER YOU PLAY THE GAME...



GO

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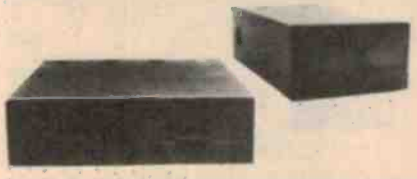

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UA7815KC	1.00	MAN72A	.65	6821	$1.00
UA7815UC	.45	4N28	.60	6840	$3.20
UA7818KC	1.00	4N33	.70	6845	$8.40
UA7818UC	.50	BDU64B	2.90	6850	$1.40
UA7824KC	1.00	BDU65B	2.90	8212	$1.10
UA7824UC	.50	AD149	1.50	8216	$1.04
UA78LO5AWC	.27	2SK134	3.80	8224	$1.30
UA78LI2AWC	.27	2SJ49	3.80	8255	$2.15
UA78L82AWC	.27	WO2	.20	8155	$3.70
UA78S40DC	1.70	WO4	.25	4011	.14
UA7905KC	1.05	IN5401	.10	4016	.24
UA7905UC	.45	IN5404	.12	4017	.44
UA7908KC	1.05	BC547	.05	4023	.16
UA7908UC	.50	BC548	.05	4028	.45
UA7912KC	1.05	BC549	.05	4040	.52
UA7912UC	.50	C1220	.65	4051	.49
UA7915KC	1.00	SC141D	.65	4066	.28
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				74LS367	.25

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8001	Red on Aluminium	300mm x 600mm	$10.00	$43.00 (5sh)
8005	Black on Aluminium	250mm x 300mm	$ 5.50	$40.00 (10sh)
8005	Black on Aluminium	300mm x 600mm	$10.00	$43.00 (5sh)
8009	Blue on Aluminium	250mm x 300mm	$ 5.50	$40.00 (10sh)
8009	Blue on Aluminium	300mm x 600mm	$10.00	$43.00 (5sh)
8007	Reversing Film	250mm x 300mm	$ 4.00	$22.50 (10sh)
8007	Reversing Film	300mm x 600mm	$ 8.50	$30.00 (5sh)
8011	Red on White Plastic	250mm x 300mm		$43.00 (10sh)
8013	Black on Yellow Plastic	250mm x 300mm		$43.00 (10sh)
8015	Black on White Plastic	250mm x 300mm		$43.00 (10sh)
8016	Blue on White Plastic	250mm x 300mm		$43.00 (10sh)
8018	Green on White Plastic	250mm x 300mm		$43.00 (10sh)
8500	1 Litre Developer			$9.00 per bottle
8500	250ml Developer			$2.50 per bottle
3900	Scotch Clear Finish	368gm Aerosol		$10.00 per can

Errors and omissions excepted.

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Please note full range of products are available on order.
Please contact Tim Bray on (03) 489-7099 for further information.

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KITS-- KITS-- KITS--

500MHz Digital Frequency Period Meter

Ref: EA Dec '81 – Feb '82
Jaycar has by far the best kit version of this project in Australia. We now supply 2 x GOLD plated BNC input connectors at no extra cost!
Cat. KA1390 $119 (50MHz Version)
Cat. KA1392 $26 (500MHz option)
(Beware of kits that don't conform to the original design).

ONLY $119

HEART RATE MONITOR

Ref: EA July '82
Brilliant kit which enables you to measure your heartbeat instantly. One of our most popular kits ever. The Jaycar kit comes in a beautiful ABS splashproof case with professional silkscreened panel.
Cat. KA1466 $79

DIGITAL CAPACITANCE METER

$74.50

Ref: EA March '82
Accurately measure capacitance from 1pF – 19.99uF. A must for the serious enthusiast.
Cat. KA1420 $74.50

Digital Thermometer

Ref: EA Feb '82
0 – 100 degrees C with 0.1 degree resolution. Bright, easy to read display. Kit includes two temperature sensors.
Cat. KA1404 $74.50

magnificent! *$74.50*

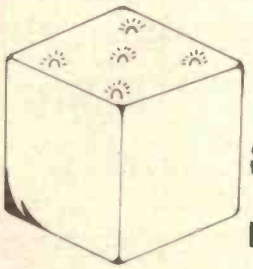
TRANSISTOR ASSISTED IGNITION

Ref: EA Jan '83
Latest version of this fantastically popular kit! The Jaycar kit comes with genuine DIE CAST box – as us ' in the EA prototype. Beware of others that use flimsy sheet metal.
Cat. KA1506 $35

MAGIDICE

The best electronic dice ever made! Firstly, this is not a kit. It is completely built and tested.
Basically the MAGIDICE is a glistening black cube measuring 75mm on all sides. It has 6 LED's set into the top of the cube under a red filter (the filter LOOKS black as well).
When the switch in the base is turned on, a wave of the hand over the top of the cube causes the circuit to operate. The cube beeps and gives you a guaranteed random dice "throw" in the form of illuminated LED's. There are no buttons to press and you don't even have to touch the cube!
The last number will remain until you note or wave your hand over the unit to "throw" another number. This (patented) product makes an absolutely unique gift and comes attractively presented.
Cat. XC-2006

Please note that a 9V battery snap (supplied) must be fitted to use on local 9V standard cell.



GREAT GIFT

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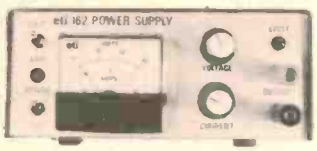
BRILLIANT FUN

0–30V 1amp power supply

Ref: ETI December 1982

- Fully protected
- Output variable from 0-30V DC
- Selectable current limit
- Both voltage and current metering
- After a multimeter & soldering iron an absolute must for the enthusiast.

You will never own a more useful piece of gear.



KE4570 $49.50

STEREO STEREO STEREO STEREO Synthesiser

Creates a very realistic stereo sound from mono sources i.e. AM tuners, TV or video units Very easy to build and comes complete.

Ref: EA September 1982

Cat. KA1478

Short Form Version Only Cat. KA1476 $39.50

EA dual tracking P/S

Extremely versatile power supply: Will give plus & minus 1.3V to 22V at up to 2 amps PLUS A FIXED +5V@0.9A. The supply is completely protected against short circuits, overloads and thermal runaway. A large meter with voltage calibration is supplied as well as IC sockets. A quality kit.

$89.50

Ref: EA April 1982

Function Generator

$99

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

JAYCAR EXCLUSIVE – 1% 50ppm metal film resistors used for stability

FREE! TILTING BAIL WORTH $4.95 included

5000 SERIES GRAPHIC EQUALISERS

Cat. KE4200 Ref: ETI JAN/MARCH 1981

Cat. KE4202

SPECIFICATIONS:
Signal-to-Noise: –102dB with respect to 1 Volt
Frequency Response: (3Hz – 105kHz to –1dB Boost/Cut, 14dB (28dB total)
Distortion: 100Hz 0.047% 1kHz 0.007% 10kHz 0.009% (essentially irrespective of cut or boost)
Current consumption (DC) Approx 100mA @ 21.5V (Requires 30V AC CT)
Output short-circuit proof.

AUSTRALIAN (NOT HONG KONG) MADE – SPECIAL BUILT RACK CABINET – QUALITY!!!

ALL IC SOCKETS PROVIDED

$199

BUY 2 AND SAVE $10 – ONLY $389

Cat. KE4204

FUNCTIONS
- MOVING COIL INPUT
- MOVING MAGNET (DYNAMIC CART)
- INPUTS (2 OFF)
- TUNER INPUT
- AUX INPUTS (2 OFF)
- TAPE INPUTS (2 OFF)
- INPUT LEVEL CONTROL
- TAPE OUTPUTS (2 OFF)
- 400Hz CALIBRATION OSCILLATOR
- LED AVERAGE (VU) & PEAK
- LEVEL METERS –48dB TO +9dB
- MODE SWITCH, STEREO BALANCE CONTROL LINE OUT, MONITOR OUT, MONITOR VOLUME CONTROL

FEATURES
- EXTREMELY CLOSE TRACKING TO RIAA PHONO EQ.
- GOLD PLATED CONNECTORS ON ALL INPUTS
- ENGLISH 'LORLIN' LOW NOISE SELECTOR SWITCHES
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NEW MAGNUM 200

NEW! – LOW COST 5000 SERIES AMP

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Black Monolith $319

"BLUEPRINT"

ONLY $299

KITS -- KITS -- KITS-

LOW COST DIGITAL MULTIMETER KIT

BY POPULAR DEMAND

ONLY $45

Ref: EA March 1983 (This month)
Almost everyday we are asked for a multimeter kit. Up until now we thought that it was just not worth it considering the fine low-cost built-up units available. The DP2010 changed all that.
This kit, fully imported from the UK uses the famous DPM-05 custom LCD/Voltmeter to achieve phenomenal accuracy at very modest cost!
All parts are included to complete the meter including an attractive and colourful front panel.
(a 9V battery is required)

Set of test probes to suit $2.95
Probe to suit Cat. WT5312 ONLY $2.50
Eveready 216 (red) 9V Battery Cat. SB2370 ONLY $1.40

DP2010 kit Cat. KJ7010 ONLY $45

AC VOLTAGE AND CURRENT RANGES
When S3a selects a.c. functions the output from either the voltage attenuator or current shunts is fed through C1 to remove any d.c. component.

SPECIFICATIONS

Function	f.s.d.	Resolution	Accuracy	Protection				
Volts (d.c.)	2V	1mV	1%±1 digit	500V for one minute	Current (a.c.)	2mA	1uA	2%±5 digit 1A/250V
	20V	10mV	1%±1 digit			20mA	10uA	2%±5 digit
	200V	100mV	1%±1 digit			200mA	100uA	4%±5 digit
	500V	1V	1%±1 digit			2000mA	1mA	7%±5 digit
Current (d.c.)	2mA	1uA	1%±1 digit	1A/250V	Resistance	2K	1	1%±1 digit 260V
	20mA	10uA	1%±1 digit			20K	10	1%±1 digit r.m.s.
	200mA	100uA	3%±1 digit			200K	100	1%±1 digit
	2000mA	1mA	5%±1 digit			2000K	1K	1%±1 digit
Volts (a.c.)	2V	1mV	2%±5 digit	500V for one minute	Diode Test	2V	1mV	1%±1 digit 260V r.m.s.
	20V	10mV	2%±5 digit					
	200V	100mV	2%±5 digit					
	500V	1V	2%±5 digit					

ROBOTICS

JAYCAR – FIRST IN AUSTRALIA WITH THE VERY LATEST IN THE FIELD OF ROBOTICS

Jaycar is the first major electronics company in Australia to stock useful robots in kit and built-up form.

MICRO GRASP

ONLY $499

The Micro Grasp is the first low-cost true robot. Basically the unit has an articulated arm jointed at the shoulder, elbow and wrist positions. The entire arm rotates on its base and has a motor driven gripper on the end of the arm. Each of the arm movements is SERVO CONTROLLED i.e. there are position sensors feeding back information to the interface board where it is compared with the programmed or intended position. Any positional error is automatically and continuously corrected. This servo action is independent of the computer, simplifying greatly the software to drive the robot. All programming is carried out with a small number of common BASIC commands. The interface board is memory mapped using only 64 Bytes at any of the 1024 switch decimate locations.
Control of the Micro Grasp as a computer peripheral is accomplished thru the parallel expansion port of most small computers. To keep the cost to an absolute minimum and to increase the learning factor the Micro Grasp is supplied as a self assembled kit. All components down to the last nut and bolt are included, as is the power supply.

MICRO GRASP KIT INCLUDING POWER SUPPLY Cat. KR1000 – SPECIAL INTRODUCTORY PRICE $499.00
UNIVERSAL COMPUTER INTERFACE BOARD (in kit form) Cat. KR1010 ONLY $179.00 (not required for Sinclair ZX81 computer)
23 + 23 way edge connector at $8.95 ZX 81 peripheral/RAM pack splitter board $10.95
CALL IN TO OUR YORK STREET SHOWROOM AND SEE WORKING!!!

AS DESCRIBED ETI MAG. APRIL 1983

EPROM programmer for the MicroBee

Ref: ETI Feb '83

Fantastic little accessory for the popular "Microbee" computer.
The Jaycar kit contains all components including the following SPECIAL features:
- 28 pin IC socket included!
- 3 x 16 pin "PERSONALITY PLUG" HEADERS
- 15 pin PARALLEL CONNECTOR
- IC sockets for all logic devices including personality socket.

ALL THIS FOR ONLY $39.95!
Cat. KE4650

24 pin ZIF socket to suit only $12.95 Cat. PI6522

Sparkrite

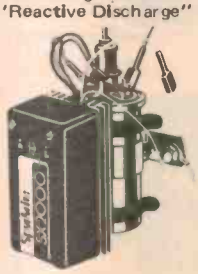
The Brandleaders in Auto Electronics

the ultimate in electronic ignition

Each kit is complete down to the last nut & bolt. All fittings included! SX-2000. UK's largest selling electronic ignition! "Reactive Discharge" system – NOT CDI – with great reliability.
Cat. KJ-6650

Sparkrite SX2000

NEW Value $59

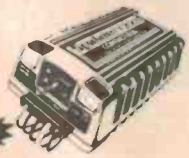


A Reactive Discharge System combines all features of the SX500 plus:
- Reactive Discharge electronics combining all the advantages of both Inductive and Capacitive Discharge for maximum spark performance.
- Gives the most thorough combustion of air/fuel ratios especially current lean mixture emission controlled engines.
- Voted "Accessory of the Year" and the best as tested by Popular Motoring Magazine.
- Patented clip-to-coil fitting.
- Systems Function Light as well as Static Timing Light.
- The ultimate brand leading contact-breaker triggered system.

TX-2002. Breakerless Ignition! Full fitting kit to convert 90% of all cars! All contactless hardware supplied. No drilling or tapping. You can easily convert – and even use your points to work the TX-2002!
Cat. KJ-6652

Sparkrite TX2002

$115



THE BRAND LEADER

A Reactive Discharge System – with unique auxiliary circuit. Combines all features of the TX1002 plus:
- Reactive Discharge electronics combining all the advantages of Inductive and Capacitive Discharge for maximum spark performance.
- Gives the most thorough combustion of air/fuel ratios especially current lean mixture emission controlled engines.
- Unique 3-way change-over switch incorporating an auxiliary back up circuit. "ELECTRONIC/OFF/AUXILIARY".
- Robust die-cast case, fully resistant to moisture and heat.
- The ultimate system – REACTIVE DISCHARGE – CONTACTLESS OR CONTACT TRIGGERED – AUXILLIARY BACK UP CIRCUIT – CLIP-TO-COIL FITTING – FOUR CONNECTIONS ONLY – ALL PARTS IN ONE BOX TO FIT OVER 500 APPLICATIONS.

TX APPLICATIONS
No separate fitting kit required, all parts in one box, to fit more than 500 vehicles

TX-1002. Slightly lower powered version of the TX-2002. Ideal for most 4 cylinder cars. All fitting pieces included!
Cat. KJ-6651

Sparkrite TX1002

$79

An Inductive Discharge System
- Can be operated utilising "Hall Effect" triggerhead, or existing contact-breakers.
- Extended dwell Inductive Discharge for maximum spark efficiency.
- Three position switch.
- Static Timing Light.
- Systems Function Light.
- Patented clip-to-coil fitting.
- Robust die-cast case.
- Fully waterproof.
- Protected from the hostile environment of the engine compartment.

Sparkrite AT-80

Brilliant Computer Programmable Car Security System.
This kit, the famous British Sparkrite AT-80 is absolutely unique. It uses a self-adhesive sensor pad that attaches to the inside of your glass windscreen. You have a special key fob (2 are supplied) and you program YOUR SPECIAL CODE in from the OUTSIDE OF THE CAR to get back in.
The windscreen pad is a REAL deterrent sticker!
Cat. KJ-6660

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WE are a No.1 Kit Supplier

SERIES 5000

PRICES SLASHED

As designed by ETI

PREAMPLIFIER

PRICES SLASHED this month only

~~$259~~ $239

SPECIFICATIONS

Frequency response:	High-level input: 15Hz-130 kHz, +0, −1 db Low-level input — conforms to RIAA equalisation, ±0.2 dB
Distortion:	1kHz <0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation).
S/N noise:	High-level input, master full, with respect to 300 mV input signal at full output (1.2V): >92 dB flat >100 dB A-weighted. MM input, master full, with respect to full output (1.2V) at 5 mV input, 50 ohm source resistance connected: >86 dB flat >92 dB A-weighted. MC input, master full, with respect to full output (1.2V) and 200 μV input signal: >71 dB flat >75 dB A-weighted.

POWER AMPLIFIER

Please note that the "Superb Quality" Heatsink for the power amp was designed and developed by Rod Irving Electronics and is being supplied to other kit suppliers. This product cost $1,200 to develop so that your amplifier kit would have a professional finish as well as sound. We also have a new range of rack mounting boxes which will be released soon.

SPECIFICATIONS

Power output:	100W RMS into 8 ohms (±55 V supply).
Frequency response:	8 Hz to 20 kHz, +0−0.4 dB 2.8-Hz to 65 kHz, +0−3 dB. NOTE: These figures are determined solely by passive filters.
Input sensitivity:	1V RMS for 100W output.
Hum:	−100dB below full output (flat).
Noise:	−116 dB below full output (flat, 20 kHz bandwidth).
2nd harmonic distortion:	<0.001% at 1 kHz (0.0007% on prototypes) at 100 W output using a ±56 V supply rated at 4 A continuous. <0.003% at 10 kHz and 100 W.
3rd harmonic distortion:	<0.0003% for all frequencies less than 10 kHz and all powers below clipping.
Total harmonic distortion:	Determined by 2nd harmonic distortion (see above).
Intermodulation distortion:	<0.003% at 100 W. (50 Hz and 7 kHz mixed 4:1).
Stability:	Unconditional

Price Slashed ~~$299~~ $279

THIRD OCTAVE GRAPHIC EQUALIZER

SPECIFICATIONS E.T.I. Dec. 1982

Bands:	28 Bands from 31.5 Hz to 16 kHz
Noise: 20 kHz bandwidth	<0.008 mV, sliders at 0, gain at 0 (−102 dB).
Distortion:	0.007% at 300 mV signal, sliders at 0, gain at 0; max. 0.01%, sliders at minimum.
Frequency Response:	12 Hz-105 kHz, +0, −1 dB, all controls flat.
Boost & Cut:	14 dB

1 unit $189
2 units $359

MX-1200 MICROPHONE/AUDIO MIXER

MX 1200 $499 this month only

~~$599~~

This unit features: 12 microphone line inputs with pan, bass, treble, effect and fold back controls for each channel • LED peak indicators for each channel • 2 turntable inputs with cross-fade and individual output controls • master equaliser for bass, midrange and treble • variable headphone output etc. etc. • complete with carrying case.

SPECIFICATIONS
INPUTS
Level/Impedance Mic .46 db/1K
Line .22 db/16K x 12
Phono .52 db/50K STEREO x 2 (.2mv) at 1KHz
Effect Return (Aux) .20 db/50K x 1
OUTPUTS
Level/Impedance L & R 0 db/2K
Effect Send 0 db/2K F/B Out 0 db/2K
Head phone Stereo +10 db/600 (100 .1K)
EQUALISATION
Channel
Bass ±15db
Treble ±15db
Master
Bass ±12db
Treble ±10db
Middle ±12db

FADER & CONTROLLERS
12 channel fader: Slide; 60mm; LOG 25%
2 Master fader: Slide; 60mm; LOG 15%
12 F/B Volume; 300; LIN
1 F/B Master level; 300; LIN
12 Effect Send; 300; LIN
1 Effect Return; 300; LOG 15%
2 Phono; 300; LOG 15%
1 Head Phone; 300; LOG 15%
S/N: 54DB
FREQUENCY RESPONSE: 20-20 KHz
TOTAL HARMONIC DISTORTION: Less than 0.1%
METER: 2 illuminated VU Meters 0db = 0.775V
PEAK INDICATOR: 12 LED Peak indicators
VOLTAGE: 240 VAL 50Hz
POWER CONSUMPTION: 7.2 watts
DIMENSIONS: 820 (W) x 386 (D) x 108 (H) mm (supplied complete with carrying case)

EXTRA FEATURES OF OUR KITS

POWER AMPLIFIER

KIT PRICE $299 P&P $8.00

- 1% Metal Film Resistors are used where possible
- Prewound Coils are supplied
- Aluminium case as per the original article
- All components are top quality
- Over 200 Kits now sold
- We have built this unit and so know what needs to go into every kit
- SUPER FINISH Front panel supplied with every kit at no extra cost to you
- We are so confident of this kit that we can now offer it assembled and tested so that people who do not have the time can appreciate the sound that this appliher puts out. This is done on a per order basis delivery approx. two weeks after placement.

only $425

**All parts available separately for both kits.*

PREAMPLIFER

KIT PRICE $259 P&P $8.00

- 1% Metal Film Resistors are supplied
- 14 metres of Low Capacitance Shielded are supplied (a bit extra in case of mistakes)
- English "Lorlin" Switches are supplied no substitutes as others supply
- We have built and tested this unit and so know what needs to go into every kit
- Specially imported black anodised aluminium knobs
- Again as with the power amp we are offering this kit A & T at a price which we do not believe there is a commercial unit available that sounds as good. Same delivery as the P.A.

only $425

Errors and omissions excepted.

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Zener diode tester plugs into your multimeter

Geoff Nicholls

This handy little adjunct for your multimeter allows you to read out the actual zener voltage of any zener diode up to 60 volts and will also test LEDs!

EVER DUG INTO a tray of components looking for a zener diode only to find that the markings have worn off? Even a brand new zener is usually marked with a code number giving little indication of the thing you want to know — the actual zener voltage rating. This simple tester will save you thumbing through the data books looking for a 1N4XXX, and allows easy identification of those unmarked diodes.

Most multimeters have a diode check position, but few can test LEDs, let alone zeners. This handy little adjunct for your multimeter allows you to test zeners up to about 60 volts, and can drive enough current through a LED to light it (and give you a reading of its forward voltage drop).

The tester simply plugs into your multimeter (a digital meter is ideal) and gives a direct reading of zener voltage. The circuit uses an inverter to provide a current-limited output of up to 70 volts dc from a nine volt battery. Table 1 shows the output characteristics of the prototype.

The leads on diodes are designated *anode* and *cathode*, the latter being marked by a band. When connected to the tester with the cathode to the black or negative terminal, the multimeter will indicate the diode forward voltage. For a silicon diode this will be about 650 mV while a germanium diode will read around 300 mV. Zener diodes are normally operated in reverse bias and are therefore tested with the cathode (banded end) connected to the red or positive terminal so that the zener voltage is displayed on the meter.

Zener characteristics

The zener voltage rating of a diode is only a nominal figure and should be considered with other parameters when designing circuitry. The first thing to realise is that the zener voltage is rounded to the *nearest preferred value*. Secondly, the voltage rating is dependent on the current passing through the diode. The diode manufacturers usually quote zener voltages at a current of 5 mA for voltages up to 30 volts and at 2 mA above this.

Low voltage zeners will not develop their nominal voltage until the current reaches a few milliamperes. As the diode current is increased the voltage drop will also increase, representing a dynamic resistance which varies from tens of ohms for zeners between six and ten volts, to hundreds of ohms outside these limits.

Lastly, the zener exhibits a temperature sensitivity that varies with zener voltage as shown in Figure 2. A detailed explanation of the temperature characteristic may be found in any solid state physics textbook, the essential features being a negative temperature coefficient associated with true zener breakdown below six volts and a positive temperature coefficient associated with avalanche breakdown above six volts.

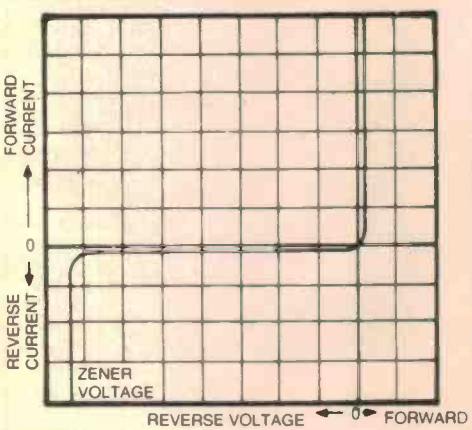


Figure 1. The fundamental characteristics of a zener diode. Little reverse current flows until a certain voltage — the zener voltage — is reached. This voltage is almost constant.

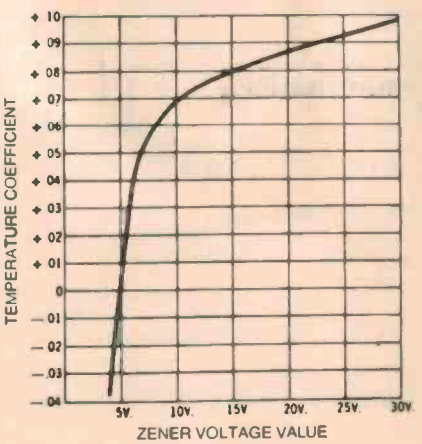


Figure 2. Temperature characteristics of zener diodes — depends on the zener voltage value.

Push-to-read. The tester is housed in a 'zippy' box with banana plugs protruding from the rear spaced to suit the multimeter input sockets spacing.

It is possible to combine zener diodes with opposing temperature coefficients in order to obtain a near temperature-independent reference, or to use a normal diode (with a negative coefficient) and a zener with the same result.

For further information on practical zener usage, refer to *ETI Circuit Techniques, Vol. 1*, pages 136 to 141.

Construction

I built the zener tester into a plastic zippy box with metal lid measuring about 30 x 50 x 80 mm. This is the smallest common low cost box that will accommodate the electronics and battery.

The pushbutton switch is mounted centrally in the lid about 10 mm from one end with the two banana plugs in the box underneath the switch. The spring terminals mount on the other end of the box, as shown in the photographs. You may wish to vary construction to suit the components on hand, but check ▶

TRANSFORMER NOTES

The transformer used in this zener tester is a 'transistor audio transformer'. Two separate types were tested, with virtually equivalent results.

The Dick Smith M-0216, described in the catalogue as being 'primary 1k ohm CT/secondary 8 ohm' was the one used in designing the circuit (CT means 'centre tapped'). Although described as having a ferrite core, the several we purchased had iron cores.

Many component suppliers stock this transformer, or an equivalent type. For example, Altronics call it an 'output transformer', catalogue number M 0216; Electronic Agencies have a '1k CT/8 ohm' mini transformer listed as cat. no. ME4012.

Just for safety's sake, in case the 1k CT/8 ohm transformers may not be available at some time or another, we tried a 500 ohm CT/8 ohm type from Altronics, cat. no. M 0226. Many other suppliers stock a transformer like this, too. As results were virtually equivalent, we can safely say transformers of this type may be used for T1 also. Connections were found to be the same as the M-0216.

Note that it may be physically larger, necessitating mounting R1 on the copper side of the board.

that the bits all fit together before chopping up your box.

The banana plugs are mounted at a spacing of 0.75", or about 19 mm, which allows the tester to plug straight into a standard multimeter with 'GR' inputs.

To mount the plugs, first remove the plastic handles and cut them down to 20 mm so they can be fitted inside the box. Solder about 100 mm of insulated wire to each plug and feed the end through the holes in the box. Grab each plug with pliers and push them through the holes from the bottom. Now slip the handles over the wires and tighten up the plugs.

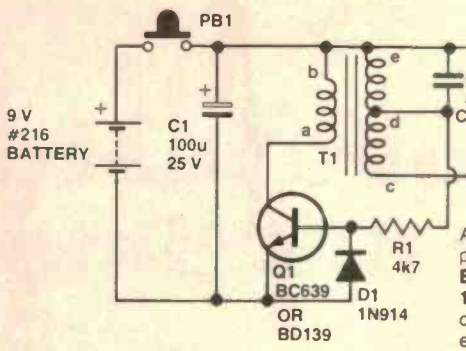
If all that seems too much, you may want to simply bring a couple of wires out to the multimeter with the banana plugs soldered to the ends.

The spring terminals I used had mounting holes about 45 mm apart which allowed screws to tap into the plastic pillars in the corners of the box. You may also mount the terminals on the long side of the box. In any case, a couple of holes will be necessary under the spring terminals to allow the solder lugs to pass through.

The pc board is straightforward to assemble, watch the orientation of the electrolytic capacitors, the two diodes (note: D1 is the smaller) and the transistor. There are several types of transformer available and some may require R1 to be mounted on the copper side of the board in order to fit properly. The pc board may slot into a groove inside the box, or simply lay alongside the battery as in our prototype. ●

TABLE 1 Performance of prototype.

OUTPUT VOLTAGE volts	OUTPUT CURRENT mA	BATTERY DRAIN mA
0	5	140
5	8	160
15	9	190
24	9	190
48	5	160
60	1.5	130
72	0	120



Artwork. A same-size film positive or negative of the pc board artwork can be obtained for $1 post paid from **ETI-164 Artwork, ETI Artwork Sales, ETI Magazine, 140 Joynton Ave, Waterloo NSW 2017.** Make out cheques or money orders to 'ETI Artwork Sales' and ensure you ask for a positive or negative as you require.

HOW IT WORKS — ETI-164

The operation of apparently simple inverter circuits is usually exceedingly complex, so the following is a simplified explanation!

After PB1 is closed, current flows through terminals 'e' and 'd' of the transformer (and C2) to the base of Q1 via R1. Q1 starts to conduct and causes current flow through transformer terminals 'b' and 'a' (the primary winding) which causes the magnetic field to build up in the transformer. This field increases the base current to Q1 because of the phasing of the windings.

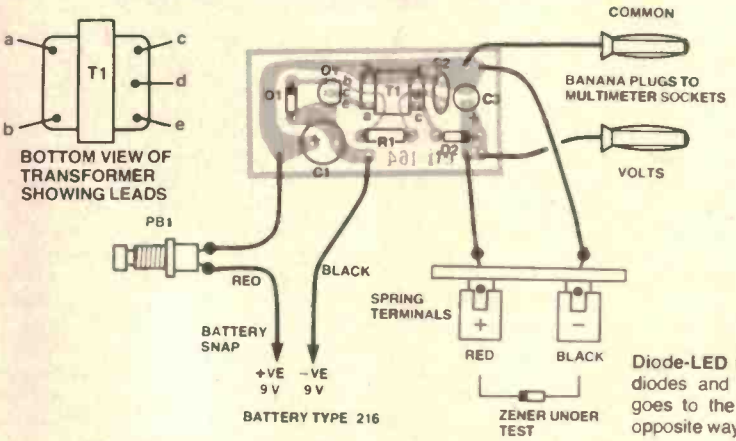
The magnetic field increases until the transformer core saturates, when the transistor base current reverses, turning the transistor off.

Diode D1 protects the base-emitter junction against excessive reverse bias voltage.

The energy in the transformer's magnetic field is dissipated via several mechanisms, one being to charge C3 via D2.

The whole cycle repeats at a rate of a few kilohertz.

Capacitor C1 provides a low impedance source to ac signals and improves operation with a battery supply.



Diode-LED test. When testing diodes and LEDs, the anode goes to the red terminal, the opposite way to zeners.

PARTS LIST — ETI-164

Resistor ..... ¼W, 5%
R1 ..... 4k7

Capacitors
C1 ..... 100u/25 V (or 16 V) RB electro.
C2 ..... 3n3 ceramic
C3 ..... 2u2/50 V RB electro. (see text).

Semiconductors
D1 ..... 1N914
D2 ..... EM401, 1N4001, EM402, 1N4002, etc.
Q1 ..... BC639 or BD139

Miscellaneous
PB1 ..... momentary action pushbutton
T1 ..... transistor audio transformer, '1k CT to 8 ohm', D.S.E. M-0216 or similar (see text).

ETI-164 pc board; UB5 zippy box (28 x 54 x 83 mm); spring terminals; wire etc.

Price estimate $8 — $9

Inside story. Internal view of the zener tester. Note the cut-down banana plug handles at the top of the box.

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VC-1
BNC plug to BNC plug. Impedance-75Ohm. Cable length 1.5m **$6.50**

VC-2
BNC plug to PL259 plug. Impedance-75Ohm. Cable length 1.5m **$6.75**

VC-3
PL 259 plug to PL 259 plug. Impedance-75Ohm. Cable length 1.5 **$4.95**

VC-4
PL 259 plug to RCA plug. Impedance-75Ohm. Cable length 1.5m **$4.95**

VC-5
RCA plug to RCA plug. Impedance-75Ohm. Cable length 1.5m **$5.95**

VC-6
BNC plug to RCA plug. Impedance-75Ohm. Cable length 1.5m **$5.95**

Video Connectors

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8 pin square video connector plug **$7.50**

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8 pin square video connector inline socket **$7.50**

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10 pin male video plug. Used in J.V.C., Panasonic, Sharp and other VHS machines **$11.50**

VS-10
10 pin female inline socket. Used in J.V.C., Panasonic, Sharp and other VHS machines **$11.50**

VP-14
14 pin male video plug. Used in Sony, Sanyo, Toshiba and other Beta machines **$16.50**

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3. Outputs: 3 Videos (RCA connectors)
4. Output lever: Video outputs: 1.0Vp-p, 75 Ohm unbalanced below 1Vp-p out.
5. Enhance: Enhance 9dB (Referenced/1.0Vp-p)
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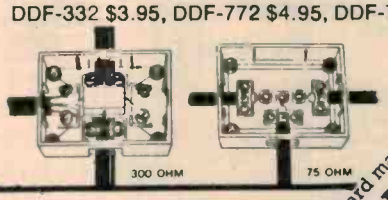
					UHF	4	20	1.7
DDF-772 U/V	50-890	75	75	2	VHF	3.5	25	1.5
					UHF	4	20	1.7
DDF-774 U/V	50-890	75	75	4	VHF	6.7	30	1.4
					UHV	7.6	22	1.8

DDF-332 $3.95, DDF-772 $4.95, DDF-774 $6.95



Errors and omissions excepted.

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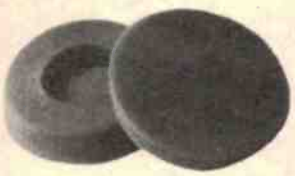

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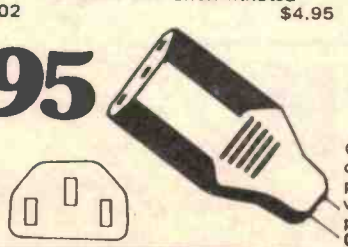

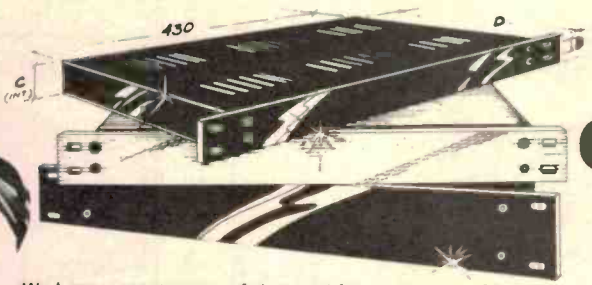

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HB5412	88mm (3½")	Black	$49.50
HB5413	" "	Silver	$49.50
HB5414	132mm (5¼")	Black	$54.95
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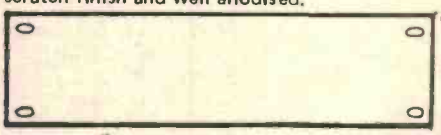

Cat. No	Height	Colour	Price
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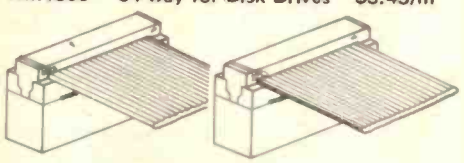

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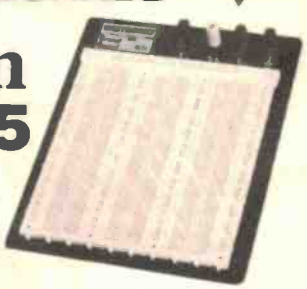

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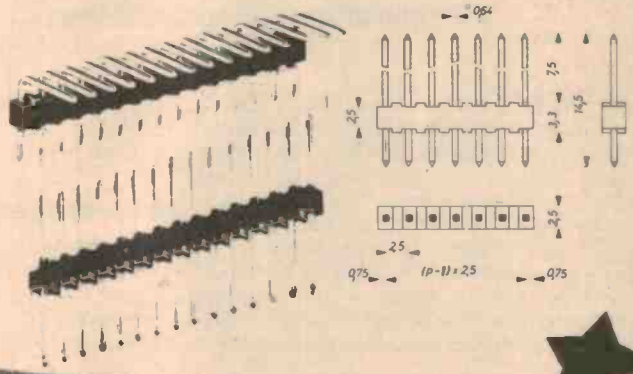

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Resistance	200Ω	100mΩ	0.5% ± 1 digit
	20kΩ	10Ω	0.5% ± 1 digit
R.P.M	20,000r.p.m.	10r.p.m.	1% ± 3 digits
Dwell	90°	0.1°	2% ± 3 digits

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How to use digital voltmeter modules

Part 2

In this concluding part of the series, Ray Marston shows how to use 3½-digit LCD DVM modules to build a multimeter and measure temperature, capacitance, frequency and a whole lot more.

Ray Marston

IN PART 1 I explained the basic characteristics and usage rules of 3½-digit LCD digital voltmeter modules and showed how these units can be used to measure voltage, current and resistance.

This part kicks off with the complete circuit of a five-function, 25-range digital multimeter and continues by showing how these modules can be used to give accurate measurement of temperature, capacitance, frequency and various other parameters. It finishes up with some vital hints on actually constructing projects that are designed around the modules.

A 25-range multimeter

Figure 21 shows how the circuits of Figures 15 to 20, in Part 1, can be joined together to make a complete five-function 25-range multimeter. Table 3 details the ranges/functions of the meter.

The reader should have little difficulty in following the Figure 21 circuit. Functions are selected by SW1, ranges by SW2. SW1a connects the inputs to the voltage, current or resistance measuring networks, and SW1d activates the ac/dc converter or energises the 'ohms' circuitry when necessary.

Voltage ranges are selected by SW2a, current ranges by SW2b, and resistance ranges by SW2c.

SW2d and SW2e control the decimal point

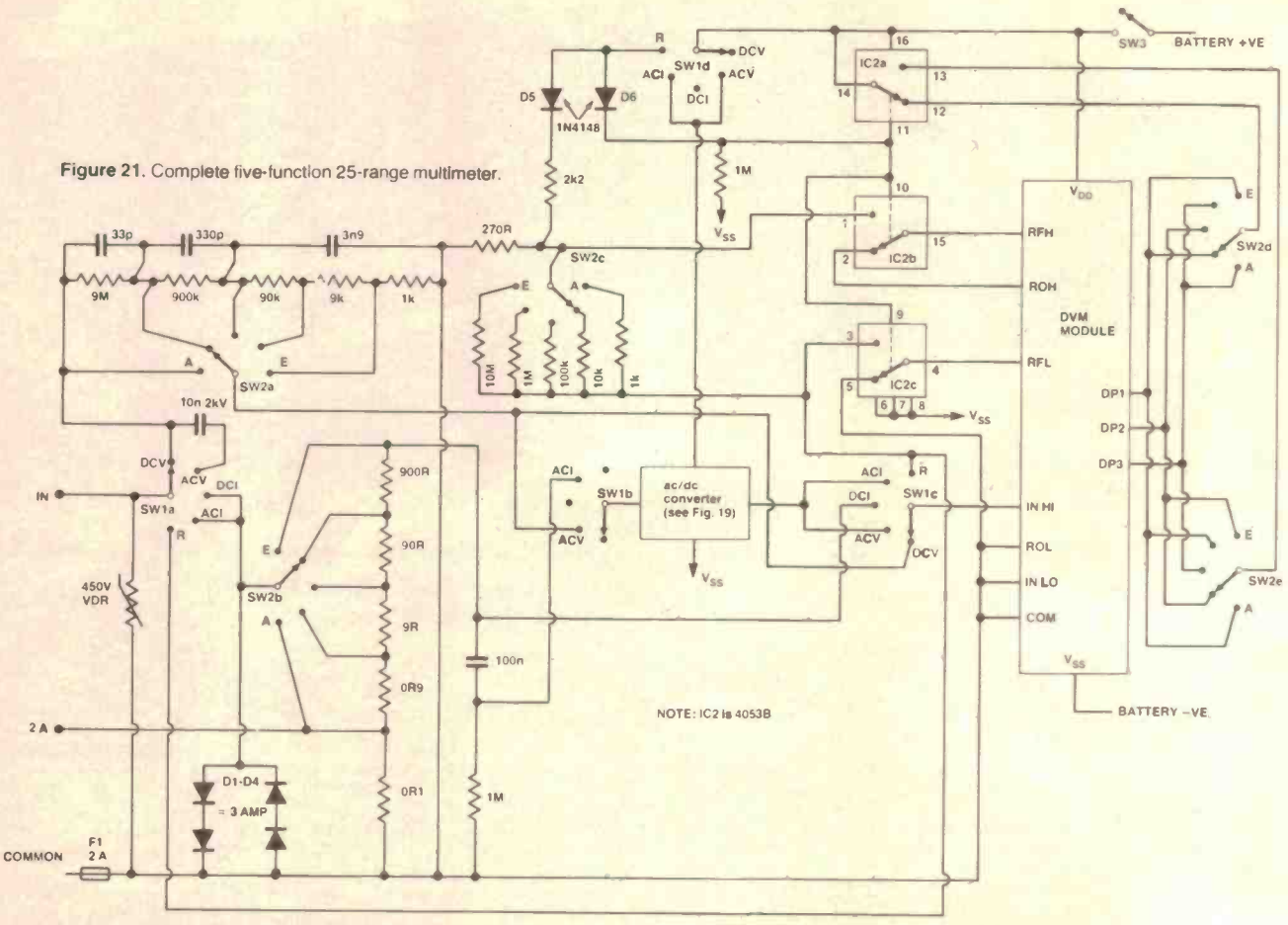


Figure 21. Complete five-function 25-range multimeter.

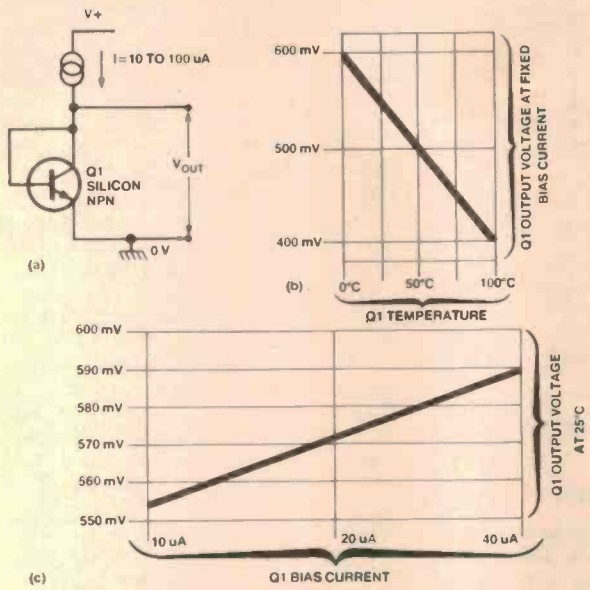


Figure 22. When a transistor is connected as in (a), its output voltage varies at a rate of about −2 mV/°C as shown in (b). The output voltage also varies with drive current as shown in (c).

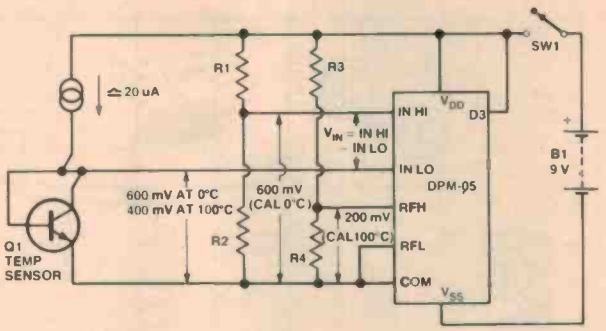


Figure 23. Basic digital thermometer circuit using an idealised (Figure 22b) transistor sensor.

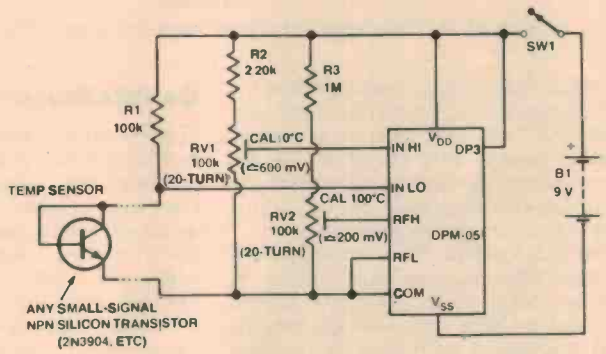


Figure 24. Simple digital thermometer using a transistor sensor. Linear accuracy is about 1.5°C.

positions on each range, the appropriate switch being selected automatically by IC2a. IC2b and IC2c control the basic configurations of the DVM module. IC2 (a triple two-way analogue switch) is activated via SW1d.

Digital thermometers

A DVM module can be made to act as a wide-range (−50°C to +150°C) digital thermometer by feeding the output of a linear voltage-generating temperature sensor to its inputs. Two suitable types of sensor are readily available; the first of these is the ordinary bipolar silicon transistor and the second is a dedicated IC. In either case, the resulting digital thermometer has a temperature discrimination of 0.1°C. Linear accuracy varies from 0.5°C to 1.5°C, depending on the sensor and circuitry used.

Because of the low mass of a transistor sensor, the device has a thermal response time some 10 to 100 times faster than a normal mercury thermometer. When used to measure a sharp change in the temperature of free air, a transistor-sensor circuit typically settles to within 0.1°C of the new temperature in less than one minute; a mercury thermometer takes some 20 minutes to attain the same accuracy.

Transistor-sensor circuits

When an ordinary NPN silicon transistor is connected as shown in Figure 22a and driven from a constant-current source, it generates an output voltage that varies in direct proportion to the transistor temperature. This voltage has a negative temperature coefficient of about −2 mV/°C and typically varies from about 600 mV at 0°C to 400 mV at 100°C, as shown in the idealised graph of Figure 22b.

In practice, the 'straight line' of the Figure 22b graph is linear within 1 mV or so over the 200 mV '0°C to 100°C' temperature variation range, but the precise voltage generated at any given temperature depends on the individual transistor and its operating current. If operating currents are kept below 100 uA, errors due to self-heating are negligible. Figure 22c shows the measured variation in voltage at 25°C of a small sample of transistors at currents ranging from 10 to 40 uA.

Figure 23 shows the basic method of connecting the idealised transistor sensor of Figure 22b to a DVM module so that the meter gives a direct readout of temperature in °C. The output of the sensor is fed directly to the module's IN LO terminal and a 600 mV offset voltage (equal to the sensor voltage at 0°C) is fed to IN HI. The module actually responds to the *differential* value (IN HI minus IN LO) of the input, so under this condition it sees an input of 600 mV − 600 mV = 0 mV, and gives a reading of '00.0'.

At 100°C the module sees an input of 600 mV − 400 mV = 200 mV. Since a reference voltage of 200 mV (equal to the difference in voltage between 0°C and 100°C) is fed to RFH, the meter gives a reading of '100.0' under this condition.

Figures 24 and 25 show two practical examples of digital thermometers. The Figure 24 circuit is virtually the 'standard' one published in many magazine articles and application sheets and has a typical linear accuracy of 1.5°C over the 0°C to 100°C temperature range. A stable 2V8 is generated between V_{DD} and COM of the DVM module, so R1 drives the sensor with a current of about 22 uA at 0°C, rising to about 24 uA at 100°C. This current variation, combined with the basic linear error of the transistor, causes the 1.5°C linear error of the circuit.

The 'CAL 0°C' voltage feeding IN HI is variable from zero to 875 mV via RV1, and the 'CAL 100°C' voltage feeding RFH is variable from zero to 255 mV via RV2. These two controls are for the calibration of the meter, using the technique to be described shortly. ▶

MODE (SW1)	RANGE (SW2) A	B	C	D	E
DCV	199.9 mV	1.999 V	19.99 V	199.9 V	1.999 kV (700V max)
ACV	199.9 mV	1.999 V	19.99 V	199.9 V	1.999 kV (450 V max)
DCI	199.9 μA	1.999 mA	19.99 mA	199.9 mA	1.999 A
ACI	199.9 μA	1.999 mA	19.99 mA	199.9 mA	1.999 A
R	1.999 k Ω	19.99 k Ω	199.9 k Ω	1.999 M Ω	19.99 M Ω

Table 3. Ranges and functions of the Figure 21 multimeter circuit.

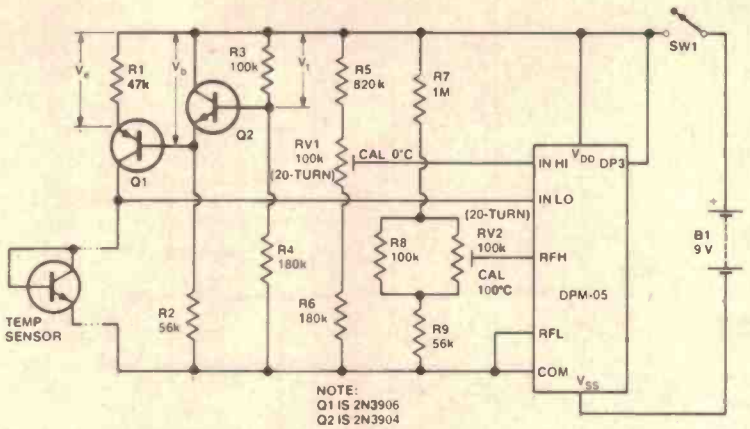


Figure 25. Precision digital thermometer using a transistor sensor. Linear accuracy is 0.5°C.

Figure 25 shows a precision version of the digital thermometer, giving a linear accuracy of about 0.5°C. In this case the transistor sensor is energised at about 20 uA via constant-current generator Q1 which is temperature compensated by Q2. This section of the circuit works as follows.

Potential divider R3-R4 is wired between V_{DD} and COM and generates voltage V_t (about one volt) across R3. This voltage is 'followed' by NPN transistor Q2, causing $V_t + V_{be}2$ to appear on Q1 base; let's call this voltage V_b. The voltage V_e appearing on the emitter of PNP transistor Q1 is equal to $V_e - V_{be}1$ and it is the product of V_e and R1 that determines the magnitude of the constant-current output of Q1. Note, however, that V_e is, in fact, equal to $V_t + V_{be}2 - V_{be}1$ and that since Q1 and Q2 operate at virtually identical temperatures and at similar current levels, the $V_{be}1$ and $V_{be}2$ values automatically cancel out at all temperatures and V_e thus equals V_t. The output current of Q1 is thus independent of ambient temperature.

Other points to note about the precision circuit of Figure 25 are that the 'CAL 0°C' control, RV1, is adjustable over the limited range of 460 mV to 710 mV. Also, the 'CAL 100°C' control, RV2, is adjustable over the limited range 140 mV to 260 mV, thus giving very fine adjustment of each calibration point.

Calibration procedure

The procedure for calibrating the Figures 24 and 25 circuits is as follows. First, solder the base and collector leads of the sensor transistor together. Then solder the sensor to a pair of flexible leads and connect it to the meter circuit. Paint all visible transistor leads and solder joints with insulating varnish (Humbrol clear varnish No 35 is excellent). Next, set RV1 and RV2 at mid value, mix a quantity of crushed ice and cold water in a tumbler (to act as a '0°C' standard) and immerse the sensor in the tumbler. Now adjust RV1 to give a reading of '00.0' on the meter. Finally, remove the sensor from the tumbler and immerse it in gently boiling water (to act as a '100°C' standard), then adjust RV2 to give a meter reading of '100.0'. Basic calibration is then complete.

If the meter is to be used mainly around some mid-scale value, such as 25°C etc, RV1 can (after initial calibration) be used to set the meter 'spot on' at that value by immersing the probe and a standard thermometer in a liquid that is raised to the desired temperature.

An IC-sensor circuit

Intersil make a special two-terminal IC for use as a temperature sensor in digital thermometers. The device is the AD590 and gives an output current of 1 uA/°K which, when fed through a 1k resistor, gives a voltage of 1 mV/°K. Uncalibrated accuracy of the device varies from 0.5°C to 10°C. Linearity error varies from 0.3°C to 1.5°C, depending on the grade of the device (indicated by a suffix number). Figure 26 shows how an AD590 can be used with a DVM module.

The AD590 needs a supply voltage of at least four volts and this is obtained by wiring the IC between V_{DD} and TEST (which is internally biased at about five volts below V_{DD}) via D1. The COM terminal is biased about 600 mV above TEST via D1. R1 is wired in series with the AD590 and generates approximately 1 mV/°K (= 273.2 mV at 0°C, 373.2 mV at 100°C). This voltage is fed to the IN HI terminal. Bandgap reference IC2 generates a temperature-stable 1.2 V via R2 and this voltage is divided down via R3-RV1-R4 to give a 'SET 0°C' offset voltage of 273.2 mV nominal at IN LO. The bandgap reference voltage is also divided down by R5-RV2-R6 to provide a 'SET 100°C' scaling voltage of 100 mV nominal at RFH. The circuit must be calibrated in the way already described for the Figures 24 and 25 circuits.

Digital capacitance meter basics

A DVM module can be made to read capacitance values by connecting the unknown capacitance to the module via a linear capacitance-to-voltage converter. The easiest way to make such a converter is to use the technique shown in Figure 27. Here, the unknown capacitor and a standard resistor are used as the timing elements in a precision monostable which produces an output pulse with a width, W, that is directly proportional to the C-R product. The monostable is triggered at a fixed frequency via a clock generator and the output of the monostable is converted to a mean dc value by a simple C-R integrator.

The mean dc value of the monostable output equals the peak pulse amplitude multiplied by W/P, where W and P are the width and the period of the pulse respectively. Thus, since R_x and P are fixed, the mean dc voltage out-

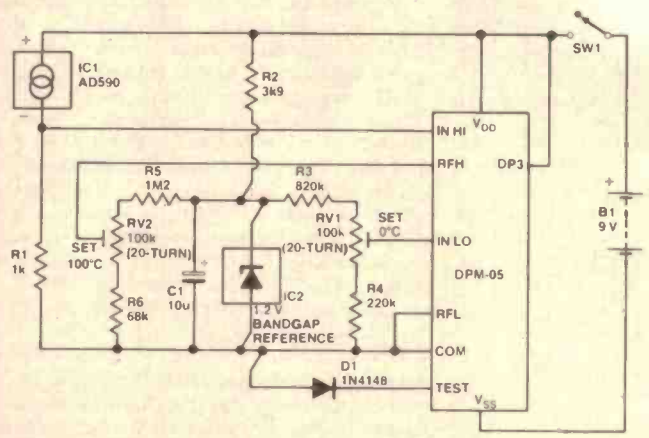


Figure 26. Digital thermometer based on the AD590 temperature-sensor IC.

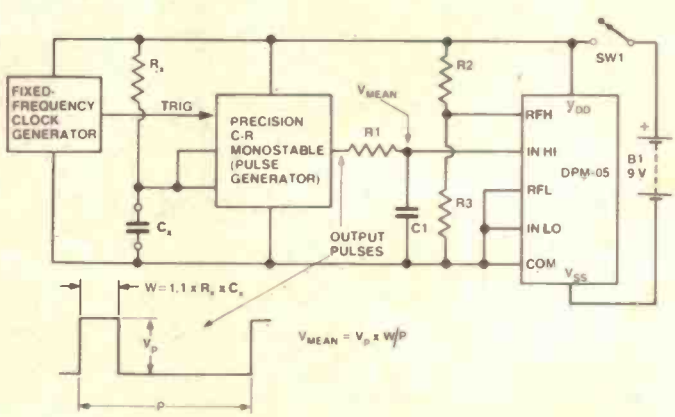
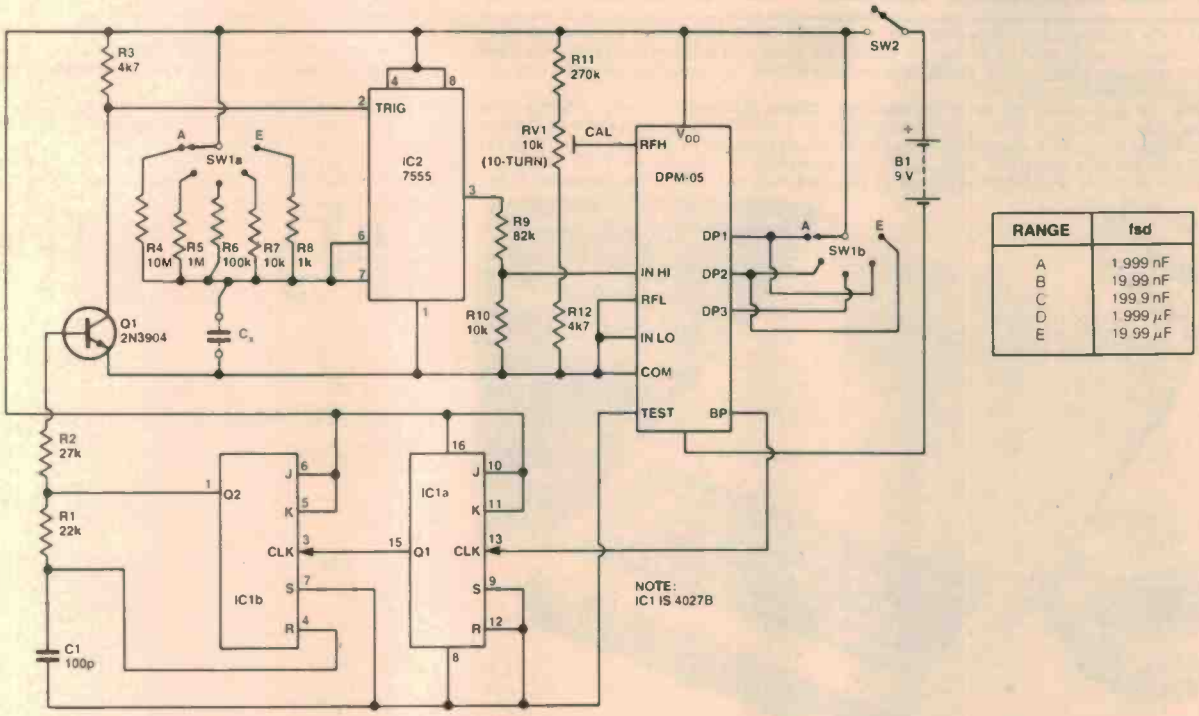


Figure 27. Basic operating principle and circuit of a digital capacitance meter.



RANGE	fsd
A	1.999 nF
B	19.99 nF
C	199.9 nF
D	1.999 µF
E	19.99 µF

Figure 28. Digital capacitance meter.

put is directly proportional to C_x and when this voltage is fed to the DVM module, the module acts as a digital capacitance meter.

In Figure 27, the reference (RFH) voltage of the module is derived from the mono's supply rail via potential divider R2-R3. Since the meter reads the *ratio* of the input and reference voltages, the calibration of the unit is independent of variations in supply rail voltage, but can be varied by altering the R2-R3 ratio. The circuit can be made to read different capacitance ranges by switching R_x in decade multiples.

Practical capacitance meters

The basic Figure 27 circuit is quite easy to implement and gives very accurate results. Figures 28 and 29 show two practical versions of the circuit. Both of these designs use a 7555 timer IC (a CMOS version of the 555 timer) as the precision monostable element, and use decade values (1k to 10M) of R_x for range selection.

The 7555 monostable generates a pulse with a width of 1.1 x C x R, giving a full-scale pulse width (at '1999' on the DVM module) of 22 ms with C and R values of 1999 pF and 10M, or 19.99 uF and 1k etc. To give the 7555 adequate recovery time between pulses, the clock period must be at least 50% longer than the maximum pulse width and must have a period of at least 33 ms.

The 7555 mono is triggered by pulling pin 2 of the IC low. If the pin is not returned high again by the time the output pulse ends naturally, the trigger pulse extends the output pulse artifically. The trigger pulse must thus be shorter than the minimum output pulse. In our application, the shortest pulse width that can be indicated by the DVM module is 22 ms/1000 = 11 us. So in the circuits of Figures 28 and 29 it is a design requirement that the 7555 must be triggered by negative-going pulses with widths less than 11 us and periods greater than 33 ms. In Figure 28 these requirements are met as follows.

In the DVM module, the TEST terminal is internally biased at about 5 V below V_{DD} and the BP (backplane) terminal switches between TEST and V_{DD} at about 50 Hz (= clock frequency divided by 800), giving a period of 20 ms. In Figure 28 IC1 is powered via the TEST terminal and the BP signal is divided-by-2 by flip-flop IC1a. The resulting 25 Hz (40 ms) signal is used to clock IC1b, which is configured as a monostable and generates positive-going output pulses with widths of 2 us via R1 and C1. These pulses are level-shifted and inverted via R2-Q1-R3 to produce negative-going 2 us trigger pulses with periods of 40 ms on the pin-2 TRIG terminal of IC2, the 7555 monostable generator.

The pulse width of the 7555 is controlled by C_x and precision range resistors R4 to R8. The 7555's output is attenuated by R9-R10 to give a mean value of about 100 mV at the midscale ('1000') setting of the DVM module. The resulting signal is fed to the module's IN HI terminal where it is integrated by the internal 10M — 10 nF filter. Divider R11-RV1-R12 feeds 100 mV nominal to the RFH terminal of the module and RV1 is used to adjust the precise calibration of the capacitance meter.

Accuracy of the Figure 28 meter is determined mainly by the precision of the R4 to R8 range resistors, which should be 1% or better hi-stab types. To calibrate the meter, simply connect a precision capacitor (say 100 nF) in place of C_x, switch to the appropriate range and adjust RV1 to give the appropriate meter reading. Calibration is then valid on all ranges.

The Figure 28 circuit has two minor defects. First, the clock signals of the 7555 are derived (via BP) from the clock signals of the DVM module. These signals are not highly frequency-stable and the calibration of the circuit may thus shift by up to 0.5% or so over the normal range of operating temperatures and supply voltages. If precise accuracy is needed, calibration should be checked before use.

The second snag is that the circuit reads *all* capacitance, including residuals, appearing between the C_x terminals. These residuals include stray capacitance and the internal capacitance of IC2 between pins 6/7 and 1, and typically total 32 pF. With no external capacitance connected, the meter thus gives a typical reading of '.032' on range A and '0.03' on range B. These residuals are too small to give readings on the remaining ranges of the meter, but must be subtracted from all readings obtained on ranges A and B.

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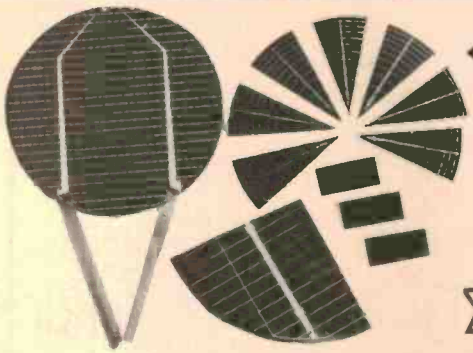

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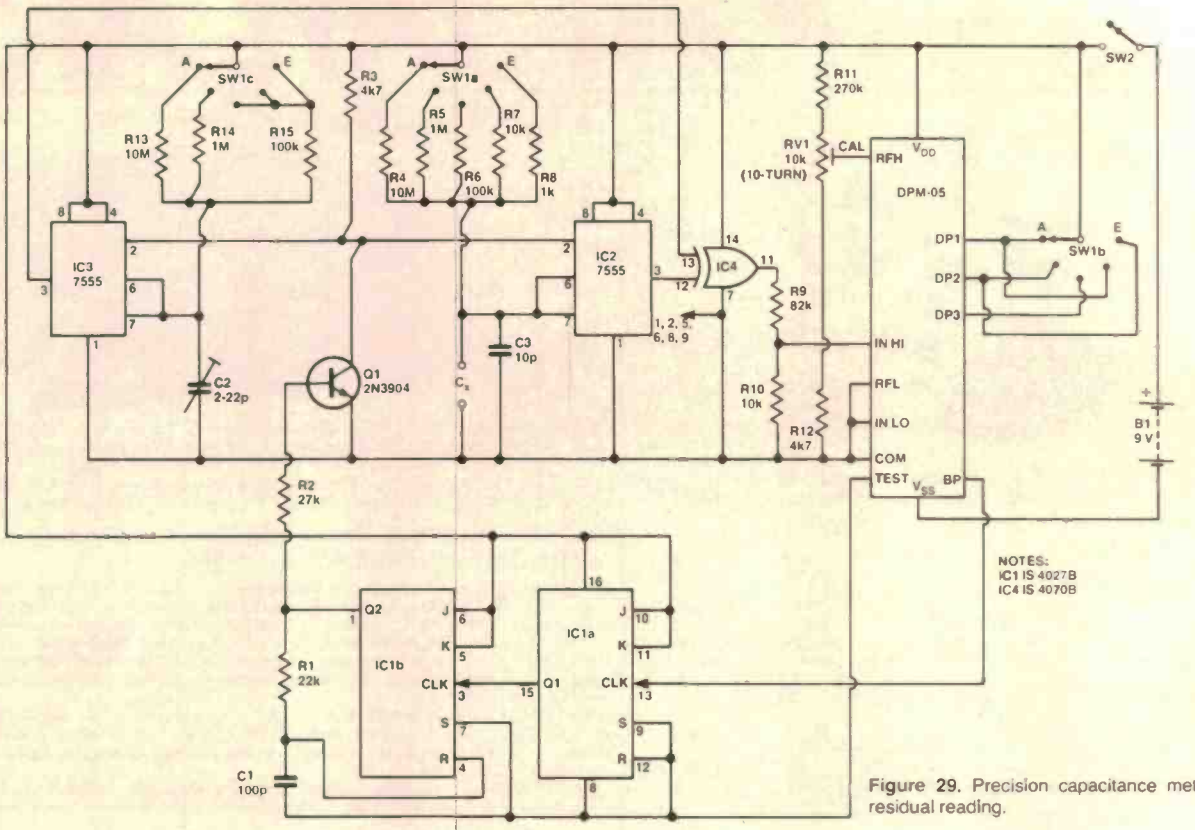


Figure 29. Precision capacitance meter with zero residual reading.

Figure 29 shows how the circuit can be modified so that residual capacitance is effectively cancelled and the meter gives a zero reading on all ranges when no external capacitance is connected to the C_x terminals. In this case the BP-derived signal is used to synchronously trigger *two* 7555 monostables. Their outputs are EX-ORed via IC4 to give a pulse with a width equal to the *difference* between the pulse widths (and thus the residual capacitances) of the two monostables. This pulse is fed to the IN HI terminal of the DVM module via R9-R10. Thus, if the monostables have identical residuals, the EX-OR pulse width is zero and the meter gives a zero reading with zero external C_x applied.

In Figure 29 monostable IC2 is connected to the C_x terminals and functions in the same way as in Figure 28, except that an additional 10 pF is permanently wired across the terminals. The IC3 monostable, however, has C2 wired across its input terminals and the value of C2 can be adjusted to equal (and thus cancel) the residual of the input of IC2. IC3 is range-switched in parallel with IC2 via SW1c. Precise ganging is provided on ranges A, B and C only and on all other ranges the residuals are too small to influence the meter readings.

Frequency measurement

A DVM module can be made to read frequency by connecting the unknown frequency to the module's input via a f-to-V converter. A suitable converter can easily be made by using a 7555 monostable; Figure 30 illustrates the principle. The input signal is first fed to an input conditioner and trigger-pulse generator which triggers a fixed-period 7555 monostable on the arrival of each new input cycle. The output pulses of the mono are converted to mean dc values by integrator R2-C2 and fed to the input of the DVM module which is scaled via R3-R4.

The mean dc value of the 7555 output pulses equals V_p (the peak amplitude of the pulses) multiplied by W/P, where W and P are the width and period of the pulses respectively. V_p and W are, however, fixed. Only the pulse period is variable and this is inversely proportional to the input frequency, f, so the mean output voltage is equal to $V_p \times W \times f$ and is thus directly proportional to f. Therefore, when the DVM module is suitably scaled via R3-R4 it gives a direct reading of input frequency.

In practice, the lowest convenient full scale frequency range of a DVM-based 3½-digit frequency meter is 1.999 kHz. In this case, the 7555 pulse has a period of 500 us at full scale. For maximum accuracy the pulse width must be as large as possible but must not be greater than two thirds of P. A pulse width of about 300 us is necessary and this can be obtained from the 7555 by choosing values for R1 and C1 of 27k and 10 nF respectively.

Figure 31 shows how the basic Figure 30 circuit can be modified to act as a multi-range frequency meter. In this case the input signal is fed to an input conditioner and Schmitt trigger and the Schmitt output is used to ripple-clock four decade dividers. The 7555 300 us monostable is provided with a trigger generator than can be fed from the output of the Schmitt or from any of the dividers. Thus, when the 7555 is triggered directly from the Schmitt the meter reads 1.999 kHz full scale and when fed from the

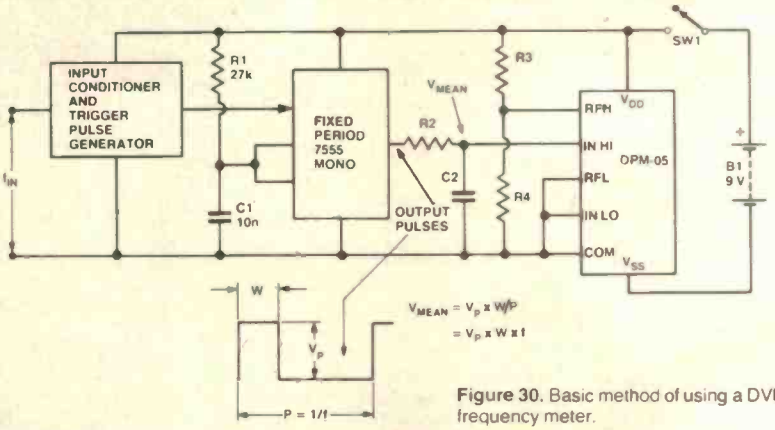


Figure 30. Basic method of using a DVM module as a frequency meter.

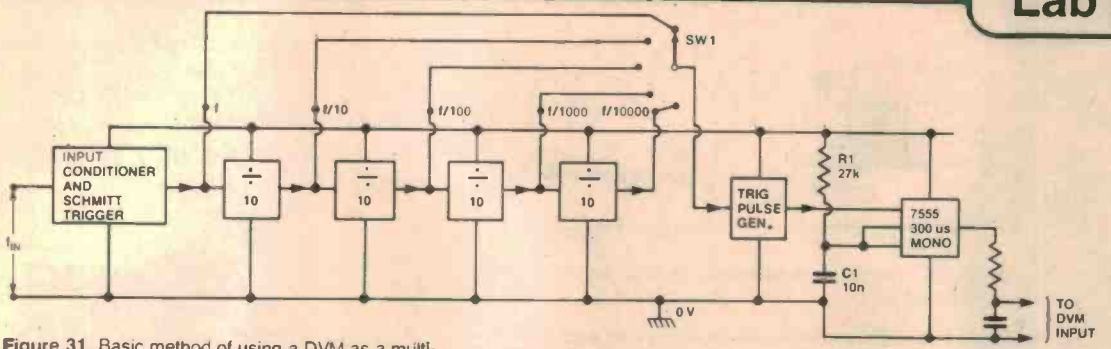


Figure 31. Basic method of using a DVM as a multi-range frequency meter.

output of the last divider stage reads 19.99 MHz full scale.

Practical frequency meters

The 7555 IC can operate from supplies as low as 2 V. Standard CMOS counter ICs, however, need supplies of at least 3 V. Consequently, if a DVM module is to be used as a frequency meter sharing supplies that are common with those of the CMOS divider stages, the DVM module must be used in the 'split-supply' mode with its COM terminal pulled below the normal 'V_{DD} — 2V8' value by external circuitry.

In other words, COM must operate at '0 volts' and V_{DD} and V_{SS} at nominal values of +4V5 and −4V5 respectively. Figure 12 in Part 1 showed how these supplies can be obtained if the module is built into existing equipment that has split supplies. Alternatively, Figure 32a shows how the supplies can be obtained from a stack of six 1V5 cells. Figure 32b shows how the supplies can be obtained from a single 9 V battery via an op-amp supply-splitter. The supply-splitter of Figure 32b adds a quiescent current consumption of about 2 mA to the DVM circuit, but can supply additional supply currents of tens of milliamps to circuitry connected between +4V5 and 0 V.

Figure 33 shows the practical circuit of a DVM-based digital frequency meter that reads up to 19.99 MHz full scale in five

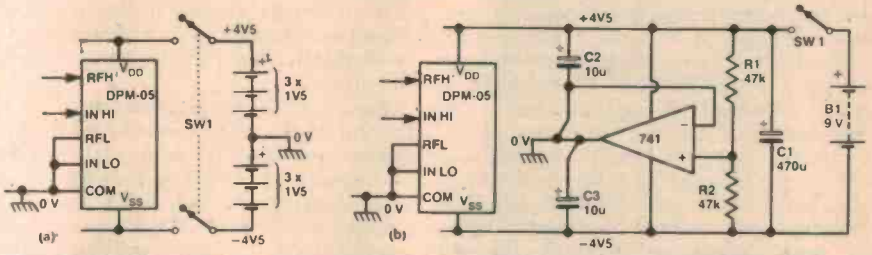


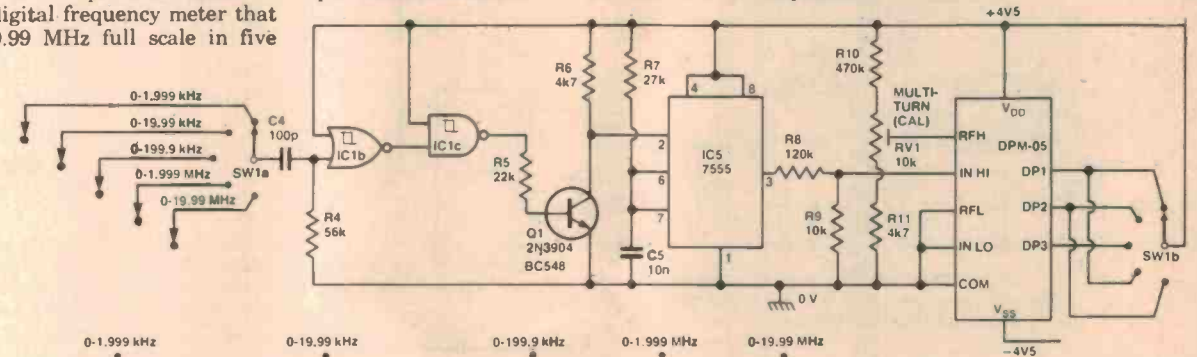
Figure 32. A DVM frequency meter needs split supplies. These can be obtained from either a stack of 1V5 cells (a), or from a single 9 V battery and an op-amp supply-splitter (b).

decade ranges. When used with the Figure 32b power supply, the circuit consumes about 3 mA quiescent from the 9 V battery, rising to 4 mA at 1 MHz, and (when calibrated) has a reading accuracy of +/− one digit. The circuit accepts input signals in the range 200 mV to 5 V RMS and operates as follows.

Input signals are fed, via C1-R1, directly to the input of IC1a, a very fast Schmitt trigger, which is biased as half-supply volts via R2-R3. The Schmitt output is used to ripple-clock four decade-divider stages. Ordinary CMOS dividers typically operate at maximum speeds of only 800 kHz or so when powered from 4V5 supplies. To give the required fast operating speeds the very latest 'HC' types of silicon-gate CMOS counters are used in the first two (IC2 and IC3) counter positions. On the prototype unit they clock at frequencies up to about 18 MHz.

The output of the IC1a Schmitt and of the four divider stages are fed to range-selector switch SW1a. The output of SW1a is fed to 4 us trigger-pulse generator C4-R4-IC1b-IC1c which triggers the 7555 monostable via Q1. The output of the 7555 is fed to IN HI of the module via R8-R9, and a calibration 'reference' voltage is fed to RFH via RV1. The circuit is calibrated by feeding in a signal of known frequency, switching to the approriate range and trimming RV1 for the appropriate reading on the DVM module.

Once RV1 has been initially calibrated, calibration is influenced only by variations in the pulse width of the 7555 and these may be caused by thermal variations in the values of R7 and C5. For optimum calibration stability R7 should be a metal-glaze resistor and C5 should be a polycarbonate capacitor. ▶



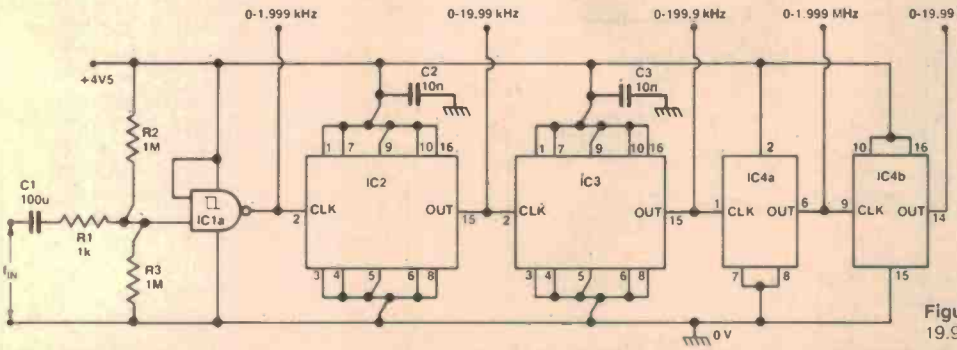


Figure 33. Digital frequency meter reading 0 to 19.99 MHz in five decade ranges.

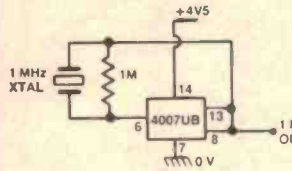


Figure 34. This 1 MHz crystal calibration oscillator can easily be added to Figure 33 circuit.

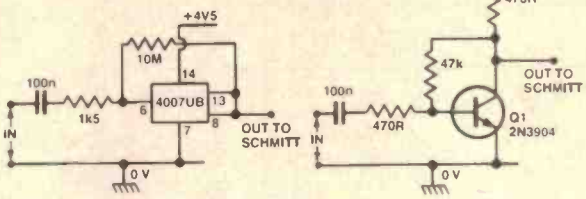


Figure 35. Two simple preamplifiers that can be used with the frequency meter.

The Figure 33 circuit can be modified in a variety of ways to satisfy individual requirements. Figure 34 shows a 1 MHz crystal calibration oscillator, designed around one section of a 4007UB CMOS IC, which can be easily added to the frequency meter and consumes a mere 300 uA when active. Figure 35 shows two simple preamplifiers which can be used to improve the basic sensitivity of the meter. The Figure 35a design, based on one section of a 4007UB, has an input impedance of about 1M and improves sensitivity by about 20 dB (to 20 mV RMS) at audio frequencies, but is useful to only a few hundred kHz. The simple Figure 35b design also gives a gain of about 20 dB at low frequencies, but has a low input impedance (about 2k2) and is useful to several MHz. Both circuits consume a couple of milliamps.

Figure 36 shows, in basic form, how the DVM module can be used to read both frequency and ac volts (or any other desired parameter). With SW1 switched to 'f', the input is switched to the input of the f-meter circuit and IN HI and RFH of the module are switched to the outputs of the circuit. When SW1 is switched to 'Vac', the input is switched to the input of the frequency-compensated attenuator, which has its output fed to IN HI via SW2 and a precision ac/dc converter (see Figure 19 in Part 1). RFH is switched to a 100 mV standard voltage derived from a bandgap reference.

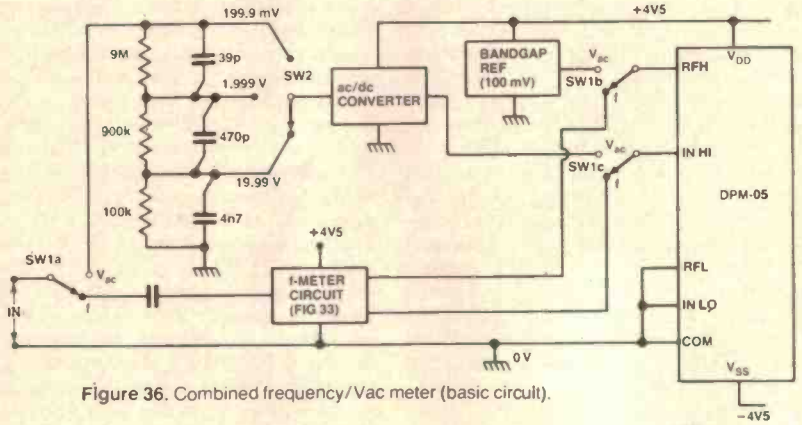


Figure 36. Combined frequency/Vac meter (basic circuit).

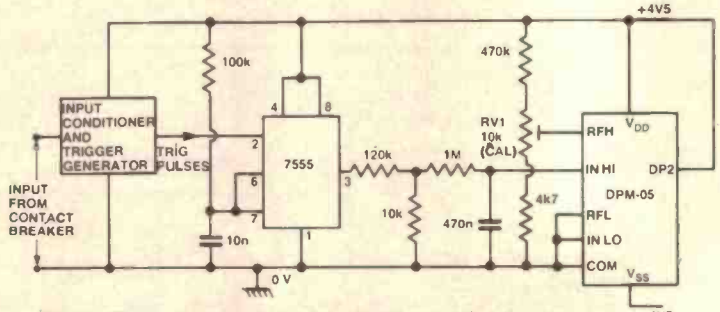
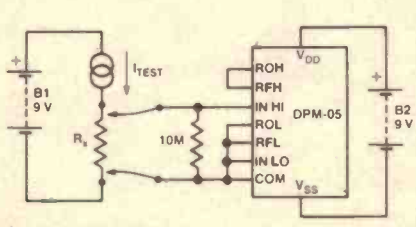


Figure 37. Basic rpm meter reading 19 990 rpm full-scale from a four-cylinder four-stroke petrol engine.



I_{test}	R_x fsd
1 mA	199.9 Ω
10 mA	19.99 Ω
100 mA	1.999 Ω

Figure 38. Basic milli-ohmmeter using four-terminal measurement technique.

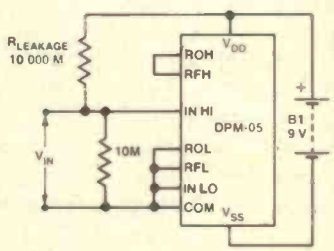


Figure 39. In this 199.9 mV dc voltmeter circuit, pc board or module leakage resistance causes the meter to indicate 28.0 mV with no external input applied.

Miscellaneous applications

DVM modules can be used to indicate the value of any parameter than can be converted into a predictable (linear or log) voltage, current or resistance. Linear transducers are readily available for measuring values of pH, light intensity, and radiation etc.

Cyclic parameters such as rpm and heartbeat rate etc, can be measured by adapting the frequency meter technique already described. The rpm of a petrol engine, for example, is directly proportional to contact-breaker (CB) frequency, f. On a four-stroke engine, f = N x rpm/120, where N is the number of cylinders. Thus, on a single-cylinder engine 10 000 rpm gives a CB frequency of 83.3 Hz, and on a four-cylinder engine a frequency of 333.3 Hz. Figure 37 shows the basic circuit of a digital rpm meter designed to read 19 990 rpm full scale (10 000 rpm at mid scale) on a four-cylinder four-stroke engine. The 7555 monostable gives an output pulse width of about 1 ms.

When measuring low values of resistance care must be taken in circuit design to ensure that the resistive effects of range switches, fuses and terminals etc, are excluded from the measurement results. The only way of achieving this is to use the four-terminal measurement technique shown in Figure 38, in which two independent circuits are used. Here, the unknown resistor is connected between the R terminals and fed with a constant current from B1. The volt drop *directly across* R_x is measured via a 199.9 mV full scale dc voltmeter powered from B2. Thus, when 10 mA is passed through R_x, the voltmeter indicates 19.99 ohms at full scale.

Constructional notes

When using DVM modules two vital usage points must be noted. The first of these arises from the high sensitivity of the module and is illustrated in Figure 39, where the module is wired as a 199.9 mV full scale dc voltmeter with a 10M input resistance. Thus, if a leakage resistance of 10 000 megohms appears between V_{DD} and IN HI, the meter will read 28.0 mV with no external input applied. Leakage resistances of this magnitude (and lower) can be caused by minute amounts of moisture or dirt appearing between the terminals of the module or the tracks of a pc board to which it is connected. To eliminate the possibility of this effect, the entire module and pc board must be cleaned and dried after project construction is complete. Then both must be thoroughly coated with insulation varnish. Humbrol clear varnish No 35 (available from model and art shops) is excellent for this purpose.

The final usage point concerns external components. General-purpose resistors and capacitors have very poor thermal stability. Consequently, in all practical DVM-based designs great care must be taken to ensure that all critical resistors are metal-glaze or similar hi-stab types, and all critical capacitors are polycarbonate types. ●

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amateur radio, DX, communications

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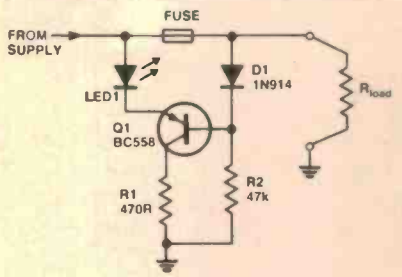
These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we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



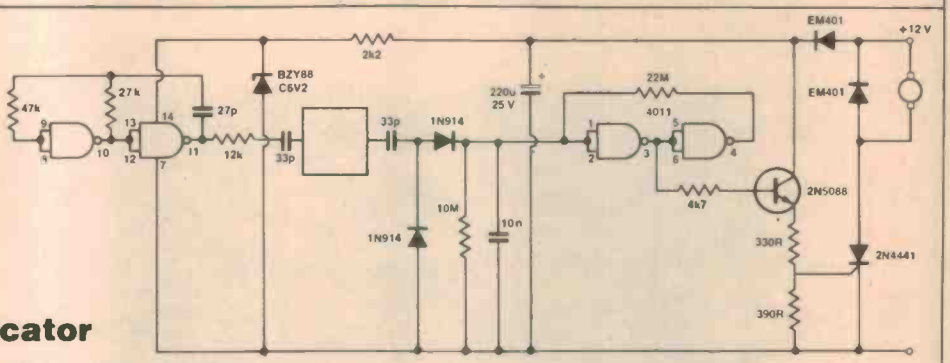
Blown fuse indicator

John Beaver, Concord NSW.

Fuses are probably the handiest tool in electronics in that for an outlay of cents they can save hundreds of dollars worth of equipment. When a fuse blows it is usually obvious as the equipment it supplies stops working, sometimes however this is not always the case. If the fuse supplies, for example, power to brake lights in a vehicle or even long delay timer circuits it may not be noticed for days. This circuit will give immediate indication of a blown fuse whether there is a load on the circuit or not as long as there is power.

On a nominal 12 volt supply there is about a 1.7 volt drop across the LED leaving a potential of about 10.3 V on the emitter of Q1. With the fuse intact there is a potential at the base (via fuse and D1) of about 11 V which holds Q1 off. If, however, the fuse blows, power is removed from the anode of D1 therefore allowing current to flow from the base of Q1 through R2 turning on the LED.

The advantage of this circuit is that in the standby mode it draws only 255 microamps, which makes it particularly useful in battery operated circuits. It may be adapted for different voltages by simply changing the values of R1 and R2 using the following formula: R1 = (Vs-2)*100/2, R2 = (Vs-2)*10000/2. (A flashing LED, which is more of an attention-getter, could be used for LED1.)



Touch motor control

L.W. Brown of Burwood Vic. designed this circuit of a touch switch suitable for operating 12 Vdc motors. He says that an excellent use for it would be to mount the touch switch on a shop window, allowing the movement of a display via a car electric fan motor.

An oscillator drives a touch plate stuck to the inside of a glass window. Anything capacitively grounding the 50 mm diameter touch plate causes the Schmitt trigger to turn on the SCR. The 10n capacitor provides several seconds extra operation once the touch plate has been released. As the SCR will latch on with a dc supply, an unregulated, unfiltered supply should be used. A suitable supply would be the A&R Chargette which is double insulated and very safe.

For intermittent operation no heatsink is required and because of this the entire circuit will be smaller than the touch plate. The small size allows the whole switch to be mounted in a sealed plastic box for protection from environmental humidity. The double insulated power supply could enable the system to operate in hazardous locations.

Avoid flat batteries

B.P. of Putney NSW has obviously forgotten to switch his car lights off on a dark winter's morning and come back, after a day's work, to find that the battery is flat.

This device has been on my car for several years now and I've found that it is extremely useful. Despite the many complicated circuits published, all that is needed is a solid state buzzer, a resistor and a couple of diodes.

The only problem is that if you really want to park the car and leave the lights on for a short time, you have to put up with the buzzer.

When the ignition is switched on both sides of the buzzer are held at a nominal 12 V, so there is no sound. The moment the car is stopped and the ignition switched off, current can flow from the lighting circuits through the buzzer and the resistor to earth. It is a very penetrating sound, so there is no way you will leave the lights on!

The connections are made to the passive side of each switch. For a positive earth system, just reverse all the diodes and the buzzer. Make this up on a small strip of bakelite or insulating material and attach it to the glove box under the dash. It will outlast the car.

There are two possibilities to overcome this problem.

1. Insert a switch between the resistor and earth, but don't forget to turn it back on later.
2. Add a relay and a push button switch (on the dash board), as in Figure 2, and you can override the system. After you have switched off the lights the relay will drop out, leaving the device reset for further protection.

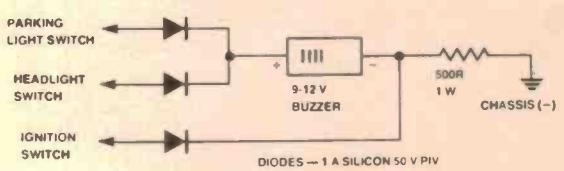


Figure 1. A buzzer warns you that you have left the lights on.

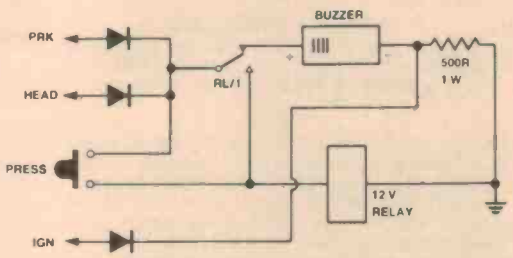


Figure 2. Over-riding the system.

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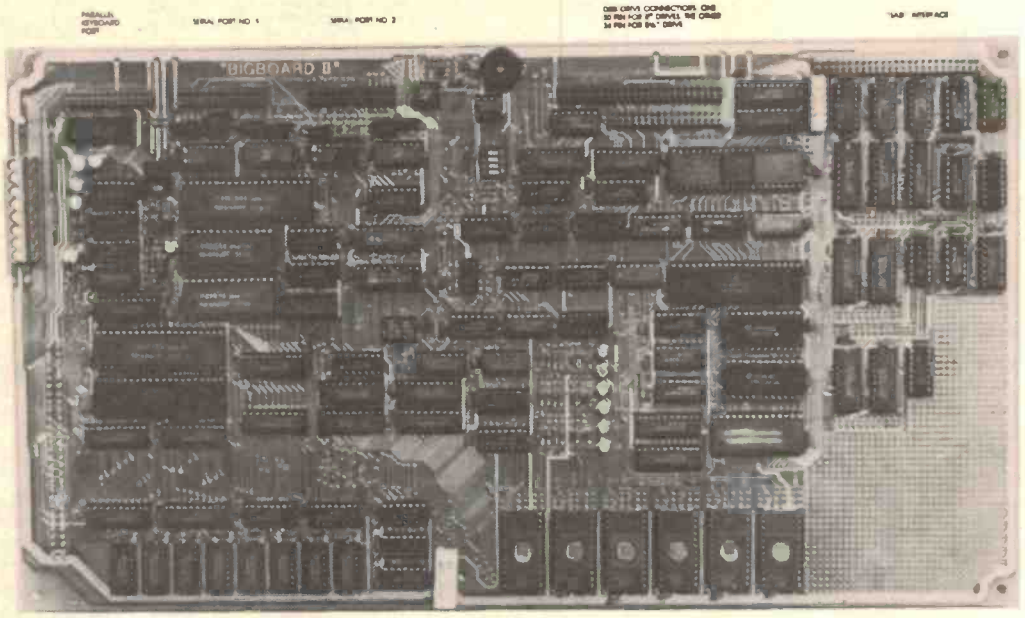
"BIG BOARD II"



STD Bus Connector

EPROMs shown only for clarity.

Prototyping Area

Jim Ferguson, the designer of the "Big Board" distributed by Digital Research: Computers, has produced a stunning new computer that we will begin shipping in November called "Big Board II", it has the following features:

4 MHz Z80 — CPU AND PERIPHERAL CHIPS

The Ferguson computer runs at 4 MHz. Its monitor code is lean, uses Mode 2 interrupts, and makes good use of the Z80-A DMA chip.

64K DYNAMIC RAM + 4K STATIC CRT RAM + 24K E(E)PROM OR STATIC RAM

"Big Board II" has the three memory banks. The first memory bank has eight 4164 RAMs that provide 60K of user space and 4K of monitor space. The second memory bank has two 2Kx8 SRAMs for the memory-mapped CRT display and space for six 2732 As, 2Kx8 staticRAMS, or pin-compatible E(E)PROMs. The third memory bank is for RAM or ROM added to the board via the STD bus. Whether bought as a bare board, a full kit, or assembled and tested, it comes with a 350 nS2732 EPROM containing the monitor.

MULIPLE-DENSITY CONTROLLER FOR SS/DS FLOPPY DISKS

The new Ferguson single-board computer has a multiple-density disk controller. It can use 1793, 1797, or 8877 controller chips since it generated the signal with TTL parts. The board has two connectors for disk signal with 34 pins for 5.25" drivers, the other with 50 pins 8" drives.

VASTLY IMPROVED CRT DISPLAY

The new Ferguson SBC uses a 6845 CRT controller and 8002 Video Attributed controller to produce a display that will rival the display of quality terminals. Characters are formed by a 5x7 dot matrix on 15.75 KHz monitors and 7x9 dot matrix on 18.60 KHz monitors. The display is user programmable with the default display 24 lines of 80 characters. 8002a chip supplied for 18 to 60 kHz monitors.

STD BUS CONNECTOR

The Ferguson computer brings its bus signals to a convenient place on the PC board where users can solder an DSTD, bus cards can be plugged directly into it, and it can as well be connected by bus cable to industry-standard card cages.

DMA

The new Ferguson computer has a Z80-A DMA chip that will allow byte-wise data transfers at 500K bytes per second and bit serial transfers via the Z80-A S10 at 880K bytes per second with serial processor overhead, though the monitor for the new computer uses the DMA chip mainly for transferring data to and from disk, the chip can readily be used for other things since its "wait/ready" pin can be connected under software control to some half a dozen signal lines. When a hard-disk subsystem is connected to the "Big Board II" via its "SASI" interface, the DMA chip makes breathtaking disk performance possible.

"SASI" INTERFACE FOR WINCHESTER DISKS

The "Big Board II" implements the Host portion of the "Shugart Associates Systems Interface". Adding a Winchester disk drive is no harder than attaching a floppy-disk drive. A user simply 1: Runs a 50-conductor ribbon cable from a header on the board to any of several inexpensive controller cards for Winchester drives that implement the controller portion of the SASI interface. 2: Cables the controller to an appropriate drive, and 3: Provides power for the controller-card and drive. Since our CBIOS contains code for communication with hard-disk, that's all a user has to do to add a Winchester to a system!

A Z80-A S10/0 = TWO ASYNCHRONOUS/SYNCHRONOUS SERIAL PORTS
A PARALLEL KEYBOARD PORT = FOUR OTHER PARALLEL PORTS USER 1/0

The new Ferguson single-board computer has one parallel port for an ASCII keyboard and four others for user-defined 1/0. When the computer is powered up or reset, the monitor looks for a carriage-return at the keyuboard and serial ports. If the first carriage-return the monitor gets comes from the parallel keyboard, the monitor uses the board's video display circuitry to communicate with the user via a CRT. If the first carriage return is typed at an ASCII terminal attached to a serial port, the monitor autabauds and makes the terminal the system console.

TWO Z80-A CTCs = EIGHT PROGRAMMABLE COUNTERS/TIMERS

The new Ferguson computer has two Z80-A CTCs. One is used to clock data into and out of the Z80-A S10/0, while the other is for systems and application use.

PROM PROGRAMMING CIRCUITRY AND SOFTWARE

The new Ferguson SBC has circuitry and drivers for programming 2716s, 2732(A)s, or pin-compatible (E)EPROMs. Software $25 extra.

CP/M

CP/M with Russell Smith's CBIOS for the new Ferguson computer is available for $220.
The CBIOS is available separately for $65
Actual board size: 39.6cm x 22.2cm. 5 inch BIOS being developed. Approx price $95

Pricing and Availability:

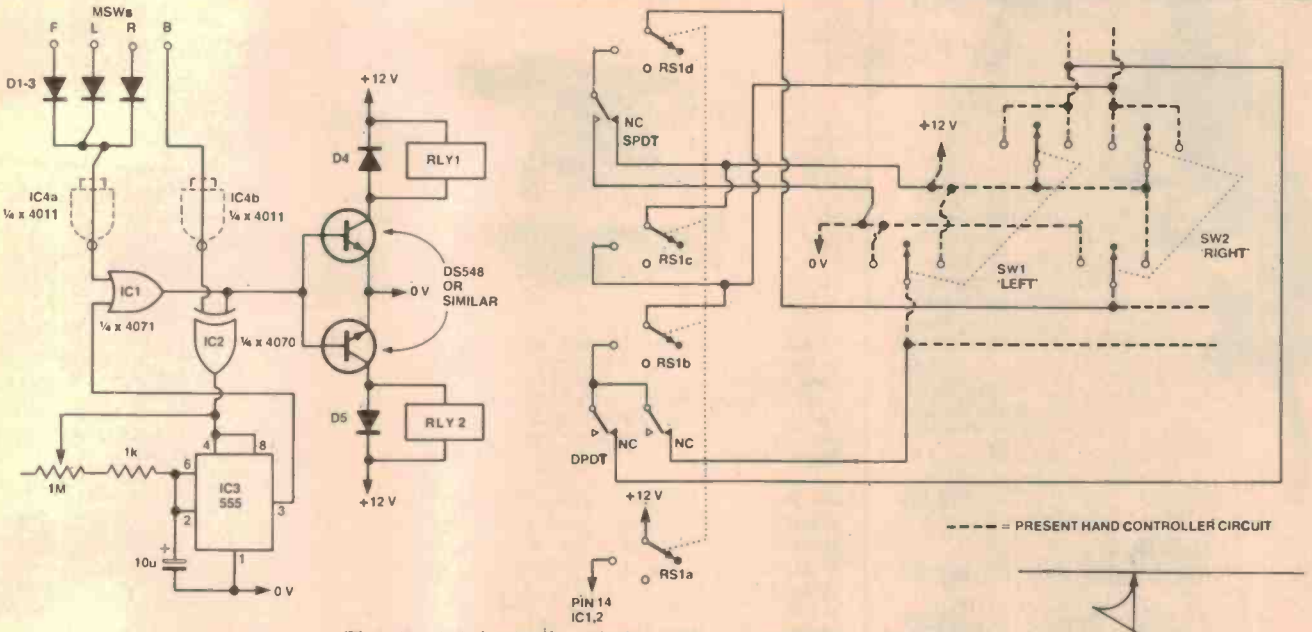
Availability: 2 weeks delivery.

In single quantities, full kits cost $775.00 + tax, and A&T'd computers cost $895. There are attractive discounts that range to 35% for OEM's and dealers. For details about them please call Rod Irving on (03) 489 7099. Ie: 3 Ferguson IL "Big Board" are less 20% off the one-off price, hard disks disk controllers, boxes and power supply to suit both 8" & 5¼" systems will be available.

Bare board with main chips now available (includes PCB, Manual, PALS, Monitor ROM, SMC chips). You have to add rest of components at $495 + tax

Errors and omissions excepted.

IDEA OF THE MONTH



Self discipline for the Turtle robot ☆

Mark Harwood, Dural NSW
Age: 14 years

The circuit was designed to 'fit in' with the Turtle robot hand controller. As the title suggests, when the robot runs into something it will 'discipline' itself by reversing at an angle, then going forward again.

If the Turtle backs into an object while reversing, it will immediately go forward.

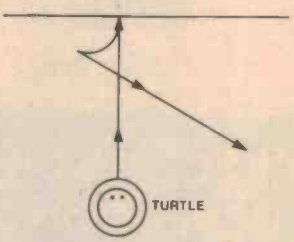
The circuit is basically a timer which reverses the right stepper motor and is triggered by microswitches around the Turtle.

D1-3 are simply to stop shorting between the LEDs already on the hand controller. IC4 is optional. The circuit is designed to work on a 'high' at the 25-pin connector when a microswitch is bumped. However, if the opposite is the case, D1-3 can be reversed and IC4a and b can be included.

If no microswitches have been bumped the output of IC1 is low and both motors are in forward gear.

However, if the left, right or front microswitch is bumped, the output of IC1 will go high, making the output of IC2 high also. This triggers the timing circuit which latches IC1 with its output. This supplies the relay driver transistors, activating both relays.

The relay contacts are merely bypassing present switches on the hand controller (see diagram). Relay 1 normally holds the right stepper motor forward. When it is activated it puts the motor into reverse. Relay 2 normally holds the left stepper motor in forward. When it is activated it stops the motor completely.



If the Turtle should back into an object the output of IC2 will go low, resetting the timer and the Turtle will go forward immediately.

RS1 is an off/on switch for the whole circuit.

The time for which the Turtle reverses is set by the 1M potentiometer in the timing circuit.

'IDEA OF THE MONTH' CONTEST

NEW PRIZE! WORTH $90!

COUPON

Cut out and send to: **Scope/ETI 'Idea of the Month' Contest, ETI Magazine, 140 Joynton Ave, Waterloo NSW 2017.**

"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 .....

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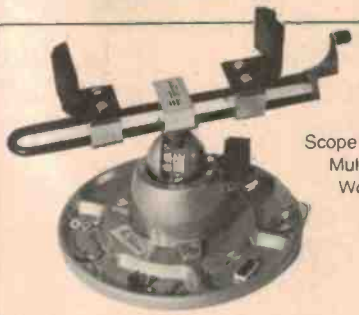
Name .....

Date .....

Address .....

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



Scope Panavise Multi-purpose Work Centre.

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 Multi-purpose Work Centre, Model 376/300/312, comprising a self-centering head (376), standard base (300) and tray base mount (312), all worth about $90! Selections will be made at the sole discretion of the editorial staff of ETI Magazine. Apart from the prize, 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, Federal Publishing Company Proprietry Limited, ESN, The Litho Centre 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.

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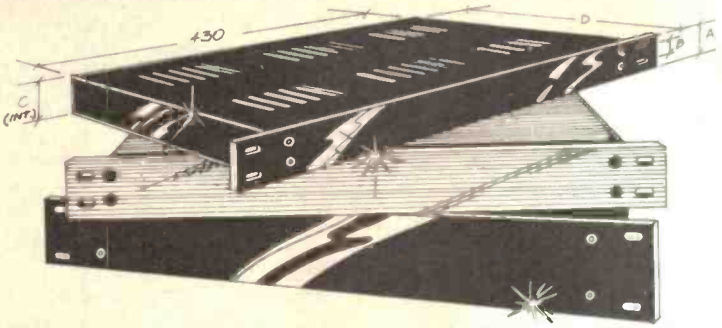

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D = 254mm C (Internal Chassis Height)
B (Mounting Bolt Centres)

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H 0402	Natural	88	57	82	49.95	47.50
H 0403	Natural	132	89	126	55.00	49.95
H 0411	Black	44	34	38	42.50	39.95
H 0412	Black	88	57	82	49.95	47.50
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TO3 Trade Pack

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H 1582 .....$12.50

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TO220 Trade Pack

100 mica washers + 100 bushes

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With 3mm Mounting Hole

Standard

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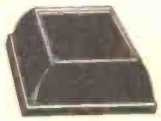

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H 0917	16mm	8	.95
H 0916	16mm	100	8.00
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1/8th inch WHITWORTH

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H 1009	25mm	25	.95
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H 1022	Hex Nut	500	5.95
H 1030	S/Proof Washer	50	.95
H 1032	S/Proof Washer	500	6.95
H 1040	Flat Washer	50	.95
H 1042	Flat Washer	500	6.95

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H 1070	Nut Hex 4BA	25	1.00
H 1072	Nut Hex 4BA	500	12.50
H 1080	Nut Hex 6BA	25	1.00
H 1082	Nut Hex 6BA	500	12.50
H 1090	4BA S/Proof Washer	50	.95
H 1092	4BA S/Proof Washer	500	5.95
H 1095	4BA Flat Washer	50	.95
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H 1362	9mm		8	.95
H 1365	9mm		100	9.50
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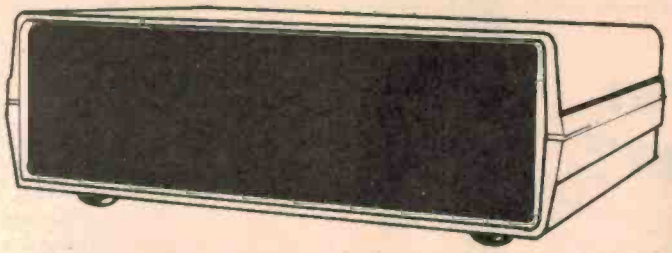
H 1373	12mm		100	11.00
H 1375	25mm		4	.95
H 1376	25mm		100	15.00

TAPPED 4 BA

Cat.	Length		Pack Qty.	Price
H 1379	9mm		8	$1.00
H 1380	9mm		100	9.50
H 1383	12mm		8	1.20
H 1384	12mm		100	12.50
H 1387	25mm		4	1.00
H 1388	25mm		100	17.50

NEW

DELUXE ABS INSTRUMENT CASE



Case color light grey front-rear panels black.

Our superb new instrument case will give your projects the professional appearance they deserve.

* Internal mounting posts enable a wide combination of PCB's, Transformers, etc. to be accommodated (screws supplied).
* PCB guide rails provided internally allow vertical PCB positioning to several locations.
* Removable front and rear panels. Attractive textured finish one side and plain the reverse side. (Enables direct engraving, silk screen printing etc. to plain side.)
* Great for test instruments and other high grade projects.

Overall Size: 200W x 160D x 70mmH

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OEM'S – Manufacturers – Bulk Users: Your product will look like it's straight out of "Hewlett Packard's" factory with this brilliant low cost case. Contact our Wholesale Department for Bulk Prices.

HIGH RESOLUTION MONITOR

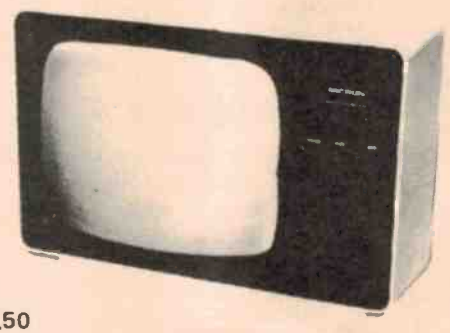
NOW WITH SCREEN INVERT FUNCTION AT NO EXTRA COST

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

NO MORE HEADACHES AND BLURRED VISION

MICRON 12

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



Guaranteed by ALTRONICS!
Incredible Value.

D 1112 **$199.50**

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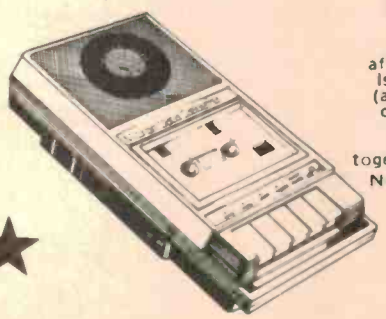

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Please note that resellers may not have all the items advertised in stock, and as resellers have to bear the cost of freight, prices may be slightly higher than advertised. ALTRONICS reseller prices should however represent a considerable saving over our competitors' prices.

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Take advantage of "off peak" low STD phone rates and phone your order to our new recorded 24 hour order service. Give your name, address with postcode, phone number, bankcard number and expiry date then your order—and presto your order will be processed and back to you in a flash—Please nominate Jetservice if you want overnight delivery.

$2.50 DELIVERY AUSTRALIA WIDE We process your order the day received and despatch via Australia Post. Allow approx. 7 days from day you post order to when you receive goods. Weight limited 10kgs.

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BANKCARD HOLDERS CAN PHONE ORDER UP TO 8PM (EST) FOR NEXT DAY DELIVERY – SOUNDS INCREDIBLE DOESN'T IT? Alright you cynics just try us! Weight limit 3.3kgs. Jetservice cannot deliver to P.O. box numbers (Australia Post would have a fit).

$10.00 HEAVY HEAVY SERVICE – AUSTRALIA-WIDE All orders over 10kgs must travel on the heavy service, that is — road express. Delivery time 7 days average.

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Pocket transceiver is world's smallest?

The Transair TW-260 is a tiny VHF pocket or handheld FM transceiver that the makers claim is the smallest in the world.

Measuring just 120 mm high by 62 mm wide by 36 mm deep, the TW-260 weighs just 340 grams, including the rechargeable batteries!

The TW-260 can operate on up to six channels in any 3 MHz segment between 134 MHz and 174 MHz. The transmitter delivers 2 W and rated deviation is +/− 5 kHz.

The double conversion receiver has a sensitivity of 0.3 uV for 12 dB SINAD, 0.5 uV for 20 dB of quieting. Audio output is given as 300 mW for less than 10% distortion at 1 kHz.

The unit is DOC approved. It operates from a rechargeable 7.2 V/450 mAh nickel cadmium battery which has a rated life of eight hours at 5% transmit, 5% receive, 90% standby.

An external microphone/speaker socket is provided so that the transceiver may be mounted on your belt and an optional remote handheld mic/speaker unit attached.

Two charger units are available to suit the TW-260; a plugpack unit and a desktop model. With the latter, the transceiver simply slips into a cradle and two contacts on the bottom provide connection to the battery.

Two cases are available for the transceiver; a soft vinyl one for ordinary use and a tough, heavy duty synthetic leather one. Although the TW-260 is provided with a flexible whip antenna, Benelec has several suitable models available in their range of antennas.

We've had the opportunity to evaluate a pair of these transceivers here at ETI and found them to be a remarkable product.

The TW-260 is an astounding size and very light weight. Nevertheless, it's performance is not at all compromised in comparison to other handheld transceivers on the market. All controls work smoothly with no 'surprises' and are easy to operate, despite the tiny 'control panel'.

Squelch operation is sensitive and clean — no annoying tendency to chatter or hang on. The audio on both transmit and receive is clear and clean. No overload breakup was detectable when operating a pair in close proximity. Well worth serious consideration if you're after a handheld VHF transceiver for any application.

Full details on specifications, pricing and availability are obtainable from **Benelec Pty Ltd, P.O. Box 21, Bondi Beach NSW 2026. (02)665-8211.**

PHASE 3-B OSCAR TO FLY THIS MONTH?

A trouble-free launch of the Arianne L-6 booster, carrying several payloads including the Phase 3-B OSCAR, is expected by the European Space Agency and AMSAT sometime between 20 and 27 May.

Following E.S.A. investigations into the L-5 booster failure, remedies have been taken to ensure, as far as possible, that a similar failure in the L-6 launch will not occur.

The last Phase 3-B bird was lost when the L-5 'terminated' a few minutes after lift-off.

If all goes well, Arianne L-6 will rise from the E.S.A. facility in Guianna to place the Phase 3-B satellite into an elliptical orbit that will provide almost hemispherical coverage for several hours per day beneath the apogee.

The main 3-B transponder uplink is around 435 MHz, downlink on two metres. Other transponders will be included. Keep your ears out for it.

US 6 m beacon

A 6 m band beacon has been put on the air from Aurora Colorado running 50 watts on 50.065 MHz, according to Westlink Report.

Operating under the new US regulations pertaining to beacon operations, the beacon was established by, and runs under the callsign of, W0IJR.

The antenna is a horizontally polarised double halo located 35 metres above ground. The beacon operates from 1300 Z to 0300 Z daily. If you're interested in transpacific TEP, look for the beacon when it's midday over the path mid-point and later (say, from 0900 EAST to when the beacon cuts out at 1300 EAST).

QSA reports should be sent to either **W0IJR or KA0CDN at their callbook addresses.**

Next Shuttle launch 'live' broadcast

Plans are afoot to provide a live amateur band broadcast of the next Shuttle launch communications.

The Jet Propulsion Lab's Amateur Radio Club trustee, Jay Holladay, W6EJJ, has been granted permission to broadcast the launch 'live' in conjunction with W5RRR at the Johnson Space Centre.

Exactly when the next Space Shuttle launch will take place was unclear at time of going to press. Dr. Owen Garriott may operate the first amateur station from space on this next flight.

For more information on the Shuttle Information Network, send a stamped-addressed envelope and 15 IRCs to the **JPL A.R.C., California Institute of Technology, 4800 Oak Grove Dr., Pasadena CA 91109 USA.**

Telescopic masts

A new series of pneumatic telescopic masts is now available in Australia designed for commercial, industrial and military purposes. The masts come in a variety of sizes up to 60 m.

Typical applications include ENG (electronic news gathering), emergency communications services, military communications and as vertical radiators etc.

When equipped with floodlights the portable and quickly erected SKI-HI masts provide instant illumination for emergency or temporary lighting, construction work etc.

The SKI-HI masts are available to be installed inside vehicles through the roof, outside of vehicles, on trailers and trucks. Some are designed for field installations.

The pneumatic seals between telescoping sections are designed to function from −50° C to +80° C, making them suitable for extreme environments.

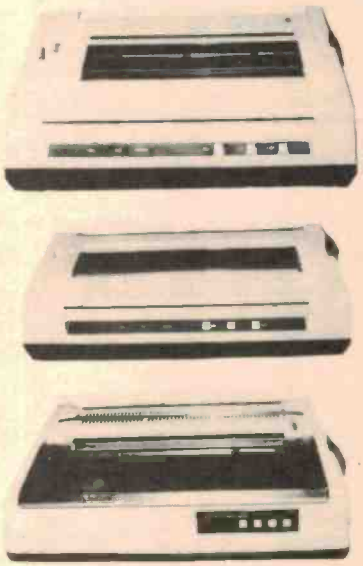
All masts are tested to raise at a speed of 30 cm per second. Wind ratings to over 30 km/hr are available.

Mast options include manual or electric rotation and sequential locking of sections as they are raised or lowered.

SKI-HI masts are manufactured in the USA by the TMD division of the Will-Burt Company. Australian agent is **Antenna Engineering Australia Pty Ltd, P.O. Box 191, Croydon Vic. 3136. (03)728-1777.**

C. Itoh PRINTERS

FROM ROD IRVING ELECTRONICS



Pro/Writer Printer 8510

Print Features: Number of columns—136 col. max. **Print Speed**—120 CPS. Print Direction—Single-directional and Bidirectional. Switch Selectable. Throughput Speed—From 44 to 152 ipm. Character spacing (max. number of columns per line)—Pica 10 CPI (80); Double Width 5 CPI (40). Compressed Font 17 CPI (136). Double Width 8.5 CPI (68). Elite 12 CPI (96). Double Width 6 CPI (48). Proportional Double Width Proportional. Line Spacing—Variable to 1/144". **Print Width**—203 mm (8") max.
Forms Type: Fan Fold Roll or Cut Sheet: Width—113 mm to 254 mm (4.5" to 10.0"). Total Thickness—0.05 to 0.28 mm (0.002" to 0.011"). Number of Copies—Original + 3 copies nominal.
Form Feed: Method—Tractor or Friction. Form Loading—Either rear or top.
Interface—Serial: Method—EIA RS232-C and 20mA (40 & 60mA switchable option) Current Loop Serial Interface. **Baud Rate (BPS)**—110, 300, 600, 1200, 2400, 4800, 9600. Transmitting Method—Half Duplex. Synchronization—Asynchronous.
Interface—Parallel: Method—TTL compatible, 7-bit, parallel interface. Control Signals—ACK, BUSY, SELECT, DATA STB, INPUT PRIME FAULT, INPUT BUSY, PAPER EMPTY. Instruction Codes—(ASCII): CR, LF, VT, FF, CAN, SO, SI, DEL, DC1, DC2, DC3, DC4, GS, RS, US, FS, EM; GRAPHIC SYMBOLS; BIT GRAPHICS.
Error Detection: (1) Parity (VRC)—Odd, Even, No-parity. Switch selectable. (2) Framing Error—Stop bit check. (3) Overrun Error—Error is detected when data are received before the previous data have been processed.
Physical dimensions: 398 mm W x 120 mm H x 285 mm D (15.7" W x 4.7" H x 11.2" D).
Weight: 8.8 kg (18 lbs., 12 oz.)

P* $975 ($845)
S** $1095 ($945)

Model 1550

The Model 1550 is a compact desk-top dot matrix serial impact printer used for data communication terminals, hardcopy of CRT displays, peripheral terminals for minicomputers and microcomputers, and small-sized business systems.
The character format is a dot matrix of 7(H) x 9(V), or 8(H) x 8(V).
Print speed is 120 characters/second. Up to 136 characters can be printed per line at 10 CPI.
Its main features are: ● Compact desk-top dot matrix printer ● 136-column print ● Light-weight ● Low power-consumption ● High-quality print ● Bit image graphics ● Graphic Symbols ● Prints in six different languages ● High reliability ● Low cost

P* $1295 ($1175)
S** $1395 ($1295)

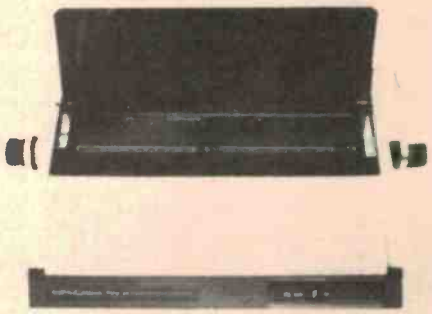
F-10 Printmaster Daisy Wheel Printer

Print Speed: 40 CPS. **Print Method:** Static Print Impact. **Number of Printable Columns:** 136, 163, Variable. **Character Spacing:** 1/120 Inch (minimum). **Line Spacing:** 1/48.
Return Time: 900 msec. **Line Feed Time** 40 msec. **Paper Width:** 406 mm (maximum).
Print Characters: 96. **Printwheel:** Industry Standard 96 Character Wheel. **Interface:** Industry Standard 8-bit Parallel, RS232-C Compatible, X-ON, X-OFF, 12-bit Qume and Diablo Compatible. **Dimensions:** 574 mm W x 405 mm d x 153.5 mm H (22.8" W x 15.9" D x 6" H). **Weight:** 14 kg (30.8 lbs.) with cover and power supply. **Noise:** Less than 65 Db (1M from Platen, A Scale).

P* $1950 ($1675)
S** $2100 ($1775)

* Parallel Interface ** Serial Interface

'THE PRINTER PEOPLE' SPECIALS AND BARGAINS



SMITH-CORONA DAISY WHEEL PRINTER

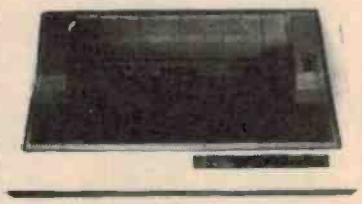
SPECIFICATIONS
Printing technique — Daisy printwheel, fully formed character
Print speed — 12 CPS
Character set — 128 ASCII, 88 printable
Character spacing (Pitch) — 10 CPI or 12 CPI
Printing — Unidirectional
Paper width — 13" (33cm) maximum
Writing line — 10.5" (26.7cm) — 105 character line in 10 pitch, 126 character line in 12 pitch
Line spacing — 6, 4.5, 3.0 lines per inch
Paper feed — Friction
Paper thickness — maximum .022" paper thickness
Impression control — Operator selectable 5 levels
Interface
Parallel — 7 bit parallel data, 3 control line (data strobe, busy, acknowledge)
Serial — RS232C Compatible, Baud Rates — 50; 75; 110; 134.5; 150; 300; 600; 1,200; 1,800; 2,000; 2,400; 3,600; 4,800; 7,200, 9,600; 19,200; BPS, Switch selectable. Parity and character bit length also switch selectable.
Physical dimensions — 6.4" (16.25cm) H; 19.5" (49.6cm) W; 13.5" (33.7cm) D. 20.7lbs (9.4kg)

$895 inc. tax

STAR PRINTER

SPECIFICATIONS
Printing system — Impact dot matrix
Interface — Centronics standardized parallel interface (TTL level) built in printer
Matrix — Character mode 9 x 7 matrix, Graphic mode 6 x 6 matrix
Printing direction — Character mode: Bi-directional printing with logical seeking function, Graphic mode: Uni-directional printing from left to right
Number of characters per line — 80/96/131 (40/48/66 for double-width characters)
Printing speed — 80 characters/sec
Character set — JIS 160 codes/ASCII 96 codes + International character codes 64 graphics patterns
Character size — 2.0 (W) x 2.6 (H) in mm in case of 80 columns/line
Character space — 2.54mm (1/10 inch) in case of 80 columns/line
Line space — 1/6, 1/8, or 1/12 inch
Paper feed system — Friction type: Friction feed, Tractor type: Variable sprocket feed or friction feed
Line feed speed — 7.5 lines/sec at 1/6 inch spacing, 10 lines/sec at 1/8 inch spacing
Buffer capacity — 2K bytes
Other important functions — Form feed, Diagnostic printing, No-paper detection, Buzzer

$495 + tax



GP-100A Graphic Printer SEIKOSHA

SPECIFICATIONS
Print method — Impact dot matrix print (SEIKOSHA's uni-hammer method)
Character matrix — 5 x 7 dot matrix
Characters — 116 upper/lower case characters, numerals and symbols
Graphics — Dot addressable, 7 vertical dots per column, max. 480 columns
Character codes — 8-bit ASCII
Character size — Height 7 dots (2.82mm), Width 5 dots (2.11mm)
Print speed — 50 character/sec (left to right, unidirectional)
Max. number of columns — 80 columns
Character spacing — 10 characters/inch
Linefeed spacing — 6 lines/inch — Character mode, 9 lines/inch — Graphic mode
Linefeed speed — 5 linefeeds/sec — Character mode, 7.5 linefeeds/sec — Graphic mode
Paper feed — Pin feed
Paper width — 4.5 to 10 inches acceptable
Multiple copies — 2 including original
Inked ribbon — Single color, inked roller built-in cassette type
External dimensions — 234.5D x 420W x 136H mm

$395 inc. tax

ERRORS AND OMISSIONS EXCEPTED

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12 MHz	2.00
16 MHz	2.00
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	1-9	10-25	25+
8 PIN	1.20	1.00	.80
14 PIN	1.40	1.20	1.00
16 PIN	1.60	1.40	1.20
18 PIN	1.90	1.70	1.50
20 PIN	2.20	2.00	1.80
22 PIN	2.40	2.30	2.10
24 PIN	2.50	2.30	2.10
28 PIN	2.80	2.60	2.50
40 PIN	3.30	2.90	2.60

IC SOCKETS ECONOMY LOW COST

	1-9	10-25	25+
8 PIN	.30	.25	.20
14 PIN	.40	.30	.25
16 PIN	.40	.35	.30
18 PIN	.50	.45	.35
20 PIN	.55	.50	.45
22 PIN	.60	.55	.50
24 PIN	.60	.55	.50
28 PIN	.60	.55	.50
40 PIN	.70	.60	.55

PRECISION MACHINED GOLD INSERT

	1-9	10-25
8 PIN	1.20	1.00
14 PIN	1.60	1.40
16 PIN	1.90	1.70
18 PIN	2.00	1.80
20 PIN	2.20	2.00
22 PIN	2.40	2.20
24 PIN	2.60	2.40
28 PIN	2.90	2.70
40 PIN	4.40	4.00

SCOTCHCAL RANGE OF PHOTOSENSITIVE PRODUCTS.

			Per Sheet	Per Box
8001	Red on Aluminium	250mm x 300mm	$ 6.60	$48.00 (10sh)
8001	Red on Aluminium	300mm x 600mm	$12.00	$51.60 (5sh)
8005	Black on Aluminium	250mm x 300mm	$ 6.60	$48.00 (10sh)
8005	Black on Aluminium	300mm x 600mm	$12.00	$51.60 (5sh)
8009	Blue on Aluminium	250mm x 300mm	$ 6.60	$48.00 (10sh)
8009	Blue on Aluminium	300mm x 600mm	$12.00	$51.60 (5sh)
8007	Reversing Film	250mm x 300mm	$ 4.80	$27.00 (10sh)
8007	Reversing Film	300mm x 600mm	$10.20	$36.00 (5sh)
8011	Red on White Plastic	250mm x 300mm		$51.60 (10sh)
8013	Black on Yellow Plastic	250mm x 300mm		$51.60 (10sh)
8015	Black on White Plastic	250mm x 300mm		$51.60 (10sh)
8016	Blue on White Plastic	250mm x 300mm		$51.60 (10sh)
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8500	1 Litre Developer			$10.80 per bottle
8500	250ml Developer			$3.00 per bottle
3900	Scotch Clear Finish	368 Aerosol		$12.00 per can

Dealer and Trade Inquiries welcome.
Full range of products are available on order. For further information please call TIM BRAY on (03) 489 7099.

ICL7106	12.50	74S157	3.10	74H04	.90	74C150	6.50	74LS12	30	74LS155	1.20	74LS354	3.95	6522	10.00	LM301H	1.50	UA710CN	1.00
ICL7107	15.50	74S158	3.10	74H05	.90	74C151	4.20	74LS13	.50	74LS156	1.20	74LS365	.60	6522A	11.00	LM302H	6.50	LM711	1.20
ICL7109	27.50	74S160	5.90	74H08	1.10	74C154	6.00	74LS14	.60	74LS157	.60	74LS366	.60	6532	12.50	LM305H	1.50	LM723	.75
ICL7116	21.50	74S161	5.90	74H10	.80	74C157	3.75	74LS15	.30	74LS158	.80	74LS367	.60	6545	32.50	LM307CN	1.00	LM723CH	1.50
ICL7117	21.50	74S162	7.90	74H11	.80	74C160	1.90	74LS18	.45	74LS160	.80	74LS368	.60	6551	12.90	LM307H	1.60	LM725	4.75
ICL7660	4.90	74S163	7.90	74H12	.80	74C161	1.90	74LS19	.45	74LS161	.70	74LS373	1.50	2650	21.00	LM308	1.00	LM733	1.50
ICL7663	4.90	74S168	11.50	74H15	.80	74C162	2.00	74LS20	.30	74LS162	1.10	74LS374	1.75	2651	23.00	LM308H	1.80	UA739	2.75
ICL7664	4.90	74S169	11.50	74H20	.80	74C163	2.00	74LS21	.30	74LS163	.90	74LS375	.85	6800	8.00	LM309K	1.90	741	.50
ICM7211	12.50	74S174	4.50	74H21	.90	74C164	1.90	74LS22	.30	74LS164	1.40	74LS377	2.15	6802	10.00	LM310N	3.20	UA747	1.30
ICM7216A	47.50	74S175	4.50	74H22	.80	74C165	1.90	74LS24	.55	74LS165	.60	74LS378	1.20	6808	12.50	LM310H	3.20	UA748	.80
ICM7216B	42.50	74S181	8.50	74H30	.90	74C173	1.50	74LS26	.30	74LS166	2.55	74LS379	1.90	6809	17.00	LM311	.80	MC1310	9.50
ICM7217A	18.50	74S182	3.40	74H40	.90	74C174	1.50	74LS27	.35	74LS170	2.45	74LS386	.50	6810	3.50	LM311H	1.80	MC1312	6.90
ICM7218A	18.50	74S188AN	4.10	74H50	.90	74C175	1.50	74LS28	.35	74LS173	.90	74LS390	1.80	6820	5.50	LM317T	2.50	MC1314	6.90
ICM7224A	18.50	74S189	8.50	74H51	.90	74C192	1.90	74LS30	.30	74LS174	.80	74LS393	1.80	6821	3.50	LM317K	4.50	MC1315	7.50
ICM7226A	48.50	74S194	3.30	74H52	.90	74C193	1.90	74LS32	.30	74LS175	.80	74LS395	2.00	6840	6.50	LM318	3.50	MC1327	6.50
ICM7227A	18.50	74S195	2.90	74H53	.90	74C195	1.90	74LS33	.35	74LS181	2.80	74LS396	2.50	6844	12.00	LM319	3.50	MC1350	1.30
ICM7231A	15.50	74S196/82590	4.90	74H54	.90	74C200	14.00	74LS37	.35	74LS183	4.00	74LS398	3.00	6845	12.00	LM324	1.20	MC1408L8	7.50
ICM7240	7.50	74S197/82591	4.90	74H55	.90	74C221	2.40	74LS38	.40	74LS190	1.20	74LS399	1.90	6847	7.50	LM325	4.50	MC1437	3.50
ICM7242	3.90	74S201	9.90	74H60	.90	74C240	2.60	74LS40	.40	74LS191	.80	74LS424	5.50	6850	3.50	LM326	4.50	MC1445	3.75
ICM7250	7.90	74S214AN	P.O.A.	74H61	.90	74C244	2.60	74LS42	.80	74LS192	.80	74LS440	5.50	6860	10.00	LM329DZ	.90	MC1456	1.50
ICM7260	7.90	74S225	10.90	74H62	.90	74C373	3.00	74LS47	1.80	74LS193	.80	74LS441	5.50	6875	13.50	LM344Z	1.70	MC1458	1.20
ICM7555	1.90	74S226	7.90	74H64	.90	74C374	3.00	74LS48	1.80	74LS194	.80	74LS442	5.50	Z80CPU	7.00	LM335Z	2.20	MC1466L	14.50
ICM7556	2.50	74S240	6.90	74H65	.90	74C901	1.50	74LS49	1.80	74LS195	1.25	74LS443	5.50	Z80ACPU	8.00	LM339	.90	MC1469R	8.90
		74S241	6.90	74H71	1.40	74C902	1.00	74LS51	.35	74LS196	1.25	74LS445	2.20	Z80BCPU	16.00	LM348	1.60	MC1488	1.20
74S		74S244	9.90	74H72	1.20	74C903	1.00	74LS54	.40	74LS197	1.20	74LS446	5.50	Z80P10	4.50	LM349	1.60	MC1489	1.20
74S00	.80	74S251	3.90	74H73	1.80	74C904	1.00	74LS55	.40	74LS221	1.20	74LS447	1.90	Z80AP10	6.50	LM350K	7.50	MC1494	7.50
74S02	.80	74S253	4.90	74H74	1.80	74C905	15.00	74LS63	2.80	74LS240	1.20	74LS448	5.50	Z80CTC	6.50	LF351-N	.80	MC1495	7.90
74S03	.80	74S257	3.30	74H76	1.90	74C906	1.00	74LS73	.50	74LS241	1.20	74LS449	5.50	Z80ACTC	8.50	LF356N	1.40	MC1496	2.90
74S04	.85	74S258	3.30	74H78	1.90	74C907	1.00	74LS74	.40	74LS242	1.50	74LS490	3.20	Z80DMA	16.00	LF357	1.40	LM1596	2.90
74S05	1.10	74S260	2.90	74H87	7.90	74C908	1.70	74LS75	.50	74LS243	1.50	74LS540	11.95	Z80ADMA	19.00	LM358	1.00	MC1648	6.90
74S08	.80	74S274	P.O.A.	74H101	1.80	74C910	14.00	74LS76	.55	74LS244	1.20	74LS541	11.95	Z80AS10	19.00	LM361	3.50	LM1812	10.50
74S09	1.10	74S275	P.O.A.	74H102	1.80	74C911	12.50	74LS77	.65	74LS245	1.50	74LS621	2.75	Z80S10	16.00	LM377	4.90	LM1830	3.90
74S10	.80	74S280	5.90	74H103	2.50	74C912	12.50	74LS78	.55	74LS247	1.20	74LS622	2.75	AY-3-8910	14.50	LM378	3.95	LM2907	3.50
74S11	.80	74S281	P.O.A.	74H106	2.50	74C914	2.50	74LS83	1.00	74LS248	1.40	74LS623	2.75	AY-3-2513	14.50	LM379-S	7.95	LM2917 8 pin	3.40
74S15	1.30	74S283	7.90	74H108	2.50	74C915	2.00	74LS85	1.30	74LS249	1.30	74LS629	2.95	MM5303	7.50	LM380 8 pin	1.40	LM2917 14 pin	3.40
74S20	1.00	74S287	3.30	74H113	1.10	74C917	12.50	74LS86	.40	74LS251	1.00	74LS640	2.95	S1883	8.50	LM380 14 pin	1.50	MN3001	19.50
74S22	1.20	74S288	3.50	74H114	1.10	74C918	1.90	74LS90	.70	74LS253	.90	74LS641	2.75	MM5303	7.50	LM381	2.00	CA3028	3.00
74S30	.80	74S299	13.90	74H183	7.90	74C920	12.50	74LS91	.70	74LS257	.75	74LS642	2.75	LH0002	9.50	LM382	2.20	CA3046	2.90
74S32	.80	74S301	12.90			74C921	12.50	74LS92	.70	74LS258	.90	74LS643	2.75	LH0042CH	7.50	LM383	2.95	CA3056	7.50
74S37	1.70	74S314	P.O.A.	74C		74C922	6.50	74LS93	.60	74LS259	2.25	74LS644	2.75	LH0070	7.50	LM384	2.75	CA3059	6.90
74S38	1.70	74S330	P.O.A.	74C00	.60	74C923	6.50	74LS95	.75	74LS261	2.50	74LS645	2.75	LH0071	7.50	LM386	1.95	CA3080	2.50
74S40	1.20	74S331	P.O.A.	74C02	.60	74C925	7.90	74LS96	1.00	74LS266	.70	74LS668	1.75	TL061	1.00	LM387	2.00	CA3086	2.50
74S51	.80	74S373	9.90	74C04	.60	74C926	7.90	74LS107	.60	74LS273	1.55	74LS669	1.75	TL062	2.90	LM390	2.95	CA3089	4.90
74S64	1.20	74S374	9.90	74C08	.60	74C927	7.90	74LS109	.60	74LS275	6.80	74LS670	2.75	TL064	2.90	LM391	2.90	CA3130E	2.50
74S65	1.20	74S381	9.90	74C10	.60	74C928	8.00	74LS112	.60	74LS279	.80	74LS673	12.55	TL074	1.20	LM393	1.00	CA3130T	2.50
74S74	1.30	74S387	3.30	74C14	1.00	74C929	9.50	74LS113	.60	74LS280	2.60	74LS674	12.55	TL072	1.60	LM394	4.95	CA3140E	2.50
74S86	1.60	74S412/8212	5.90	74C20	.60	74C930	2.75	74LS114	.60	74LS283	1.20	74LS690	3.95	TL073	3.20	LM395T		CA3140T	2.50
74S109	2.50	74S428/8228	7.90	74C30	.60	74C932	2.50	74LS122	.90	74LS290	1.20	74LS691	3.95	TL074	2.90	LM396K	19.50	LM3401	1.00
74S112	1.30	74S470	9.90	74C32	.60	74C941	2.50	74LS123	.90	74LS293	1.10	74LS692	3.95	TL081	1.90	LF398	5.90	LM3900	1.20
74S113	1.30	74S471	9.90	74C42	1.60	74C989	8.90	74LS125	.60	74LS295	1.50	74LS693	3.95	TL082	1.80	NE544	6.50	LM3905	1.75
74S114	2.50	74S472	P.O.A.	74C48	2.50			74LS126	.65	74LS297	16.50	74LS696	3.95	TL083	2.90	NE555	.50	LM3909	1.30
74S124	5.90	74S473	P.O.A.	74C73	1.20	74LS		74LS132	.80	74LS298	1.20	74LS699	3.95	TL084	2.90	NE556	1.20	LM3911	1.95
74S132	3.50	74S474	P.O.A.	74C74	1.20	74LS00	.25	74LS136	.60	74LS299	3.90			TL494	4.90	NE558	4.90	LM3914	4.90
74S133	1.20	74S475	P.O.A.	74C76	1.20	74LS01	.30	74LS138	.70	74LS320	3.95	CPU		TCA220	2.20	NE560	4.60	LM3915	4.90
74S134	1.40	74S482	11.90	74C83	2.30	74LS02	.25	74LS139	.70	74LS321	3.95	6502	11.00	TCA280	4.50	NE561	4.60	LM3916	4.90
74S135	2.30	74S289	7.90	74C85	2.30	74LS03	.30	74LS145	2.10	74LS322	6.75	6502A	12.00	TDA1024	2.90	NE565	1.60	LM3999Z	2.60
74S138	3.30			74C86	1.20	74LS04	.30	74LS147	2.50	74LS323	6.50	6503	11.00	TA7205P	3.90	NE566	2.90	RL4136	1.50
74S139	3.30	74H		74C89	6.90	74LS05	.35	74LS148	1.20	74LS324	2.20	6504	11.00	TEA1002	17.50	NE567	2.00	RC4145	2090
74S140	1.90	74H00	.80	74C90	1.60	74LS08	.30	74LS151	.90	74LS326	2.20	6505	11.00	UAA170	3.75	NE570	5.90	RC4194	3.90
74S151	3.10	74H01	.80	74C93	1.50	74LS09	.30	74LS152	1.95	74LS327	2.20	6507	11.00	UAA180	3.75	NE571	5.90		
74S153	2.90	74H02	.80	74C95	1.80	74LS10	.30	74LS153	.70	74LS352	2.20	6520	5.50	LM10CH	7.50	NE594	9.50	SCR & TMACS	
		74H03	.80	74C107	2.20	74LS11	.30	74LS154	1.75	74LS353	2.20	6521	5.90	LM301	.50	LM709-14	1.00	SC141D	1.50

Errors and omissions excepted.

The 'Phony Patch' — a landline interface for your ham rig

Be ready for 'phone patch when it comes. In the meantime, you can practice operating your rig over the house intercom, or whatever.

The phone patch committee*

SPECIFICATIONS — ETI-734

SENSITIVITY

Rx-to-line (at 1 kHz)

level pot. mid-position	3.0 V for 0.77 V (0 dBm) in line
level pot. maximum	1.5 V for 0.77 V (0 dBm) in line

Line-to-Tx (at 1 kHz)

level pot. mid-position	0.77 V (0 dBm) in line gives 0.5 V out
level pot. maximum	0.77 V (0 dBm) in line gives 1.3 V out

CROSSTALK

Rx output to Tx input

level pots mid-position (dependant on level settings; decreases with higher settings)	26 dB with 0 dBm on line

* All voltages RMS; line terminated in 600 ohms

ONE OF the more positive aspects of the CB 'boom' was that it paved the way for 'third party traffic' in both the citizens bands and (later) the amateur bands.

Third party traffic means that an amateur or CB operator is allowed to relay messages, via his equipment, to another amateur or CB operator for someone else (i.e: neither of the operators).

This in itself was a 'breakthrough', but didn't go quite far enough. For it still meant that the message had to be actually re-broadcast by the operator.

The ridiculous part was that, if the message was being relayed from Australia to, say, the USA, the American amateur could connect his transceiver directly to his phone, call the party to whom the message is directed — and sit back!

This is because amateurs in the United States have long had access to 'phone patches', which were fully legal to connect to the telephone network. In Australia there has been no method of connecting a transceiver to a telephone line.

The current situation is this: the Department of Communication permits third party 'phone patch' operation for amateurs, but to connect a phone patch device to Telecom lines would breach Telecom regulations — with the risk of having your service disconnected plus prosecution for effecting a 'non-permitted' attachment.

In fact, not only are phone patches not permitted, but there are no standards laid down to which equipment can be made. Certain safety standards for equipment in general are all that can be relied on.

The recent report of the Davidson Inquiry into telecommunications foreshadows that Telecom is, or shortly will be, taking a much more enlightened attitude to attachments to their phone lines. Witness the recent decision by Telecom to allow 'user connected' phone devices to be plugged in to Telecom lines (for the first time — until now any item, even permitted, had to be 'installed' by Telecom).

In light of the changing attitude of Telecom, we set about designing an interface which could, when allowed, connect transceivers to Telecom lines. In the meantime, there are a large number of private installations, intercoms, links etc, which could still make use of such a device.

In the absence of any technical specifications, the interface was made to meet all of Telecom's safety standards. It was also designed to meet the audio level requirements of other equipment.

The interface is equipped with its own monitor speaker so it can be used as a direct link between the transmitter and line. Obviously, normal transceiver operating practice must be followed as the transceiver will only operate in simplex mode.

However, the interface can make use of the ▶

** This project was designed, developed and written up by a group of radio amateurs interested in promoting 'phone patch in Australia. They modestly wish to remain anonymous.*

transceiver's VOX, if available, for 'hands free' operation.

It is anticipated that a large number of amateur operators, and maybe even CB operators, will build the interface, ready for the time when such devices are 'legalised'. And it appears that this is not too far away!

Design

A block diagram of the interface is shown in Figure 1. The object is to convert a 'four wire' communications path — a pair for the receiver output and a pair for the transmitter input — to a 'two wire' link.

For safety's sake, and to take into account the later likelihood of the unit requiring approval for attachment to Telecom lines, the interface is isolated from the line by a special transformer and a high voltage, high reliability capacitor. This is terminated in a resistance of a value that provides a close match to the general line impedance of about 600 ohms.

A bidirectional amplifier system is attached to this to pass audio from the line to the transmitter mic. input and from the receiver output to the line. Each of these amplifiers has a bandpass response. Figure 2 shows the two response curves.

The response from receiver output to the line shows a narrow bandwidth with steep rolloff above and below the speech midband frequency of 1 kHz. The −6 dB bandwidth is from about 500 Hz to 1.7 kHz, rolling off at about 12 dB per octave below 500 Hz and at about 15 dB per octave above 1.7 kHz. This is perfectly adequate for speech, and in fact, provides a measure of improvement with noisy signals as well as attenuating noise and heterodynes that may be passed down the line.

The response from the line to the transmitter mic. input is considerably broader, the −6 dB bandwidth running from about 200 Hz to 6 kHz. Rolloff below 200 Hz is about 12 dB per octave, about −15 dB per octave above 6 kHz. Why is it different? Well, many modern transceivers incorporate speech filtering and bandwidth shaping to improve the effectiveness and clarity of the signal. Any filter in the mic. line may adversely affect the performance of a transceiver's own speech filter. But, any extraneous noise (hum, clicks-pops, etc) that may be on the line should not be passed to the transceiver, either. Hence the line-to-Tx filter response was rolled off above and below the usual speech band limits of 3 kHz and 300 Hz, respectively.

The 'Rx output' is intended to come from the transceiver's external speaker output or a high level, low impedance auxilliary output. Most modern transceivers have an audio power output of around two to three watts. Under normal use, average output power into the speaker is perhaps 0.5 W, which is about 2 V into an eight ohm load. Hence, this amplifier was designed to deal with signals from about 1.5 V RMS (level control at maximum) to produce 0 dBm in the line (0.77 V in 600 ohms).

With the line-to-Tx amplifier, 0 dBm on the line will produce a maximum output of about 1.3 V RMS (level control at maximum),

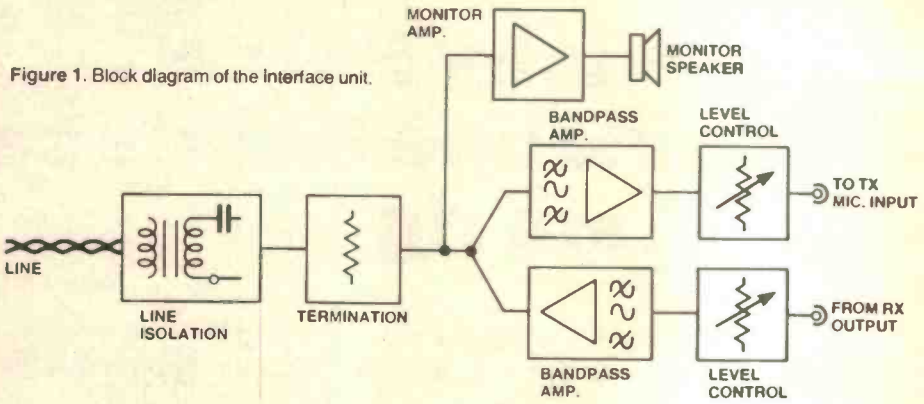


Figure 1. Block diagram of the interface unit.

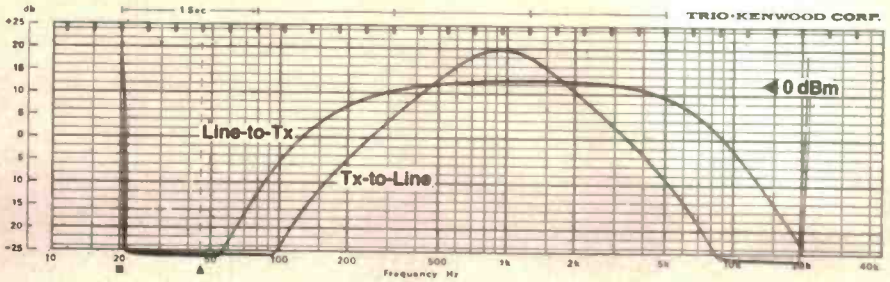


Figure 2. Response curves of the 'Rx-to-line' and 'Line-to-Tx' stages of the interface. (Measured on the prototype using ETI's Trio SE-3000 acoustic test set.)

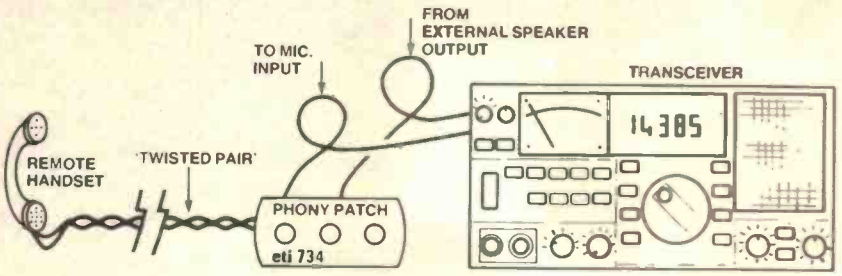
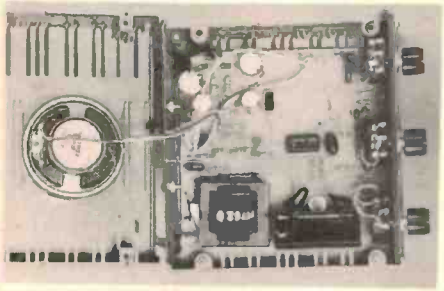


Figure 3. General arrangement of how the ETI-734 interface unit is hooked up.



Inside story. General internal view of the project.

which should be more than adequate to handle the majority of situations.

For local monitoring, a simple amplifier picks audio off at the isolation stage and drives a small loudspeaker in the interface.

Power is derived from an ac plugpack so that mains is not brought into the unit at all — again, for safety's sake.

Construction

All the electronic components, with the exception of the pots, are mounted on a single printed circuit board measuring 113 mm square. This fits nicely inside an ARLEC PC1 plastic case which we used to house the project. This case has a plastic front panel and a metal rear panel. The pc board has four mounting holes at each corner that match the plastic pegs in the bottom half of the ARLEC case so that the board is easily secured with four small self-tapping screws.

The three pots mount on the front panel and all the external 'interfacing' connections exit via the back panel. The transceiver connections are made via two RCA sockets. The line enters via a grommet and is soldered to the appropriate pc board points. A flying lead with a suitable plug attached permits convenient connection to and removal from the line. The ac plugpack adaptor was hard wired direct to the board using figure-8 cable. Some plugpacks come with a flying lead of Figure-8 cable, some have two screw terminals on the plugpack body.

We dressed up the front panel with an aluminium Scotchcal label, the artwork for which is reproduced elsewhere in the article. The monitor speaker was mounted on the lid, simply glued in place with Silastic. Holes were drilled in the lid over the speaker position, before mounting (it's too hard afterwards!).

Probably the best way to go about con-

structing the project is to tackle the pc board first. If you're making your own board, give it a thorough check after etching and drilling it. Even if you've purchased a ready-made board or a kit, check the board for missed holes, bridges between tracks (particularly between IC pins) and holes not drilled to the correct size. Make sure the four mounting holes line up with the pegs in the base of the box. Correct any problems and then proceed with mounting the components.

Assemble the resistors, capacitors (except C2) and semiconductors first. If you wish, a socket can be used for IC1. Watch the orientation of the electrolytic capacitors and all the diodes, especially. The orientation of the transistors and IC1 should be clear from the overlay diagram.

Leave the line isolation transformer, T1, and capacitor C2 until last as these are bulky components. We used pc stakes for all the external leads from the board. These should be mounted next. Check everything so far. All OK? Now bolt C2 in place, then mount T1. C2 has flying leads, note, while T1 has been designed for direct pc board mounting.

Now you can attach the flying leads to the pc board stakes around the perimeter of the board. Make sure the leads are long enough to reach their destination, but not too long so that they form a 'rat's nest' inside the box when it's all assembled. Don't attach the line or ac input leads yet.

Now you can tackle the box. Mark out and drill the front and rear panels. The Scotchcal label can be used as a template to mark out the front panel. Drill holes in the box top where the speaker will be positioned, then glue the speaker in place.

The Scotchcal label can now be applied to the front panel. Trim the label to size first. Cut it slightly undersize, the box pieces have an overhanging lip which covers the panel all round the edge. Peel off the backing strip and carefully position one end of the label on the panel. Smooth the Scotchcal onto the panel slowly, then give it a hard rub all over, using a soft cloth, when you've got it in place. Trim off any overhanging bits.

Now mount the potentiometers to the front panel. Position them so that their terminals face upwards; this makes it easier to solder the leads to them. Put grommets in the holes in the rear panel where the line and ac input leads will pass through. Mount the stereo RCA connector strip (or two individual RCA sockets).

Screw the pc board into place in the bottom

AC PLUGPACKS

There are a number of ac plugpacks available that will suit this project.

The prototype was powered by a **Dick Smith Electronics** M-9555 ac plugpack which is rated at 12 Vac/500 mA.

The **ARLEC APP.V/79309/60672** is rated to deliver 12.8 Vac no load, 9.3 Vac at 1 A. The project draws about 125 mA (quiescent) and this plugpack will deliver around 12.5 Vac at that load current.

The **Ferguson PPB 8/1000** is rated to deliver 8 Vac at 1 A, and delivers about 11.5 V or so at around 150 mA, so it will suit, as would their **PPB 12/500** (12 V @ 500 mA).

PARTS LIST — ETI-734

Resistors ..... all ¼W, 5%
- R1 ..... 82R
- R2, R4 ..... 150k
- R3 ..... 15k
- R5, R8 ..... 1k5
- R6, 7, 22, 23 ..... 220R
- R9, R10 ..... 2R2
- R11, 14, 17, 20 ..... 68k
- R12 ..... 560R
- R13 ..... 39k
- R15, R18 ..... 4k7
- R16 ..... 1k2
- R19 ..... 1M5
- R21 ..... 22k
- RV1 ..... 22k/C log. pot.
- RV2 ..... 500R/C log. pot.
- RV3 ..... 5k/C log. pot.

Capacitors
- C1 ..... 10n/400 V or 630 V greencap
- C2 ..... 2u/440 Vac film cap. (see text)
- C3 ..... 10n greencap
- C4, 6, 10 ..... 100n greencap
- C5 ..... 33n greencap
- C7 ..... 220n greencap
- C8, C9 ..... 4n7 greencap
- C11, C12 ..... 330u/25 V RB electro.
- C13, C14 ..... 1000u/16 V RB electro.

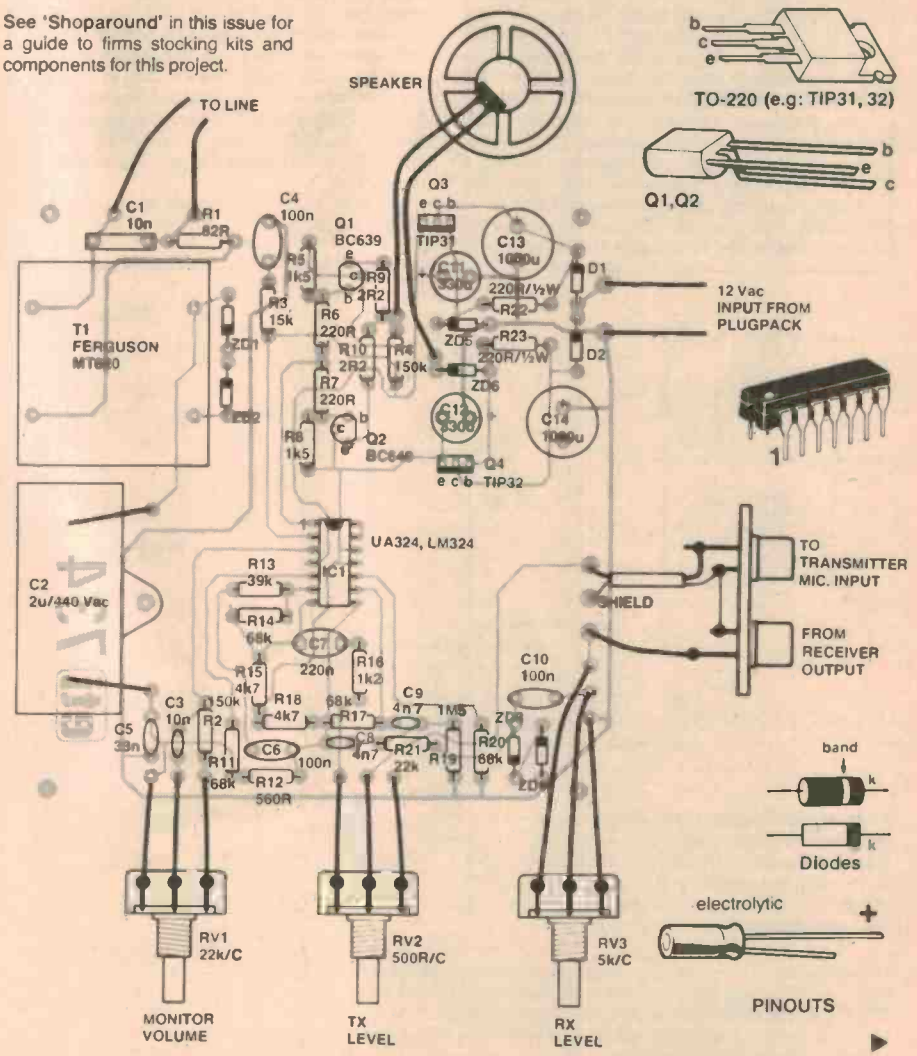
Semiconductors
- D1, D2 ..... 1N4001, 1N4002, EM401, EM402, etc.
- IC1 ..... uA324, LM324, etc.
- Q1 ..... BC639
- Q2 ..... BC640
- Q3 ..... TIP31
- Q4 ..... TIP32
- ZD1, 2, 5, 6 ..... 5V6/1 W zeners
- ZD3, ZD4 ..... 4V7/1 W zeners

Miscellaneous
- T1 ..... Ferguson MT620 line isolation transformer

ETI-734 pc board; Arlec PC1 box or similar (plastic, 140 x 130 x 78 mm); 50 mm diameter 8 ohm speaker; Arlec ac plugpack adaptor 9.3 V @ 1 A, or similar; stereo RCA socket strip; one rubber grommet; knobs; Scotchcal front panel; wire, etc.

Price estimate
$55 — $65

See 'Shoparound' in this issue for a guide to firms stocking kits and components for this project.



HOW IT WORKS — ETI-734

The overall design of the interface is detailed under design notes in the main text.

The line and interface are coupled via T1 which provides isolation to Telecom requirements. Further isolation is provided by the coupling capacitor, C2. Capacitor C1 and resistor R1 attenuate transients on the line. Two back-to-back zener diodes, ZD1 and ZD2, clip any signals with amplitudes above about 6 V peak.

The interface side of T1 is terminated by R12, which provides a close match to the 600 ohm line impedance. The junction of R12-C6-C8-R17-etc is a 'virtual earth' point.

Signals going in the line-to-Tx direction are coupled into IC1b via R11. The output of IC1b is coupled to the level control via C7 and R16. Capacitor C5 provides high frequency rolloff, as its impedance decreases with increasing frequency, while C6 provides low frequency rolloff as its impedance increases with decreasing frequency and the feedback ratio increases (R14 divided by the impedance of R13-C6). Frequency response is shown in Figure 2. The characteristics of T1 also affect the high frequency rolloff. IC1b has a mid-band gain of a little under two.

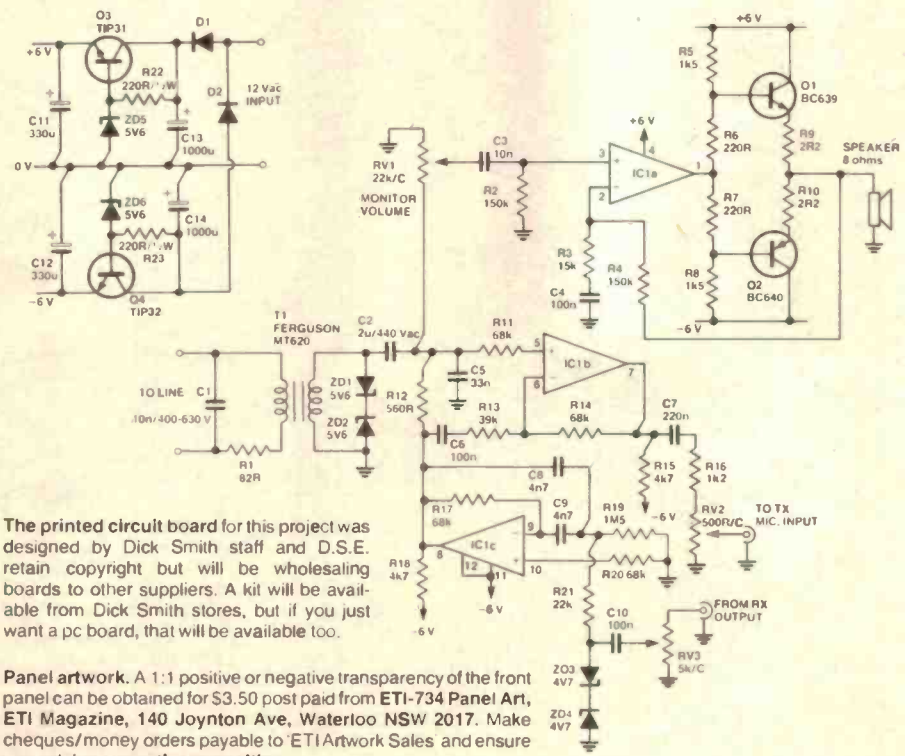
Signals going in the Rx-to-line direction pass via the level control RV3, then via C10, R21 and C9 to the input of IC1c. Two zener diodes, ZD3 and ZD4, clip any signals with amplitudes exceeding about 5 V peak. IC1c is a filter having loss, not gain, as the receiver output level will generally be higher than the required 0 dBm line level. Capacitor C8 provides high frequency rolloff as it shunts the feedback, reducing IC1c's gain with increasing frequency. Capacitor C9 provides low frequency rolloff as its impedance increases with decreasing frequency. The frequency response of this stage is shown in Figure 2.

Now, it is obvious that the output of the Rx-to-line stage is coupled to the line-to-Tx stage. Why then, doesn't the output of the receiver appear at the Tx mic. input? Well, R12 ties the inverting and non-inverting inputs of IC1b together, the Tx output looks like a common-mode signal and will not be amplified by IC1b. It's not a 'perfect' arrangement, but the cross-coupling between the Tx output and Tx mic. input is adequately low.

For the purpose of local monitoring, signals appearing at the common coupling point — the junction of C2 and R12 — are 'picked off' by RV1, the monitor volume control. Signals are coupled to the input of IC1a via C3/R2. The output of IC1a drives a simple class B amplifier comprised of Q1,Q2 and associated resistors, which drives a small eight ohm loudspeaker. Negative feedback is provided via R4 to the inverting input of IC1a. This stage has a midband gain of 10. Low frequency rolloff is provided by C4, the impedance of which rises with decreasing frequency, thus increasing the feedback ratio.

The interface requires positive and negative power rails. An ac plugpack, delivering 12 Vac output, provides power and isolation from the mains for safety. Two halfwave rectifiers, D1 and D2, provide positive and negative dc rails, of about 16 V or so, smoothed by capacitors C13 and C14 respectively. These are each regulated to about 5 V or 6 V using simple zener controlled series pass regulators comprised of Q3,ZD5,R22 and Q4,ZD6,R23. The two zeners are each 5V6, though 6V2 or 6V8 zeners could be used. The supply rails will each be equal to the zener voltages less the b-e drop of the series pass transistors (about 0.6 V). Thus, with 5V6 zeners, the supply rails will be about 5 V each, or with 6V2 zeners, about 5½ V. The actual supply rail voltage is not critical.

Capacitors C11 and C12 provide ac bypassing for the supply rails.



The printed circuit board for this project was designed by Dick Smith staff and D.S.E. retain copyright but will be wholesaling boards to other suppliers. A kit will be available from Dick Smith stores, but if you just want a pc board, that will be available too.

Panel artwork. A 1:1 positive or negative transparency of the front panel can be obtained for $3.50 post paid from **ETI-734 Panel Art, ETI Magazine, 140 Joynton Ave, Waterloo NSW 2017.** Make cheques/money orders payable to 'ETI Artwork Sales and ensure you ask for a **negative** or **positive.**

In and out. Rear view of the interface showing the ac input line at left, the RCA sockets for connections to the transceiver and the cable to the line at right.

half of the box. Slip the front and rear panels in place and solder the appropriate flying leads to the three pots and the RCA connectors. Solder the speaker leads in place, then pass the line lead and ac input lead through their respective grommets and knot them just inside the box, to prevent strain on the board terminals, if they're pulled, then solder them to their respective pc stakes.

Put the lid on the box and you're ready to test it.

Getting it on the air

Apply power and run a multimeter over the supply rails. These should be within one volt of the specified rail voltage (see the circuit diagram). If you've used 5V6 zeners, for ZD5 and ZD6, the rails will be around 5 V, or a bit over 6 V if you've used 6V8 zeners.

Check the voltage on pin 1 of IC1. This should be less than ±100 mV. The base of Q1 should be about 0.6 V positive, the base of Q2 about 0.6 V negative. See that pin 4 of IC1 is at the positive supply rail and pin 11 at the negative supply rail.

Temporarily hook up a 'phone handset to the line and your transceiver to the RCA connectors. Use a shielded lead to the transmitter mic. input. You won't need a shielded lead between the interface's 'receiver output' socket and the rig's external speaker output as you're dealing with high levels and low impedances. Figure-8 cable is quite OK.

Set the Rx and Tx gain controls to about half way and the monitor gain well down, or you'll get 'howl round' feedback. Set your transceiver VOX controls to where you normally have them, as well as the transmitter mic. gain (if your rig has a mic. gain control).

Turn up the rig's audio gain and listen in the handset for band noise or signals. Set the interface unit's 'Rx output level' control for a comfortable volume in the earpiece.

Talk and the VOX should operate the transceiver. Adjust the interface's 'Tx input level' control and your rig's VOX controls if necessary to get the desired operation.

With the handset located at the end of your twisted pair line, check the overall operation. Adjust the interface monitor level to suit.

Have fun with your 'Phony Patch'!

When the authorities get around to permitting 'phone patch for amateurs, you'll be ready. In the meantime, remember it's an offence to use this unit on the public telephone network. ●

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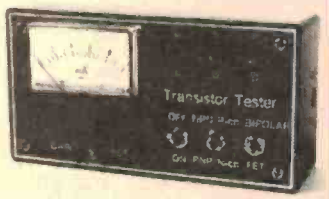

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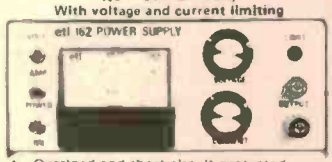

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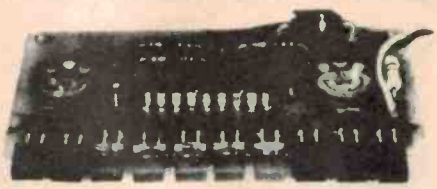

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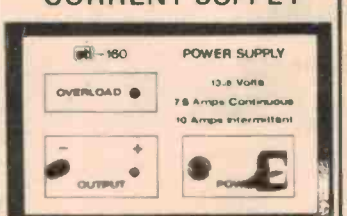

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SHOP AROUND

This page is to assist readers in the continual search for components, kits, printed circuit boards and other parts for ETI projects and circuits. If you are looking for a particular item or project and it is not mentioned here, check with our advertisers.

ETI-163 Lab. supply

This project is a 'must' for any electronics laboratory, whether you're an engineer, technician, serviceman or serious hobbyist. The power transformer for it was specially designed for the project and will be manufactured by Permatran of Melbourne. With 12, 24 and 36 V secondary outputs rated at 5 A, this transformer should find wide application apart from this project and will likely become a stock item from a number of electronic parts suppliers.

To date, the following suppliers have indicated they will be stocking kits for this project: **Altronics** in Perth, **Rod Irving** in Melbourne and **Dick Smith Electronics** (stores in all states). You might also try **All Electronic Components** in Melbourne.

The three relays we obtained from **Dick Smith Electronics**. They only cost $3.50, which is remarkable value, and they are listed in the latest catalogue as "extra heavy duty" types, no. S-7140. They are made by Fujitsu and are type no. FRL-264 D012/02CK. Plenty of similar types are available.

The SPST momentary action pushbutton switch is a common type, listed by **Altronics** as cat. no. S 1080 and **D.S.E.** as S-1199. The contacts are rated at 6 A, 125 Vac.

The three DPDT toggle switches are of the miniature type, rated at 5 A, 240 Vac and known as 'heavy duty' models. **Electronic Agencies** list them as cat. no. SE0120, **D.S.E.** as cat. no. S-1168.

The heatsinks were supplied by **Rod Irving Electronics**. They are the black-anodised, single-sided radial fin type 150 mm long, cat. no. HS5.

The case we used is Australian-made by **K&W** of Ballarat, Victoria, model no. C1066, also supplied by **Rod Irving Electronics**. It has an aluminium U-shaped chassis with turned-in lips and a steel cover with ventilation strips, painted hammertone blue. Overall, it measures 255 x 165 x 155 mm. Four feet are provided with it. The same case was used in the ETI-160 13.8 V/10 A power supply in the July '82 issue.

The 1 mA meter movements we used are the widely available Minipa MU-65s, kindly supplied by **Altronics** (who introduced us to Permatran, makers of the transformer). Other types of comparable size can be used, but mounting details are likely to vary slightly.

Scotchcal labels for the meter scales and case front panel will be obtainable from suppliers listed at the end of this column. Printed circuit boards can be obtained by consulting the same list.

ETI-164 zener tester

This handy little adjunct for your multimeter uses commonly available components, so constructors should have little difficulty getting it together. We obtained several models of the 'transistor audio transformer' to try in our prototypes, and all worked well. Suitable '1k CT to 8 ohm' transformers are available from many suppliers, and we don't anticipate any supply problems. **Dick Smith Electronics** lists one as cat. no. M-0216; **Altronics** lists two suitable types — M 0216 and M 0226 (we tried both); **Tandy** lists one as cat. no. 273-1380.

All the other parts are standard stock items in most parts suppliers.

Printed circuit suppliers are listed at the end of this column.

If you're after a kit for this project, check out **Rod Irving Electronics** and **All Electronic Components** in Melbourne.

ETI-323 headlight delay

There's nothing so simple as a project for which all the components are stock items in almost every electronics shop. Constructors should have no difficulty with this project. Printed circuit boards will be available through the suppliers listed at the end of this column. You may find firms like **All Electronic Components** and **Rod Irving Electronics** will be stocking kits.

ETI-734 phony patch

This project was a late inclusion, but constructors should find most parts to be readily available. The line isolation transformer is locally made by Ferguson but we didn't know at press time which suppliers would have stocks, so you'll have to check around. The 2u/440 Vac block capacitor is Japanese-made, by Shizuki. There are similar types around, so it's worth checking with several suppliers. Dick Smith Electronics may have it in stock, but it's not listed in the current catalogue.

As the project is a late inclusion, kits may not be available until late in the month. **Dick Smith Electronics** will definitely be stocking it and we'll advise about other suppliers in this column next month, hopefully.

Printed circuit board and panel suppliers

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

All Electronic Components
118 Lonsdale St
Melbourne Vic. 3000

RCS Radio
651 Forest Rd
Bexley NSW 2207

Panels, meter scales and dial faces for almost every ETI project published may also be obtained from the above two firms.

For pc boards produced over the past three to five years, the following suppliers generally keep stocks on hand:

Electronic Agencies
115-117 Parramatta Rd
Concord NSW 2137
and
117 York St
Sydney NSW 2000

Radio Despatch Service
869 George St
Sydney NSW 2000

Rod Irving Electronics
425 High St
Northcote Vic. 3070

James Phototronics
522 Grange Rd
Fulham Gardens SA 5024

Jemal Products
P.O. Box 168
Victoria Park WA 6100

Jaetronics
58 Appian Drive
St Albans Vic. 3021

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

Billco Electronics
Shop 2, 31 Pultney St
Dandenong Vic. 3175

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

Jaycar, Carlingford. Located on the corner of Carlingford and Pennant Hills Roads. Jaycar's Carlingford store is conveniently placed for enthusiasts in Sydney's north shore and NW suburbs. All Jaycar items are stocked and many kits can be demonstrated (like the Series 5000 gear). Avoid the city traffic, congregate at Carlingford! The store is open 9 am to 5.30 pm weekdays, till 8.30 pm Thursdays and 9-12 am Saturdays. Phone no. is 872-4444.

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8062A

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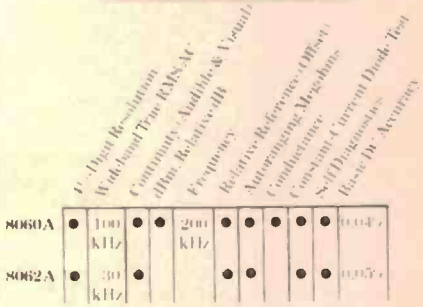

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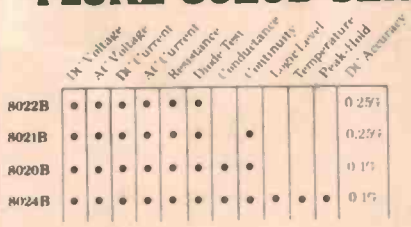

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The 8026A is the latest addition to the Fluke range and offers the advantage of true rms readings on ac functions. While most meters measure ac voltages almost all use the average-sensing, rms-scaled technique. In many applications average sensing does not give an accurate result – especially with non-sinusoidal waveforms. If you work with motors or data transmission type circuitry, true rms is critical to your measurements. For quick circuit checking the 8026A also incorporates the Fluke high speed continuity beeper.

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BC559	.20
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BC638	.80
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BD137	.90
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7480	.70
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7490	.50
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7493	.50
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7495	.45
7496	.80
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74109	.60
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74111	.80
74112	.80
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74122	.65
74123	.60
74125	.55
74126	.60
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74132	.80
74136	.55
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74141	1.10
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74143	1.45
74144	3.90
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74147	1.95
74148	1.40
74150	1.15
74151	.60
74153	.65
74154	1.15
74155	.85
74156	1.45
74157	.60
74158	.85
74160	.85
74161	1.00
74162	1.00
74163	1.00
74164	.60
74165	.60
74166	1.35
74167	2.20
74174	1.45
74175	.85
74176	1.10
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74179	2.15
74180	.90
74182	.90
74184	1.20
74190	1.00
74191	1.45
74192	1.65
74193	.80
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74198	1.10
74199	1.30
74221	.90
74240	1.50
74241	1.50
74242	1.50
74243	1.50
74244	1.75
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74247	2.25
74248	2.25
74249	2.25
74251	1.10
74253	1.10
74257	1.50
74258	1.50
74259	2.45
74273	2.45
74276	2.45
74278	3.45
74279	.85
74283	2.45
74289	3.25
74290	.90
74293	.90
74295	1.65
74298	2.45
74299	1.75
74351	1.85
74352	1.85
74365	.80
74366	.80
74367	1.20
74368	1.20
74373	2.25
74374	2.25
74375	.75
74377	2.45
74390	1.95
74393	1.95
74425	2.55
74426	2.55
74490	2.65
9300	1.50
9301	2.50
9302	2.90
9304	4.00
9305	2.40
9307	3.80
9308	2.60
9309	2.40
9310	1.50
9311	2.50
9312	2.50
9313	6.00
9314	2.40
9316	1.90
9317	4.20
9318	4.60
9319	2.00
9320	6.90
9321	2.40
9322	1.90
9324	1.40
9328	4.90
9334	6.00
9338	5.90
9340	9.90
9342	5.90
9368	2.20
9374	3.30
9386	2.40
75107	2.50
75110	2.50
75154	2.50
75450	1.50
75451	.60
75452	.60
75453	.60
75461	1.50
75462	1.50
75471	3.00
75472	3.00
75491	2.00
75492	2.00
75493	3.00
75494	3.00
8121	4.00
8123	4.00
8130	6.00
8131	3.95
8135	
8136	4.25
8303	5.50
8304	6.90
82S23	4.50
82S123	3.90
8311	4.87
8641	3.83
8820	4.95
8830	5.00
8831	5.00
8832	5.00
8833	4.90
8834	5.90
8835	4.00
8836	2.00
1488	1.20
1489	1.20
81LS95	2.50
81LS96	2.90
81LS97	2.90
81LS98	2.90
8T26	3.00
8T28	3.00
8T30	3.00
8T96	1.80
8T97	1.80
8T13	2.95
8T14	2.95
8080	8.00
8085	8.50
8086	59.00
8088	25.00
8155	6.50
8156	6.50
8185	37.50
8202	52.50
8203	58.50
8206	115.50
8212	3.00
8214	4.90
8216	3.00
8224	3.50
8226	4.90
8228	5.50
8231	199.00
8232	199.00
8237	39.00
8238	9.50
8243	8.50
8251	4.90
8253	7.50
8255	5.50
8257	16.50
8259	6.50
8271	89.00
8272	33.00
8273	65.00
8274	42.50
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8284	8.50
8286	6.50
8287	6.50
8288	25.00
8289	73.00
8291	43.00
8292	34.50
8293-10	26.50
8741	57.50
8748	29.50
8749	58.50
8755	33.50
2911	26.50
2912	27.50
2920	239.00
3205/8205	9.90
3242	17.50
3245	10.90
3628	18.50
8008-1	62.50
8031-3	29.50
8035	6.90
8039	7.90
FD1771	19.00
FD1791	39.00
FD1793	39.00
FD1795	39.00
FD1797	39.00
WD1691	16.50
WD2143	12.50
WD1931	22.50
WD1933	34.00
WD1983	14.75
WD1993	59.00
WD2123	26.50
WD8250	16.50
TR1602	8.50
TR1863	8.90
COM8116	24.00
BR1941	18.50

74F SERIES

74F00	.79
74F02	.79
74F04	.92
74F08	.79
74F10	.79
74F11	.79
74F20	.79
74F32	.79
74F64	.79
74F74	.89
74F86	1.19
74F109	.99
74F138	1.79
74F139	1.79
74F151	1.79
74F153	1.79
74F157	1.79
74F158	1.79
74F175	2.78
74F181	5.98
74F182	2.73
74F189	7.44
74F190	4.86
74F191	4.86
74F194	2.41
74F241	3.72
74F243	4.34
74F244	3.72
74F251	1.93
74F253	1.93
74F257	1.93
74F258	1.93
74F350	4.34
74F352	1.93
74F353	1.93
74F373	4.84
74F374	4.84
74F399	2.78
74F521	4.22
74F533	4.84
74F534	4.84

MEMORY

2101	6.90
2102	2.50
2112	7.90
2114	1.95
3147	6.90
2708	6.90
2716	5.90
2732	7.00
2764	15.00
4116	2.20
4164	7.00
6116	10.00
58725	9.00
5101	7.90
8101	7.90
2532	12.50

OPTO	
4N25	1.20
4N26	1.20
4N27	1.20
4N28	1.20
4N29	1.50
4N30	1.60
4N32	2.50
4N33	2.50
4N35	2.50
4N37	2.00
MCT6	2.50
MCT66	6.90
MCT2	1.50
1LD74	5.90
1LQ74	6.50
FND357	1.80
FND500	1.80
FND507	1.80
FND800	3.50
T1L31A	2.95
T1L81C	2.95
T1L306	14.50
BPW50	2.25
CQY89	1.50
MOC3011	2.95
MOC3020	2.50
MOC3021	2.95

LEDS

3mm RED	.25
3mm YELLOW	.30
3mm GREEN	.15
5mm RED	.15
5mm GREEN	.30
5mm YELLOW	.30
5mm ORANGE	.30
RED RECT	.30
GREEN RECT	.30
YELLOW RECT	.30
RED CHROME BEZEL	1.20
YELLOW CHROME BEZEL	1.20
GREEN CHROME BEZEL	1.20

VOLTAGE REGS

7805UC	.90
7805KC	2.00
7812UC	.90
7812KC	2.00
7815UC	.90
7815KC	2.20
7818UC	1.00
7818KC	2.20
7824UC	1.00
7824KC	2.40
7905UC	1.40
7905KC	3.00
7912UC	1.40
7912KC	3.00
7915UC	1.50
7915KC	3.00
7918UC	1.50
7924UC	1.50
78L05	.50
78L12	.50
78L15	.60
78L18	.60
78L24	.60
79L05	1.00
79L12	1.00
79L15	1.00
79L18	1.00
79L24	1.00
LM309K	1.90
LM317T	2.50
LM317K	4.50
LM323K	6.50
LM337T	2.90
LM337	6.50
LM338K	9.50
LM350T	6.50
LM350K	7.50
LM395K	
LM396K	19.50
78H05KC	9.00
78H12KC	9.00
78HGKC	9.50
78P05KC	14.50
79HGKC	16.50
78S40	3.50
MC1496L	14.50

SPECIAL FUNCTION

LM4250	2.45
NE5534N	1.95
NE5534AN	2.50
MC3340	1.90
MC3341	2.90
76477	5.95
76488	5.95
8038	6.50

OM350	10.50
IM65X08CPE	5.00
XR2206	6.50
XR2207	6.50
XR2208	4.90
XR2209	5.90
XR2211	6.90
XR2216	4.90
XR2240	4.90
XR2242	4.90
XR2243	5.90
XR8038	6.50
ICC7660	12.50
95H90	8.50
11C90	16.50
LM7555	1.90
MC10116L	1.50
LF13741	.80
LF13741-H	1.50
DS75451	.60
DS75452	.60
DS75491	2.00
DS75492	2.00
7216A	41.50
7216B	42.50
DM2502	10.00
ADC0800	16.00
ADC0808	17.00
DAC0800	4.50
DAC0808	3.50
SAK140	9.50
ZN414	1.95
4000	.40
4001	.40
4002	.40
4006	1.60
4007	.50
4008	1.40
4009	.60
4010	.70
4011	.40
4012	.50
4013	.75
4014	1.50
4015	.95
4016	.55
4017	1.20
4018	1.50
4019	.60
4020	1.35
4021	1.10
4022	1.15
4023	.40
4024	1.00
4025	.40
4026	2.00
4027	.60
4028	.90
4029	1.20
4030	.60
4031	2.50
4032	2.25
4033	2.25
4034	3.00
4035	1.30
4038	2.75
4040	1.40
4041	1.50
4042	.70
4043	.80
4044	.75
4045	4.90
4046	1.25
4047	1.50
4048	1.00
4049	.60
4050	.60
4051	1.20
4052	1.20
4053	1.20
4054	3.90
4055	3.90
4056	4.20
4060	1.85
4063	2.00
4066	.80
4067	9.90
4068	.50
4069	.60
4070	.45
4071	.40
4072	.45
4073	.55
4075	.55
4076	1.20
4077	.50
4078	.60
4081	.40
4082	.40
4085	2.20
4086	2.30
4089	3.50
4093	.75
4094	3.35
4095	2.40
4096	2.40
4097	6.50
4098	2.90
4099	3.90
4104	6.90
4160	1.25
4161	1.25
4162	1.25
4163	1.25
4174	1.25
4175	1.60
4194	1.95
4402	1.00
4404	1.15
4408	6.90
4409	13.50
4410	11.50
4411	12.60
4412	.45
4415	10.15
4416	.60
4419	3.45
4422	9.50
4426	2.35
4428	1.75
4433	2.25
MC14433	13.90
4435	7.95
4441	1.50
4443	3.90
4445	2.65
4446	3.55
4449	1.00
4450	3.75
4451	3.75
4457	5.90
4458	9.90
4469	14.90
4490	5.90
4495	3.95
4500	8.90
4501	.50
4502	1.80
4503	.90
4504	2.00
4506	.75
4507	.40
4508	4.50
4510	1.50
4511	1.50
4512	1.10
4513	2.65
4514	2.90
4515	2.90
4516	1.45
4517	8.75
4518	1.50
4519	.90
4520	1.55
4521	3.90
4522	1.90
4526	1.85
4527	2.65
4528	1.15
4529	1.80
4530	1.60
4531	1.65
4532	2.65
4534	8.90
4536	6.50
4538	2.75
4539	1.65
4541	1.60
4543	2.50
4544	10.50
4549	7.25
4551	1.80
4553	5.50
4554	2.35
4555	1.10
4556	1.25
4557	7.85
4558	2.25
4559	7.25
4560	3.75
4561	1.80
4562	8.45
4566	3.00
4568	4.25
4569	2.50
4572	.75
4580	8.95
4581	3.10
4582	2.25
4583	1.65
4584	.85
4585	2.10
4597	
4599	3.45
45104	7.25
45106	7.85
45107	7.25
4109	7.25
45112	7.85

Errors and omissions excepted.

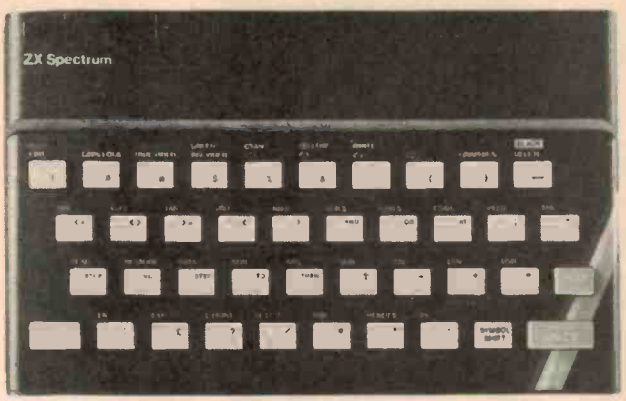
That was the PC show that was . . .

If you didn't already know, there's a new computer trade buzzword. It's 'pee see', or just PC on your user-friendly, sculptured-key, ergonomically designed qwerty keyboard. The 'first' Australian Personal Computer Show had them all.

Portable power. The Otrona 'Attache'.

Junior? National's JR.100 home computer.

Yes, Captain?
Commodore's latest — the Commodore 64.



Colourful. The Sinclair Spectrum, here at last.

Crowded into three days in March, and crowded into three levels of the convention centre at Centrepoint in Sydney, the show attracted over 50 000 computer voyeurs who pushed, POKEd, RAMmed, PEEKed, BRUNned, asked questions, took brochures and generally got into it. (Thank go for press passes or I'd never have got the kids in . . .)

Every PC worth its salt was there, plus every imaginable peripheral, attachment, inputter, outputter and set of software imaginable . . . and some that weren't.

Not to be overwhelmed by myriads of imports, several Australian manufacturers were there. **Applied Technology** released the 64K MicroBee (with CP/M 2.2 et al) and the Colour-Bee. The latter was perpetually surrounded six-deep by school kids.

RDM Computers showed their all-singing & dancing single board computer featuring a Z80 running at 4 MHz, 256K of RAM and numerous ports plus STD buss expansion. It supports both 130 mm and 200 mm disk drives with disk formats for the Osborne 1, ICL PC and a few others. Display is standard 80 x 24. plus hi-res graphics. You can run CP/M, MP/M and Turbodos. Basic board costs just $950!

Amongst the 'home' PCs, were **Commodore** with the new 64, **The Computer Company** with National's JR100 (16K RAM, 8K BASIC, 45-key keyboard, graphics, RF output, et al), **Barson Computers** with the Sinclair ZX Spectrum and the Acorn Atom. **Apple** trotted out the IIe (64K RAM, 80 x 24 display, etc).

Portable computers are obviously the 'coming thing' in one sector of the market. **Elmeasco** showed the Otrona, **Sharp** showed their handheld PC range, **Hewlett Packard** had the HP-75 on show with some really 'smick' software and **Warburton Franki** heavily promoted Epson's new QX-10 and HX-20 portables (featuring LCD displays . . .).

The 'big boys' threw their busses around and flexed their memories. Wouldn't you know it, the **IBM PC** was there, represented on about half a dozen stands apart from IBM's. **DEC** occupied a corner with their latest systems — or was it a corner and two walls? **H-P** had their new 68000-based machine on show.

NEC had ranks of their Advanced PC demonstrating themselves (leaving the salesmen free to sell). If you've never seen the Advanced PC's graphics demo, you've missed one of life's great experiences.

Mitsui, not content with showing one machine, showed three new Sords. Flagship was the 16-bit 8086-based M343, with arithmetic co-processor and Z80 'housekeeper'. Talking of 16-bit machines, they're everywhere.

A.E.D. decided some public education was in order and ran a series of seminars on their new machines (more native technology).

Attracting a lot of attention was a large-screen display video demo for the **Apple Lisa.** If that's the shape of things to come, 'mice' will reach plague proportions within a few years.

If you wanted a printer, they were on show in every conceivable shape, size, configuration and cost. If you wanted something a little out of the ordinary, robots were shown by both **Elmeasco** and **Jaycar** (who had the Powertran Genesis and Micro-Grasp).

At this stage, we're running out of space . . . so we bid farewell to Balham's PC show as the nursemaid reads the brochures to her pre-school charges; ". . . with one bound he was by her side. He planted a hot 1Kbyte on her buss as he ripped the . . .".

Serial-parallel and parallel-serial converters

Alfatron, the Melbourne-based computer hardware company, has released a line of serial to parallel and parallel to serial converters for use on RS-232 and Centronics type communications channels.

The AL range is designed to go from a serial RS-232 input to a Centronics parallel output. They are available with 256, 1024 and 2048 character buffer built in and can handshake using XON/XOFF or hardware control.

The units are designed to power themselves completely from the Centronics side if possible (requires 5V at 400 mA). If no power is available from the Centronics port then power may be provided with an optional plug pack.

The serial channel has baud rates switch selectable from 110 to 9600.

Mounting of the units is facilitated with the use of self-adhesive 'Velcro' strips that allow removal of the unit from its mounting for service or altering switch settings. The switches have been deliberately mounted internal to the case to prevent tampering once they are set as these units have been designed to be placed in service and forgotten.

The CS-256 converts a parallel Centronics style output to a serial RS-232 output. This is especially useful when a printer needs to be a long distance away and only a parallel port is available.

The AL series of converters will directly interface with the CS-256 (back to back) to allow a parallel printer to be driven a long way from the source over a three wire link using RS-232. The handshaking in between will be transparent to the printer and driving system.

An additional advantage is that the units can be optionally programmed to provide protocol conversion.

Details from **Alfatron Pty Ltd, 1761 Ferntree Gully Rd, Ferntree Gully Vic 3156. (03) 758-9551.**

GaAs and CMOS gate arrays

Toshiba has developed ultra high-speed Gallium Arsenide and CMOS gate arrays.

The GaAs gate array LSI chip has an operating speed of 80 ps, which is about five times faster than an ECL device, and a power dissipation of 0.2 mW.

To make a chip with such low power consumption the active layer coating the whole surface of the substrate had to be as thin as 0.1 micron. Toshiba developed the 'Pt bury gate electrode' technology which made it possible to form a 0.1 micron active layer.

They are now using this technology to build a gate array with about 2400 elements and 500 gates on a chip of about 16 mm.

The CMOS gate array has about 88 000 elements integrated on a chip in an area of 10 mm with 20 010 gates. The gate array is equivalent to about 2000 TTL ICs in terms of integration.

ACICS appointed as national IBM PC distributor

Australian Consolidated Industries Computer Services has been appointed national distributor for IBM's new personal computer.

Mr A. K. Klingender, ACICS General Manager, said the company would draw upon its extensive experience in data processing for major Australian and international companies to provide specialist hardware and software support and backup.

"IBM has selected us as the national distributor because of our familiarity with the computing needs of the business and professional community, and experience of our staff in servicing often very complex data processing requirements," Mr Klingender said.

He added that ACICS had augmented the basic software packages with a carefully-selected range of business packages.

Software would be drawn from a number of overseas and local suppliers, which provided customers with a great deal of flexibility, Mr Klingender said.

"Since the new personal computer can also function as a terminal to a mainframe computer, we will be carrying data banks of business information to be assessed by IBM PC owners.

"Naturally, we will be happy to sell a PC for any purposes, but we believe our market strength lies in the business and professional area," he added.

Mr Klingender said ACICS would promote the product in non-technical terms, highlighting the utility and usefulness of the PC, and the comprehensive service and software backup available nationally.

The company would also offer training programs and user-information updates on a regular basis.

High speed letter quality printer

Datatel Pty Ltd has announced the release of a high performance 18-needle matrix printer which gives letter quality printing at 110 char. per sec., and doubles as a data output printer with a rate of 400 char. per sec.

The Swiss-made Wenger 4/1 features a high standard of letter quality printing, supported by precision engineering and powerful hardware and firmware.

The printer utilises an 18-needle staggered or in-line printhead, is bi-directional and logic seeking, and produces letter output in a single pass at 110 char. per sec.

Paper transport is both by tractor and friction feed, and a sheet feeder is optional. Up to five resident character sets may be down loaded into the printer, and 136 columns at 10 char. per inch are accommodated in a single line.

Compressed printing and proportional spacing is also available. Left and right margins and tabulation points are programmable, as are forms length, print zone and perforation skip.

Text may be printed as underlined, elongated, compressed, double intensity as well as half line feed forward and reverse. Multi-colour printing is provided as an option, using four basic colours.

Further options include block graphics, vector graphics and bar code printing.

The standard printer is fitted with a 5K buffer, which may be expanded to 40K. Self diagnostics, confidence testing and printout of configured character sets is available during the self test function.

Interfaces include RS232, RS422, current loop and industry standard parallel. A range of switch selectable serial interface handshake protocols is also available.

The manufacturer claims exceptionally low noise performance to maintain high comfort levels in an office environment.

Further details are available from Datatel Pty Ltd, **19 Raglan Street, South Melbourne Vic. 3205. (03) 690-4000.**

New Apple III disk drives

Two high-density floppy disk products, Unifile and Duofile, which provide new mass storage options for the Apple III personal computer, have been introduced by Apple Computer.

Apple claims that the drives ensure a greater integrity of data than other high-density drives by way of a unique, double-sided mechanism designed and manufactured by Apple.

Unifile is also designed to serve as the ideal backup for Profile, which allows the user to backup to one location information that would fill 35 floppy diskettes. Unifile requires only six diskettes to back up the total contents of Profile. It also takes advantage of Backup III, a new software utility that selectively backs up and restores Profile's files.

The systems are equipped with a doorless self-ejecting mechanism that eliminates the chance of errors that occur when disk drive doors are opened while writing data to a diskette. Unifile is designed to fit between the Apple III and the Apple III monitor.

Apple claim that the 871 disk drive is the first high-density, double-sided disk drive mechanism to be built specifically for personal computer applications.

For more information contact **Electronic Concepts**, Apple's Australian distributor, at **55-57 Wentworth Ave, Sydney NSW 2000. (02) 212-2833.**

Add bar code to RS-232C terminals

Bar code data input may now be easily added to VDU terminals operating in RS-232C systems with the Databar 401V Bar Code reader.

The bar code reader receives and retransmits all data from the terminal keyboard without change and as it is connected through a patch cable no modifications are necessary to either the computer or terminal hardware or software.

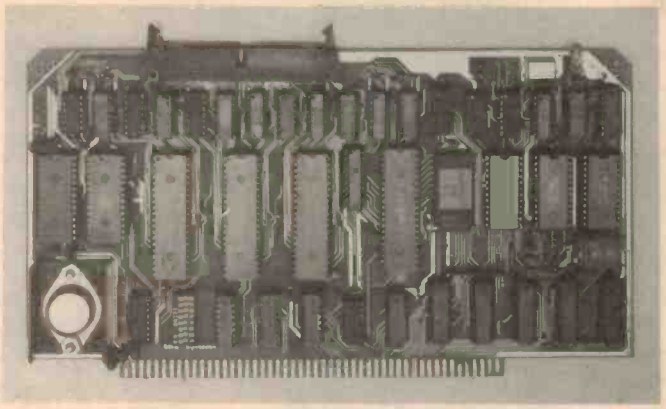
To allow its use in a wide range of operating systems and hardware configurations, a selectable inter-character delay is available in 10 ms increments to a maximum of 150 ms.

Data transmission rates from 110 baud to 9600 baud are also switch selectable.

The Australian designed and manufactured Databar 401V Bar Code Reader is available with any of the commonly used bar codes. Depending on the code selected, the reader may perform a check digit calculation before transmission, transmit or ignore start-stop characters or test for a specified message length.

Bar code readers are commonly used in libraries, blood banks and other organisations requiring fast and accurate data entry to a computer system.

Enquiries to Harold Norrie, **Nortronic Instruments, Box 995, GPO Sydney 2001. (02) 290-2844.**



Multichannel intelligent RS232 I/O card

SME Systems has released the MPC-6 Dartbaud, a Z80 based six channel I/O card.

It is designed for use in multiterminal systems or industrial monitoring situations where fully buffered peripheral devices can be connected to the system.

It provides against loss of data due to latency in the main processor by buffering data in both directions through 6K of CMOS on-board memory (battery backed). This facility also ensures that the MPC-6 will continue from where it was interrupted once power is restored.

Each of the six channels can have independent baud rates set by the control program on power up. These can be changed by the host processor. Default parameters can be altered simply by issuing 'Opcodes' to the control port which will be interpreted by the on-board processor as instructions to perform certain tasks. It is possible to change or reset parameters 'on-the-fly'.

Some of the directions that can be given by the host CPU are to redirect data from one channel to another, alter baud rates of individual channels and alter buffer size allocations to each channel in 128 byte increments.

The boards are S100 bus compatible, supplied assembled and tested and are backed by an unconditional 90-day guarantee.

SME Systems are at **22 Queen St, Mitcham Vic. 3132. (03) 874-3666.**

A gay holiday with a camp computer

The proprietors of Morton Park Farm, a stud property near Moss Vale in NSW, are now offering 'Compucamps', a variation on their usual camping holidays for young people.

Their new project is a camping adventure in the world of microcomputers and is intended primarily for high school students. It is a camping holiday but at the same time the students will gain 'hands on' experience in the use of micros from basics to advanced applications.

Six computer stations will be available for individual practice and instruction. There will also be films, lectures and demonstrations and, of course, recreational activities.

The microcomputers are from the OKI range and are fully supported with an OKI/Microsoft enhanced BASIC language and the CP/M operating system. Disk and cassette storage media will be operated.

Most of the equipment was purchased from Sigma Data Corporation which is assisting with the installation of the hardware and training.

Future plans involve using the wider range of software and hardware available to business users as a basis for an agricultural orientated course for local farmers.

Weekday courses for school groups or weekend courses for individuals can be booked by contacting John Molloy at **Morton Park Farm, Foxgrove Rd, Canyonleigh NSW 2577. (048) 78-9132.**

Colour graphics terminal

The 2405 colour graphics terminal from Anderson Digital Equipment features an 80-column, 24-line alphanumeric and graphics display on a 13 inch CRT.

It is a new single-board terminal using the 8085 microprocessor. It has a 6 x 12 dot character matrix, 36 programmable functions, 4K screen refresh RAM and 8K EPROM for the operating system.

To find out more about the new 2405 colour graphics terminal contact your nearest ADE branch in Australia or New Zealand or **14 Whiteside Rd, Clayton Vic. (03) 544-3444.**

4M bubble memory pin compatible with 1M

Intel's new 7114 is a VLSI magnetic, non-volatile, bubble memory chip which has a storage capacity of four million bits.

The 4M 7114 is 14.6 mm x 13.5 mm which is smaller in size than the 1M 7110.

The 7114 and support circuits are pin-compatible and directly upgraded from the 1M architecture. Motorola has agreed to alternate-source the Intel 7110.

Initially the 7114 will have an average access time of 80 ms and a data transfer rate of 200K per second. A high performance version, the 7114A, will have a 40 ms average access time and a 400K per second data transfer rate. This performance equals four 7110 1M devices operating in parallel.

Production and distributor stocking of the 7114 will take place in the second half of 1983. More information can be obtained from **Total Electronics, 9 Harker St, Burwood Vic. 3125. (03) 288-4044.**

Text editor/word processor for Commodore VIC

The Microcomputer House developed VIC-TEXT because there was no text editor/word processor available for the Commodore VIC.

The VIC-TEXT cartridge, incorporating 8K of RAM, is a professionally written package, programmed in machine code for maximum speed and efficiency.

It costs $149 and can be used as a second word processing system at home. The prepared disk can then be taken to the office where a compatible system can edit it, format and print it.

VIC-TEXT features full cursor control by character, word or line, deletion, restore deleted text, duplicate text, tabulations, right justification when printing, programming the text editor, searching for a word, etc.

Microcomputer House can be contacted at **116 Abercrombie St, Chippendale NSW 2006. (02) 698-7076.**

Downturn in sales of video games

ROM suppliers are concerned with the apparent dip in the once booming sales of video games.

Warner Communications put Wall Street in a spin by announcing that its sales of video game cartridges were 'disappointing'. Then Mattel announced that it was expecting to make a loss.

After these announcements stocks of all video game manufacturers, home computer manufacturers and semiconductor companies that supply parts to both went into a sharp decline.

Semiconductor companies maintain, however, that their orders for ROMS from video game makers have not declined.

16-word by 4-bit port RAM

Fairchild's 29F705 is a 16-word by 4-bit port RAM with tri-state output.

This RAM features two separate output ports such that any two 4-bit words can be read simultaneously. Each output port has a 4-bit latch with a common latch enable (LE).

The device has two write enable inputs (WE) and is designed such that the write enable ($\overline{WE}$1) and latch enable (LE) inputs can be wired together to make the operation of the RAM appear edge triggered. Also the A latch can be forced to zero using the A-LO input.

The device has a fully decoded 4-bit A-address to select any of the 16-memory words through the A-output port.

Likewise a 4-bit B-address input is used to simultaneously select any of the 16-memory words through the B-output port. New incoming data is written into the RAM location selected by the B-address.

More information about this device is available from **Fairchild Australia Pty Ltd, 366 Whitehorse Rd, Nunawading Vic. 3131. (03)877-5444.**

New software source for Commodore computers

A new software company, Acme Software, specialises in programs for the Commodore range of microcomputers.

They have four programs available now for the VIC-20 computer and they plan to have more titles soon.

Locomotion is a game based on a railway network where you have to keep the trains on the tracks, avoiding collisions and derailments.

Up to nine players can play Vic-Derby which simulates real horse racing.

Sentinels is a game which uses 3-D sentinels to block your path and keep your score down.

Vic-Voice is a machine language program which shows how pseudo voice synthesis can be achieved by using the standard VIC electronics.

Acme Software requires at least an additional 8K of memory, in addition to the VIC's standard memory, to operate.

The programs, with instruction manual, cost $20 each and can be obtained from most VIC dealers or **Acme Software, P.O. Box 1053, Richmond North Vic 3121. (03) 41-5708.**

Club Call

The Sydney Forth Group has recently been established to promote the use and understanding of the Forth computer language. The group will meet on the second Friday of each month at 7pm in room LG16, Morven Brown Building (opposite the library), University of New South Wales.

The next meeting of this group will be held on Friday April 15 which, if you checked your calendar like I did, isn't the second Friday of the month. To find out about this or for any information contact Peter Tregeagle, 10 Binda Rd, Yowie Bay NSW 2228. (02)524-7490.

The Commodore User's Group in Queensland has changed its postal address to P.O. Box 274, Springwood Qld. 4127. The President of the group is Greg Perry and meetings are held on the first Tuesday of the month at 130 Petrie Terrace, Brisbane. There's easy wheelchair access to the room, for those who require it.

The group is for the owners of Pet/CBM and VIC-20 machines and is endeavouring to meet the needs of the new CBM-64 owners. If you have any questions contact the secretary/treasurer, John Egan, on (07)287-2705.

A Super-80 User's Group has started up in Perth, Western Australia. To contact the group get in touch with either Garry Black, 19 Bendigo Way, City Beach WA 6015. (09)385-8813 or Geoff Dixon, 13 Ardross Way, Noranda WA 6062. (09)176-7662.

Intel releases high performance Multibus extension for fast access to local memory

Intel Corporation has announced a new iLBX buss extension to the company's well-known Multibus that allows a microprocessor to access up to 16M of local system memory at very high speeds.

The new iLBX (for Local Buss Extension) definition is compatible with and uses the P2 connectors of the exisiting Multibus connector layout on board-level products.

The new iLBX buss is optimized for high-speed, high-bandwidth system memory transfer such that it can be used with existing and planned 8- and 16-bit microprocessor-based single board computers and with current and future high-density memory products.

For example, the new iLBX buss allows data transfer at the rate of 9.5 megabytes per second for 8-bit data, and 19 megabytes per second for 16-bit data.

The new iLBX buss is the fourth part of Intel's buss architecture for single and multiple board-level systems.

Earlier buss specifications include the Multibus (now IEEE standard P796) system interface buss, the iSBX (now IEEE standard P959) single board expansion buss and related multimodules, and the multichannel high-speed, general purpose data path between a microcomputer system and up to 15 direct memory access (DMA) devices.

"The new iLBX buss extension rounds out our approach to buss architecture", said William W. Lattin, vice president and assistant general manager of Intel's systems group.

"Moreover, it continues the trend toward specialization of buss architectures that will be required to handle rapidly advancing Very Large Scale Integration (VLSI) technology. The iLBX buss extension will carry the basic Multibus approach through at least the next three generations of random access memory".

The development of new, high-performance microprocessors has been responsible for expanding buss architectures, such as that reflected in the new iLBX buss extension.

Earlier microprocessors, such as the Intel 8080 8-bit device, could directly access only 64K of system memory. The second generation Intel 8086, however, can directly access 1M, and the recently introduced third generation iAPX 286 can access 16M of physical system memory.

As a result, systems are being designed that use large amounts of local memory. Applications include graphics display, robotics, office and business systems, and CAD/CAM.

While advancements in memory technology have resulted in high-density memory devices such as the 64K dynamic RAM, microprocessor addressability has advanced at a faster rate.

Using 64K dynamic RAMs, for example, only approximately one-fourth of a megabyte of local memory can be placed on a typical single board computer. Configurations using large amounts of system memory require the use of separate memory boards.

The iLBX buss architecture provides a direct specialized link between up to five iLBX compatible processor and memory boards.

Because it is optimised for system memory applications, the iLBX buss provides a designer with the equivalent of up to 16M of virtual memory addressability and no-wait-state performance for new, high-performance microprocessors.

In 1982 the market for single board computers was estimated by Intel at about $375 million in sales revenue, approximately one-half of which was Multibus compatible. By 1985, according to Intel, the value of revenues is expected to grow to almost $800 million, with Multibus compatible products expected to maintain an approximate 50% share of market.

Currently, approximately 150 different firms supply over 1000 different Multibus-based products.

Details from **Total Electronics, 9 Harker St, Burwood Vic 3125. (03) 288-4044.**

Micronix to distribute ADA subset compiler JANUS

Queensland-based Micronix has been appointed Australian distributor for RR Software's ADA subset compiler called JANUS which provides programming features like walk-back, re-entrant initialised variables, true modular programming and full error messages in English.

The compiler package comes with a large set of tools for program development. In addition to the compiler, the package includes an assembler for the target machine, the JANUS linker, a disassembler, a cross reference generator, a syntax checker, example programs and the source code for the run-time libraries.

What's more, the package also includes full documentation and you can get a full screen editor, ADA textbooks and other tools.

The JANUS compiler and assembler produce relocatable code files. The linker combines the relocatable files into target machine code files. All code generated by the JANUS compiler can be stored in ROM and is re-entrant.

Code generators are currently available for 8080, Z80 and 8086/8088 microprocessors.

Further details from **Micronix, 11 Blackmore St, Windsor Qld. 4030. (07) 57-6999.**

New address for MicroPro design

The new address for MicroPro Design is 1st Floor, 192 Pacific Hwy, Greenwich NSW 2065. (02) 438-1055.

The entrance is in Bellevue Avenue.

The postal address remains the same, P.O. Box 153, North Sydney NSW 2060.

AED Universe Computers for Tonga

AED Microcomputer Products has been awarded a large contract to supply a number of multi-user Universe Supercomputer II microcomputer systems to Tongan government departments.

Multi/OS is the operating system which will be used mostly. The Universe computer provides both 8- and 16-bit facilities in the one computer.

AED will install the systems on site and provide extensive technical and non-technical operator training. Several on-site maintenance personal will also be trained.

For further information about these systems contact **AED Microcomputer Products, 130 Military Rd, Guildford NSW 2161. (02) 681-4966.**

Apple Signal Conditioners ISAAC 41A

Bell & Howell have available the low cost ISAAC 41A system which interfaces directly into an Apple microcomputer.

The basic ISAAC 41A includes the Apple interface, distribution panel, test kit, Labsoft programming language and instruction and reference manuals, turning the Apple into a powerful laboratory or process micro.

A system can be configured using any four combinations of 16 channels A/D, four channels D/A, 16 bit in and 16 bit out.

A further enhancement is to use the Remote Input system to configure for low level signals such as transducers, thermocouples, etc.

Together with the Apple, the system can be used in chemical, engineering, psychology, physiology and process applications.

For further information contact **Bell & Howell Australia Pty Ltd, Electronics & Instrumentation Div, GPO Box 4788, Sydney NSW 2001. (02) 660-5366.**

Five books for TRS-80 users

The Richcraft Engineering Co of New York has produced a series of five volumes for users of the Tandy Mod I and Mod III.

The material is also applicable to the Dick Smith System 80.

Volumes 6 and 7, which are in preparation, feature the ultimate radio teletype program and packet radio.

The books cover little known functions of the Microsoft ROM, Morse, RTTY, ASCII, Bulletin Board, analogue and digital conversions, satellite locator and a host of other interesting and useful programs.

They were originally intended to be tutorials for student machine language programmers. They contain information for programmers, amateur radio operators or users of these computers who are not interested in these fields.

The programs are mostly in machine language and, for those who do not wish to enter the programs themselves, single sided disks are available covering each volume. Mod III disks are available for vol 5 only. All disks are compatible with TRSDOS and NEWDOS 80.

For the amateur radio operator these books represent the least expensive way of getting into computer operated morse, RTTY and ASCII.

Simple interface circuits for the Mod I are available. Minor hardware and program alterations for the Mod III are fully covered in the text.

Northern Digital, P.O. Box 33, Charlestown NSW 2290, is the Australia and New Zealand distributor of these products.

Intelec address

Intelec Data Systems has moved to 217 Blackburn Rd, Mount Waverley, Vic. 3149. (03) 233-1844.

The new larger premises cater for demonstration, training and support facilities of the Charles River Universe 68 computer system together with the Charles River DEC based systems, Servogor Plotters and Datamedia Video Display Terminals.

Expansion chassis for VIC20

An expansion chassis unit for the Commodore VIC20 is available from Seahorse Computers.

It fits into the VIC20 expansion slot and provides sockets for up to four memory expansion modules or ROM cartridges.

This well-made unit from DATA20 is available for $59.95 plus $1.50 post and packing from **Seahorse Computers, 10 Mitchell St, Camden NSW 2570. (046) 666-406.**

UniFLEX on Pennywise systems

Pennywise Peripherals, Australian manufacturers of 6809 microcomputer systems, has just completed a licensing agreement with TSC to run UniFLEX, the UNIX-like multiuser, multitasking disk operating system.

Each intelligent peripheral controller has an on-board 6809 with a DMA channel to main memory. The intelligent disk controller controls both floppies and hard disks, together with a serial and parallel printer. The intelligent VDU controller can handle up to five VDUs. Any number of controllers can be installed.

Pennywise Peripherals offers systems with dual double-sided, double-density eight inch floppies and an optional five inch Winchester disk up to 20M. At present an interface is being developed for eight inch Winchesters which are available with over 100M.

UniFLEX languages include Pascal, BASIC, Fortran, Cobol, C and Assembler.

For more information contact **Pennywise Peripherals, 96 Camberwell Rd, Hawthorn East Vic. 3123. (03)82-2389.**

Taking a leaf from the Apple tree —

The Microprofessor II

Clearly marketed as a strong contender in the home/educational computer market, Multitech Industrial Corporation's latest offering is a colour computer featuring Apple BASIC software compatibility, 64K of RAM on-board and plug-in ROM-based software.

Roger Harrison
Jonathan Scott

THERE HAS BEEN much controversy over the past year about 'clones' or copies of the highly successful Apple II appearing on the market. The US-based Apple company has been vigorously pursuing the protection of their rights in Taiwan, Hong Kong and Japan in an effort to stamp out the manufacture and distribution of machines which are both hardware and software copies of the Apple II.

The Microprofessor II is *not* one such beast. Its link to the Apple II is via the BASIC compatibility that Multitech claim for it and some hardware similarities.

Compared to the Apple II, the MPF II is positively leprechaun-ish, measuring a mere 175 mm wide by 241 mm deep by 30 mm high! At the front is a scaled-down, calculator-type keyboard with 49 keys in the familiar QWERTY layout. This keyboard has a 'standard' overlay showing all the 'shifted' functions available which includes one-key BASIC commands (after the fashion of Sinclair's ZX81 and Spectrum). An overlay for special graphics symbols is also supplied.

Located down the left hand side of the machine are a number of connectors: at the rear is a 50-pin socket that is similar to an Apple II 'slot'. Just in front of that is a Centronics-type parallel interface socket for a printer and forward again of that is another, similar socket, for either a remote keyboard or a joystick controller.

On the rear panel is the power supply connector, cassette recorder connectors, TV output (from an RF modulator) and a direct video output (monitor).

The MPF II comes with 64K of RAM, 16K ROM with operating system (OS), monitor and BASIC. The video display is memory-mapped into system RAM and, like the Apple II, you get text, low-res and high-res graphics. The screen format on text is the same as the Apple's — 40 columns by

24 lines, as is the character set — standard ASCII, 64 characters 5 x 7 dot matrix. In low-res graphics mode you get a 40 x 48 array (1920 blocks); in high-res you get a 280 x 192 array (53 760 dots). Six colours can be called on the video display: black, white, green, purple, orange and blue (although black and white are not colours as such).

In low-res graphics mode, you can colour your blocks using any of those colours, anywhere on the screen. In high-res graphics mode dots in the even-numbered screen columns can only be coloured black, blue or purple while dots in the odd-numbered screen columns can only be coloured black, green or orange.

A speaker is housed in the top of the MPF II case, at the right rear. You can address the speaker from software to create sounds.

A remote full-size keyboard is available as an option and one was supplied as part of the review equipment. This has switches beneath rubber keys and, frankly, we found it terrible to use. It is a 55-key unit in the general QWERTY layout with two FIRE keys at either end of the base row.

The cursor control keys are not only non-standard but difficult to use with left and right keys duplicated on different ranks. All the 'shifted' functions are printed either on the keyboard face or the keys themselves, including the special graphics characters. That's a saving grace, but the key operation is where it falls down.

All is not lost, though. It seems a 'proper' keyboard is on its way and should be released around mid-year.

Software in ROMs is available and come in a plastic pack that simply plugs into the 50-way connector. We received a number of ROM software packages with the review equipment: Space Invaders, Rain (rather like 'Galaxians') and a demo pack. A word processing package is to be released shortly, we understand.

A disk drive, or dual disk drive, can be obtained for the MPF II. Either plugs into the MPF II via an interface unit that slips into the 50-way connector. We received a single disk drive unit with the review equipment with which we were able to assess the disk-based compatibility between the MPF II and the Apple II.

You get an MDOS II disk and a blank disk with the disk drive and, for converting Apple II DOS 3.3 software to MPF II DOS, you can obtain an 'ATOM' disk as an optional extra.

We also received a joystick with the MPF II. This comes in a rectangular plastic case with a switch-type joystick handle at one end and 'fire' button at the other. Size-wise it seems to be more suited to the average 10 year-old's hand, rather than an adult's, which makes sense. Pity it's not an analogue type. With Apple II software calling for an analogue joystick, you're in trouble (and probably in more ways than one — see under 'Apple Compatability'). The joystick is, however, adequate for the ROM-based software which was supplied with the review equipment.

The machine itself comes with an Installation Manual, a User's Manual and an Introduction to BASIC Programming. Each peripheral comes with an instruction booklet. ROM-based software throws up instructions on-screen.

Operator-wise

For the first-time computer user, the MPF II is straightforward to set up and easy to use, particularly for those under 16. The on-board keyboard is for two-finger hunt-and-peck typists (otherwise known as biblical system typists — seek and thou shalt find) under 16 years of age (small fingers).

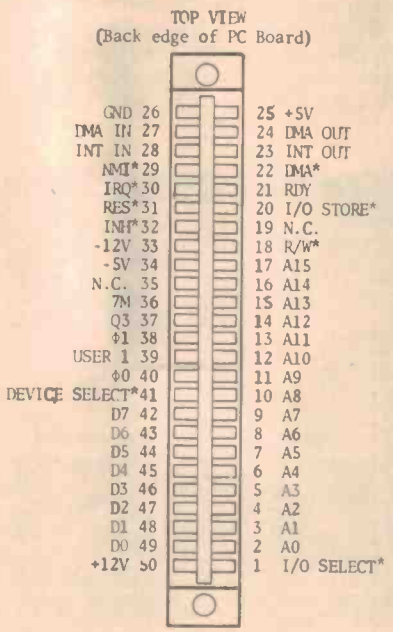
The full-size add-on keyboard we were given with the review equipment is an abomination. The space bar is ineffective unless you hit it in the right place, your fingers are often deflected by the rubber keys without operating the key switch and some keys are unconventionally placed.

Presumably the next model of outboard keyboard will be better. Here's an opening for a do-it-yourselfer to attach his own keyboard. It should be pretty simple as only a scanned row-and-column arrangement is involved.

The machine design at the hardware level is very good — compact, powerful and capable, within the usually necessary constraints. There is one drawback with the ports — you can only plug one thing in at a time to the erstwhile-Centronics port (the keyboard/joystick connector is not a port), unless you have some sort of port expansion plugged into the 50-way slot. Which brings us to the next one — you can virtually only have one thing at a time plugged into the 50-way slot. But that's a price you pay for simplification on a lower-priced machine. It seems an acceptable compromise under the circumstances.

The games ROM packs are great. They can be plugged in upside down but the label identifies which way is up. The software we got with the review equipment was well thought out and well executed; Rain being the favourite!

The graphics is quite good, but not a lot is said about it in the documentation. It is apparent that you need to have much Apple documentation to exploit this aspect of the MPF II to the fullest.



The text on-screen is just as ugly as the Apple's. It's a pity this couldn't be fixed, but then the MPF II wouldn't emulate the Apple as closely as it does and confusion might arise. It seems that Multitech intend the MPF II to be purchased and used, by the educational sector of the market, as an adjunct to an existing Apple-based teaching setup.

Having both RF modulated and direct video outputs is a big plus for the MPF II. The RF output would primarily be used in the home, the direct video where a monitor is available.

There's a powerful argument for purchasing the MPF II for a student, for use at home, where Apples are used at school. But beware the compatabilty question, to which we shall now address ourselves.

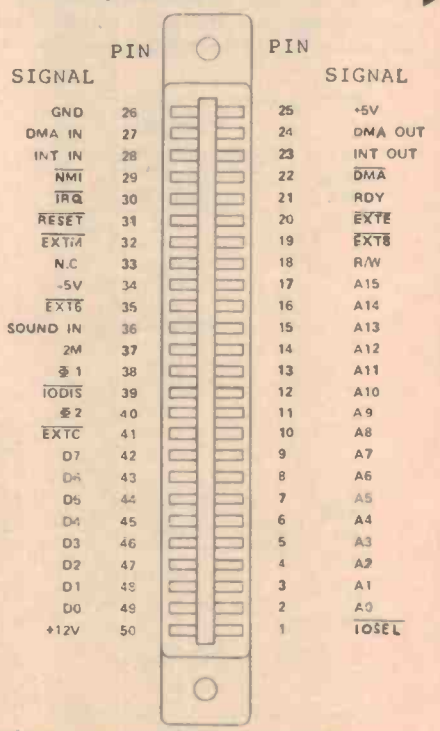
Apple compatible?

The MPF II is described as 'Apple compatible', and a strong case is made in the billing for its ability to draw on the vast reserve of support for the Apple II machine. Just how compatible is compatible?

Well, basically it is designed very much the same as the Apple II. It is a 6502 based system with identical graphics capability and identical monitor layout and BASIC operation.

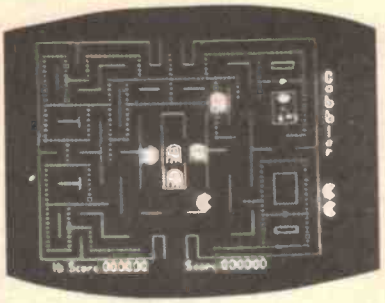
It comes with a 16K page of RAM which can be switched in over the ROMs, built-in printer interface capability and graphics colour ability; which three things must be added in three of the expansion slots of all but the very latest model Apples, where these are standard in the MPF II.

It has only one slot with the format of the Apple expansion slots, so clearly it will be unable to replace a system which uses more than one expansion slot beyond the three functions mentioned above. (The disk drive, if used, requires a slot.) ▶



Apple slot versus the MPF II's. On the left is the standard Apple II slot pinout. On the right is the MPF II's single 'slot' pinout. Major differences on the MPF II connector are at pins 19, 20, 32, 33, 35, 36, 37, 40 and 41 but you'd have to directly compare them to see how it matters in particular circumstances.

Text. Example of the text screen format — 40 columns by 24 lines.



Mixed screen: Much of the games software has mixed text and hi-res graphics.

Ogle-boggle. Focus your eyes on that! Example of the hi-res graphics (and it was in colour).

However, this is OK for most systems not dedicated to some peculiar task. There are machine differences in the MPF II, but these are hidden from the user by the operating system (OS) and disk operating system (DOS). It will read Apple disks directly once the DOS is booted from an MPF disk; it is also provided with a utility for updating Apple disks to MPF II DOS or MDOS. This is where the compatibility ends, however.

While memory (RAM) usage is kept identical in format, certain machine locations are different. Any program which PEEKs or POKEs, or is direct rather than going through the interpreter and DOS, is liable to malfunction because it does not have the totally identical machine layout to the Apple.

A good deal of existent software will bypass the interpreter occasionally, and fail; but such programs can be modified to work on the MPF II. The adjustment to these programs which PEEK and POKE past the BASIC system should be trivial. For instance, the PEEKing at the keyboard can be moved to the correct location. The holdup is the acutely rudimentary documentation provided.

Programs which use machine routines for I/O are no good at all on the MPF II. The more sophisticated games or well protected disks that tamper with the straight DOS are flat useless. It would represent a lot of work, but some program-inspecting program utility might be concocted for the upgrade of packages with simple hardware PEEK/POKEs, but the job would be hard for anyone who had to sift the documentation for clues as to what was what. It would also not help the cases of machine level programs — BRUNning an Apple file is doomed on the MPF II. (It should be noted that most fast action or heavy thinking Apple games are of this sort.)

The above notwithstanding, programs and routines can be readily transferred from the MPF II to the Apple II because of the disk compatibility. Any software written with compatibility in mind would be OK, because the changes, *once you know what they are*, are not too major it would seem. So you could work hand in hand with Apples, but a good deal of the Apple support stuff is not instantly useable.

Peripherals

We received a single disk drive (with interface) and a dot matrix thermal printer with the review equipment.

The disk drive is a 'slimline' 5¼" unit that comes with an interface that plugs into the 50-way slot. It works just like an Apple II disk drive — which means the disk format is unique — quite unlike any other disk system on the market. This unit operated perfectly and we had no serious hitches in using it.

The printer is a thermal type and will print the standard 96 ASCII character set, 40 columns to the page. Each character is a 5 x 7 dot matrix in a 7 x 10 dot raster. On graphics it can print 280 dots per horizontal line and you can access 50 internal-generator graphics symbols.

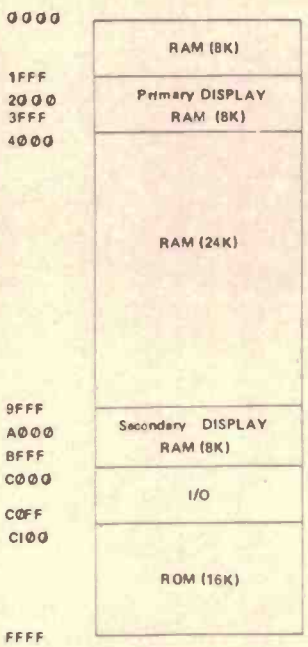
Printing is bidirectional at around 150 to 180 lines per minute. The paper is 112 mm wide. Printing pitch is 0.36 mm character-to-character, line pitch 0.42 mm. The print head has two sets of 20 needles and is replaceable. Quoted life is one million lines. The interface is a Centronics-style 8-bit parallel type. Seeing as this is a relatively inexpensive printer, it will no doubt find a market for itself aside from the MPF II.

The print quality is adequate, considering the cheapness of the unit, and the graphics reproduction remarkable for a printer of this type.

Documentation

While it is apparent that Multitech is aware of the necessity of good documentation, and have appeared to have gone to some length to prepare comprehensive, illustrated manuals for Chinese or Japanese consumption, as English translations they're abyssmal. With some effort, you'll make sense of them. But, they're poorly organised — even though everything is there — and the peculiar 'Chinglish' makes it hard going. Also, it demands Apple documentation to be really useful in depth.

If you're using, or intend to use, the MPF II in conjunction with an Apple, well and good, otherwise arm yourself with as much literature on the 6502 and the Apple II as you can muster. ▶



Take a left at 9FFF. Memory map of the Microprofessor II.

You can be boss of the DOS. On the left is the MPF II DOS boot disk which comes with a utility for converting Apple DOS programs on disk to MPF II DOS. For programs running under Apple II DOS 3.3, you use the ATOM disk, at right. The disk interface manual assumes you are already familiar with the Apple II DOS manual.

Micro-Professor

MPF-II

Only $549

plus sales tax

A VERSATILE PERSONAL COMPUTER FOR PEOPLE FROM THE AGE OF 5 TO 95

HOME

For finding either an exciting new electronic hobby or ways to just take it easy, there's no place like home. And no computer quite like the Micro-Professor. Since MPF-II runs most of the existing Apple II software for home management and entertainment, you'll never be at a loss for interesting and work saving ways to apply its capabilities. For keeping tabs on family budgets and investments, managing personal finances, balancing a chequebook and spotting stock trends, exploring the emerging worlds of computer music, art, design and animation — the MPF-II is invaluable.

GAMES

The games people play today with personal computers like the Micro-Professor are simply amazing. There's a lot more to games than meets the eye. There are mind games — like bridge and chess — where planning counts for more than luck, and games of chance like poker and blackjack, where remembering the computers last card can help you win. Then there are fantasy games and games for the sports minded too. In all of these, there's still the basic challenge of the game: to win over a worthy opponent. In the case of MPF-II a very worthy one.

BUSINESS

If you can get the Micro-Professor away from your kids, it can be a valuable tool at work too. Because of its compact size it can be carried comfortably if you're on the road a lot. If you operate your own business and have to keep a close tab on expenses, the modestly priced MPF-II can actually pay for itself almost immediately. With it, you can use many of the pre-written programs for accounting, payroll, job costing and inventory control. If you have a special problem unique to your business, you can write your own programs using one of MPF-II's several high-level language options. Then too, if you're a member of a large organizaiton who can't get access to mainframe computing power, you'll appreciate the convenience of having an MPF-II right on your own desk.

EDUCATION

If education is "what's left after you've forgotten all the facts" then with a powerful learning tool like the Micro-Professor, you should begin to notice more of "what's left". With educational packages that run on MPF-II students are constantly challenged in new ways, and individually prompted to respond — something that doesn't usually happen in a large classroom. With self-paced, interactive learning sequences, students can work through exercises in reading, math, science — any academic subject, or practice skills in more practical areas, such as typing. They can even begin to prepare for the computer age by becoming familiar with basic concepts in machine logic, programming and data structures.

The Micro-Professor MPF-II is the perfect computer for modern homes. All the features that a home/personal computer can have are packaged in the compact, portable MPF-II.

EMONA COMPUTERS

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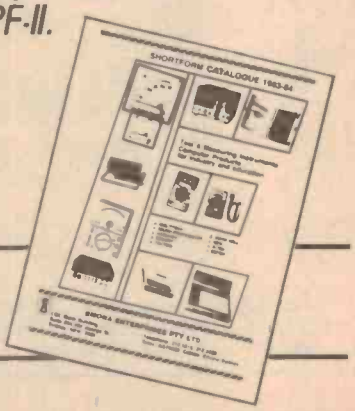


Software notes

Looking at the MPF II on its own, software-wise it's powerful and flexible. Without a disk drive, most of the user RAM will go to waste, but if you're going to get at all serious about computing, a disk drive will be contemplated at some stage — probably sooner, than later.

Rooting through some of the published Apple software and trying it out, we experienced no difficulties, providing all that was involved was straightforward Applesoft BASIC. A really useful feature of the MPF II is the one-key entry of BASIC commands using the shift and control keys (strictly, that's three keys, but you get the gist . . .).

On top of the Applesoft BASIC commands, the MPF II BASIC interpreter has some 90 additional commands, so the BASIC you get is pretty versatile. Note that text and graphics can be mixed in the same way as with the Apple II.

Using the MPF II with its printer is a breeze. You can get a screen dump (direct copy of what's on the monitor's screen) or just have it obey the common set of PRINT commands.

We suspect there may be a not-inconsiderable demand for local software backup on either disk or tape, or even ROM packs.

The cassette interface seems to work well. We received a 'Micro-Nurse' diagnostic program on cassette with the review equipment which tests the hardware and software, throwing up OK or FAIL messages as you go.

Summary

The MPF II is an intriguing and potentially powerful machine marketed at a very attractive price. It has a great deal to offer, particularly if it is intended to be used in conjunction, at least in association, with an Apple II.

Starting with the basic machine, you can progress to a 'proper' disk-based system and full-size keyboard in easy stages, which is a great plus. The on-board BASIC is flexible and, being compatible with Applesoft BASIC, is backed up by a large amount of published and commercially available software.

It's a pity there isn't more machine-level compatibility between the MPF II and the Apple II, but that might transgress Apple's patents and copyrights, so it seems understandable.

From a practical, user point of view, the on-board keyboard will likely prove an early frustration, particularly if you start getting into some heavy programming.

The documentation is disappointing, but it does contain pretty well all the information you'll need. Only you'll have to do some digging and Chinglish-English translating to get at it. Just to ameliorate that blow a little, *very, very few* personal computers on the market have decent documentation so the MPF II is at no real disadvantage in the documentation department. And considering the huge array of literature on the 6502 and the Apple II, it's well supported with additional material.

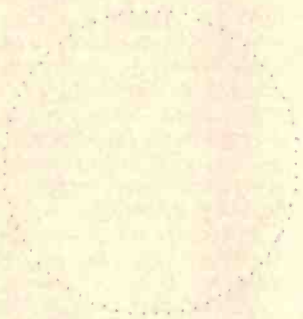
If you lust after an Apple II, but your budget falls way below the probable possession line, the MPF II is the next best thing. If you're after a 'starter' home computer that can grow as your needs grow — and not cost you an arm and a leg on the way — then the MPF II is certainly worth very close scrutiny.

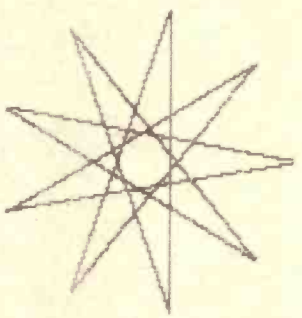
Despite the drawbacks we've critised, we suspect the MPF II will be a popular machine. ●

ACKNOWLEDGEMENTS

Review equipment supplied by Emona Enterprises Pty Ltd, CBC Bank Building, 661 George St, Sydney NSW 2000.

We would like to acknowledge the kind assistance of Visionhire who loaned us a Philips colour monitor receiver for the evaluation of this and other products.





```
>
>LIST

  1  HGR2
  2  HCOLOR= 3
 10  PI = 3.14159
 20  X = 100
 30  Y = 100
 40  R = 60
 50  INC =  .09
100  FOR THETA = 0 TO 2 * PI STEP INC
110  HPLOT R *  COS (THETA) + X,R *  SIN
 (THETA) + Y
120  NEXT THETA
>
>
>
```

```
>
>LIST

  1  HGR2
  2  HCOLOR= 3
 10  PI = 3.14159
 20  X = 100
 30  Y = 100
 40  R = 60
 42  X2 = X + R
 43  Y2 = Y
 44  N = 8
 45  A = 2.25
 50  INC = 2 * PI / A
100  FOR THETA = 0 TO N * PI + INC STEP
INC
105  X1 = R *  COS (THETA) + X
106  Y1 = R *  SIN (THETA) + Y
110  HPLOT X2,Y2 TO X1,Y1
115  X2 = X1
116  Y2 = Y1
120  NEXT THETA
>
```

Hard copy. Examples of printouts direct from the MPF II printer, about 90% actual size. Both are screen dumps of two versions of a hi-res graphics program with the program listed beneath the display.

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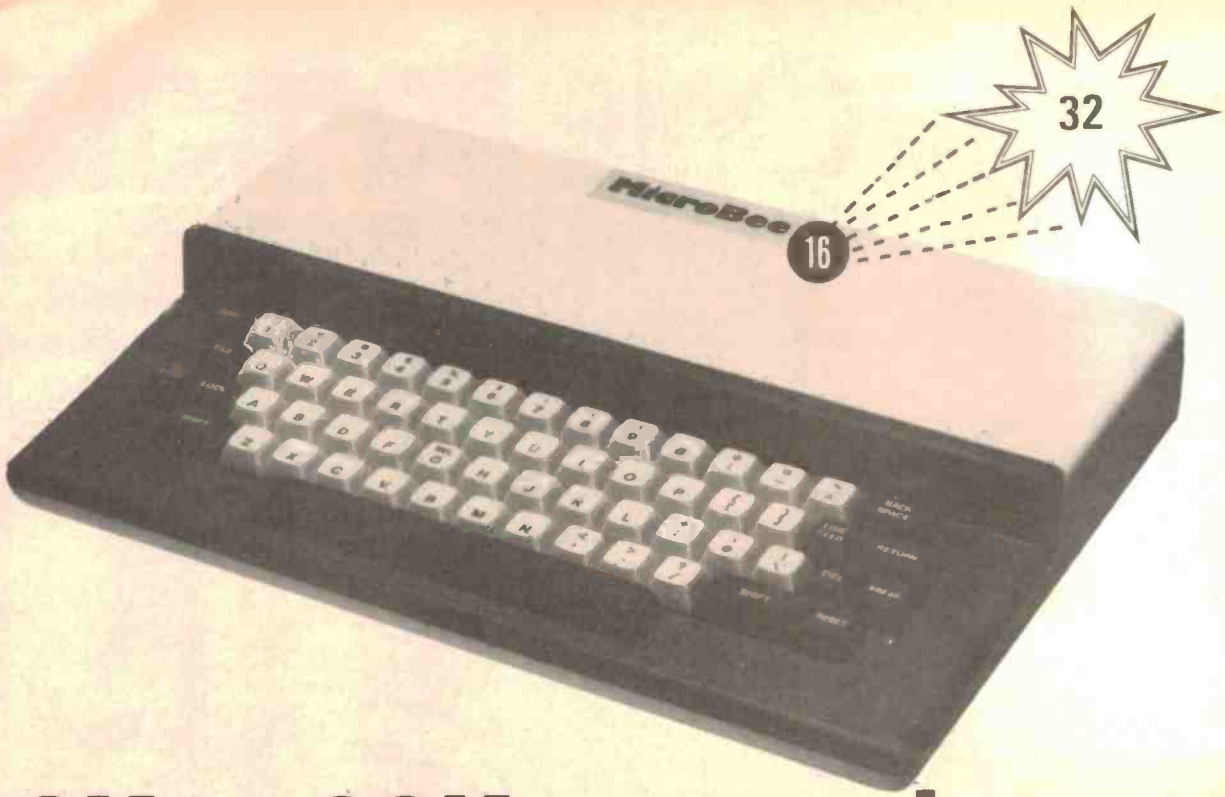


16K to 32K expansion for your MicroBee

Considering going on to bigger and better things with your MicroBee? Not afraid of a little soldering and want to save money? Here's how!

Tom Moffat

PAGE TWO of my MicroBee construction manual says: "Should you wish to upgrade your 16K MICROBEE you will need to purchase a 32K changeover CORE BOARD. WARNING do not attempt to upgrade your 16K board as this will invalidate your warranty and will require an updated BASIC anyhow."

But don't believe everything you read. It is entirely feasible to upgrade your own MicroBee memory, if you take care. Yes, you will blow your warranty, but the warranty only runs for 90 days. That much time has probably passed already now that you've learned to use your MicroBee, and want to move on to bigger and better things.

As for the "updated BASIC" all I can say is the BASIC in my MicroBee handles expanded memory nicely without any updating. It took a bit of digging to discover this. The MicroBee Users Manual gives the 'top of memory' pointer location as 00A0 (hex). The 'Search' feature of the MicroBee Monitor was used to find a load instruction to that address. Sure enough, there it was in the BASIC ROMs at 857D. It was then necessary to work backwards from that address, disassembling the code by hand, to find how the data for the top of the memory pointer was developed.

It seems that the MicroBee finds out where the memory ends automatically by testing each byte and declaring "end of memory" when the test fails or when the start of the BASIC ROMs is reached. So it can cope with any amount of memory up to 32K, in any sized blocks. The relevant part of BASIC is reproduced in Listing 1, for those interested.

Pros and cons

Now to the pros and cons of doing it yourself. The prime advantage is financial . . . it cost exactly $75.40 to turn my MicroBee 16 into a MicroBee 32. Applied Technology charges $125 to change a 16 into a 32 PLUS. The 'PLUS' part involves supplying the parallel port plug and the battery backup arrangement, another seven dollars or so worth of goodies.

This is not to suggest that Applied Technology is ripping anybody off. If you took your 'Bee to your local electronics shop they'd probably charge more than $125 for the job. After all, there's a lot of labour in it. If you do it yourself, you supply the labour and you save the shipping which, from Tasmania at least, is dreadfully expensive.

Now before you get stuck into it, it's time to do a bit of soul-searching. Are you technically competent to do it? Is your soldering up to truly *professional* standard? Is your soldering *iron* up to professional standard? Something like a Weller or Adcola temperature-controlled soldering station is needed with the finest possible tip.

Do you have one, or can you borrow one? Look at the pictures, you'll notice that just about all IC pins have other tracks running between them on the board. It will be a very delicate job, and a mistake could ruin your MicroBee forever. If you don't feel you're up to it there's certainly no shame in handing it over to Applied Technology.

Ready?

If, after all that scary stuff, you still want to press on, here's what to do. First, get your ICs and eight 10n 'blue chip' ceramic bypass capacitors, or similar. My ICs were bought from a normal supplier in Hobart, and the capacitors were ratted from a defunct computer board (these are usually very good quality).

Because of the MicroBee's memory testing feature it is possible to upgrade your computer in 2K stages. You only install the chips you need, or can afford. Table 1 sets out what chips are required for each level of 'K', and it should be understood that each level's

LISTING 1

```
ADDR    CODE    LINE    LABEL   MNEM    OPERAND

                00100 ;END OF MEMORY DETERMINATION, FROM BASIC. 16/1/83
                00110
0400            00120           DEFR    16
8567            00130           ORG     8567
E000            00140 DEBUG     EQU     0E000
8567 210009     00150           LD      HL,0900 ;START OF BASIC
856A 3E80       00160 JUMP1     LD      A,80
856C BC         00170           CP      H
856D 280E       00180           JR      Z,JUMP2 ;GET OUT IF HL=8000
856F 7E         00190           LD      A,(HL)  ;LOAD BYTE INTO ACCUMULATOR,
8570 2F         00200           CPL             ;TURN IT UPSIDE DOWN,
8571 77         00210           LD      (HL),A  ;AND PUT IT BACK.
8572 2B         00220           DEC     HL
8573 70         00230           LD      (HL),B  ;PREVIOUS BYTE INTO B
8574 23         00240           INC     HL
8575 BE         00250           CP      (HL)    ;COMPARE A WITH (HL)
8576 2005       00260           JR      NZ,JUMP2;NO GOOD? GET OUT.
8578 2F         00270           CPL             ;TURN BYTE OVER AGAIN
8579 47         00280           LD      B,A     ;AND PUT IT INTO B.
857A 23         00290           INC     HL      ;NOW DO NEXT BYTE.
857B 18ED       00300           JR      JUMP1
857D 22A000     00310 JUMP2     LD      (0A0),HL;TOP OF MEMORY POINTER
0000            00320           END
00000 Total errors

JUMP2   857D    JUMP1   856A    DEBUG   E000
```

requirements are in addition to previous levels. Even if you're going for the full 32K it's a good idea to upgrade 2K at a time, testing as you go.

To begin the job, open up the MicroBee, disconnect the memory battery (if installed), and carefully unplug the core board. If you don't know what the core board is STOP right now and don't attempt the upgrade.

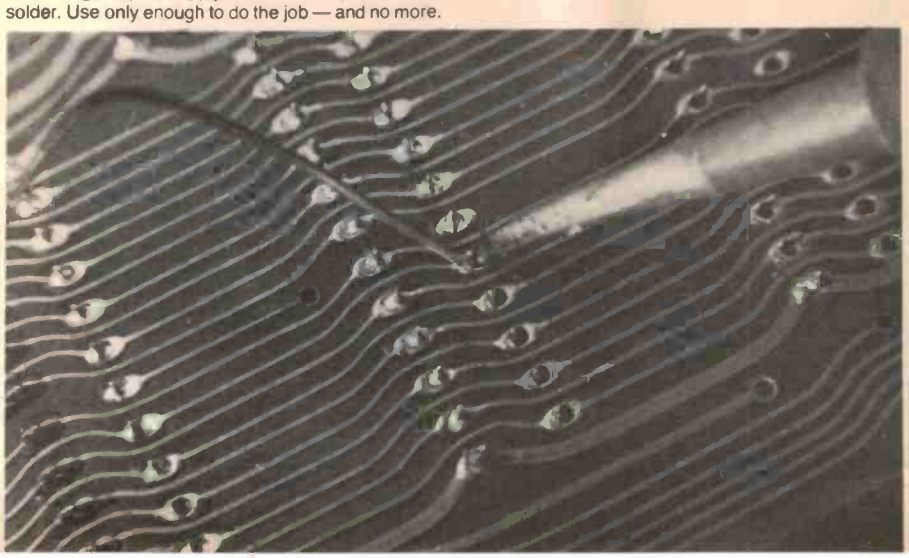
Put the computer aside and lay the core board on the workbench. Study the silk screened labelling on the top (component side) and work out what ICs go where, and which way around. In other words think the job through in advance.

Now, install the eight bypass capacitors in their positions next to the empty memory chip locations. You might as well put them all in even if you're not installing all the memory now.

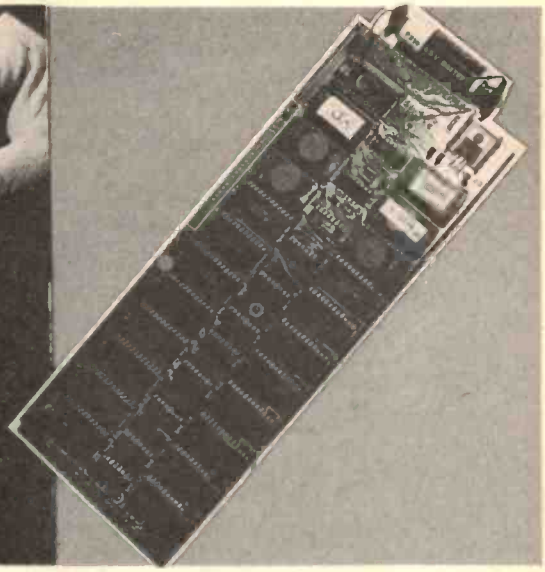
Next come the ICs. Start with the small ones first to get a bit of practise for the big ones. When soldering them in, remember that they are CMOS devices and you should take the usual precautions against static damage. Don't handle the pins, pick up the packages with your thumb and forefinger holding the ends only. Use a soldering iron with an earthed tip and solder the supply and earth pins first. ▶

TOTAL K	74LS138	4053	6116P	PEEK(161)
18	IC14	IC16	IC13	72
20			IC15	80
22			IC17	88
24		IC19	IC18	96
26			IC20	104
28			IC21	112
30		IC23	IC22	120
32			IC24	128

Soldering the pins. Apply the iron to the pin and the pad from the 'inside' of the IC, heat the joint, *then* apply the solder. Use only enough to do the job — and no more.



Inspect it! Inspect each soldered joint carefully. Look for solder 'bridges' across tracks, pins not soldered, etc.



Finito! The completed coreboard — now the 'full bottle' 32K.

Look at the close-up photograph. Notice that the soldering iron tip is applied to the pins from the 'inside the IC' direction. You press down on the pad and the pin at the same time and then apply the solder from the 'outer' side of the pin. Each pin will take about two seconds to do, keeping the total heat input to a reasonable level.

The results should look like the photograph . . . just enough solder to do the job and no more.

Test as you go

Testing your work is simple. After each 2K, reinstall the core board and fire up the computer. It should 'beep' into a cold start. If you inspect location 161 (decimal) with a PEEK instruction, you will find where the MicroBee thinks the end of memory is. If it agrees with where *you* think the end of memory is, congratulations.

If you've gone for the full 32K, try out the 'self-test' routine by holding down 'S' and operating RESET at the same time. The computer should now pass the '32K RAM' part of the test that it had always failed in the past. ●

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1000uF	25v	pcb	5 FOR $2
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THE VIC-20 COLUMN

'LOTTO 8' SELECTOR

H.J. Smith, Tempe NSW

If you're into the 'numbers game' — Lotto — you'll know how tedious it is choosing the field of numbers each week. Here's a program to automate the task, especially written for syndicate pickers.

Seven mates and I go into an 8x8 ticket each week. I have a VIC-20 with printer attached and press it into service to provide a string of printouts. I run the program and cut up the printout so we can all have the fun of following the numbers.

The program listing reproduced here is pretty well self explanatory for those with a modicum of experience with VIC BASIC. Note that the listing has been printed out in lower case. All the calculations are performed between lines 10 and 70, the rest is basically output formatting.

A sample of the printout is shown below.

```
          Lotto: 14
G1- 4  17  32  15  33  34  25  7
G2- 21  1  12  20  30  24  22  11
G3- 22  20  16  3  8  24  38  7
G4- 32  26  18  38  35  12  31  24
G5- 14  3  24  7  4  8  10  17
G6- 17  1  16  34  31  27  30  25
G7- 25  10  24  16  37  30  5  17
G8- 7  9  15  27  22  3  4  39
```

```
 2 print"{clr}"
 3 print:print:print:print:printspc(6)"systems 8":print:
          printspc(8)"lotto"
 4 fort=1to3000:nextt
 5 printchr$(9)+chr$(14):gosub1010:print"{clr}"
 6 print:print:input"Lotto Week Number:";v
 7 input"No.of games:";z:print:input"Printout Y or N:";
          w$:print"{clr}"
 8 ifw$="y"thenopen3,4,7:ifw$="y"thencmd3
10 rem"lotto"
11 dimq(63):dimx(7)
30 s=int(1+40*rnd(0))
31 s(x)=s:onxgoto107,106,105,104,103,102,101,100
33 ifx=7thengosub50
34 x=x+1:ifx=9thenx=0
36 ify=zthen70
37 goto30
49 print:print
50 prints(0);s(1);s(2);s(3);s(4);s(5);s(6);s(7)
53 y=y+1
54 onygoto300,400,500,600,700,800,900,1000
55 return
69 r=r+1
70 print:print:printspc(6)"Lotto:";v
73 print"G1-";q(0);q(1);q(2);q(3);q(4);q(5);q(6);q(7)
75 print"G2-";q(8);q(9);q(10);q(11);q(12);q(13);q(14);q(15)
77 print"G3-";q(16);q(17);q(18);q(19);q(20);q(21);q(22);q(23)
79 print"G4-";q(24);q(25);q(26);q(27);q(28);q(29);q(30);q(31)
81 print"G5-";q(32);q(33);q(34);q(35);q(36);q(37);q(38);q(39)
83 print"G6-";q(40);q(41);q(42);q(43);q(44);q(45);q(46);q(47)
85 print"G7-";q(48);q(49);q(50);q(51);q(52);q(53);q(54);q(55)
87 print"G8-";q(56);q(57);q(58);q(59);q(60);q(61);q(62);q(63)
88 ifr=8then90
89 goto69
90 rem
91 ifw$="y"thenclose3
92 end
100 ifs(x)=s(7)then30
101 ifs(x)=s(6)then30
102 ifs(x)=s(5)then30
103 ifs(x)=s(4)then30
104 ifs(x)=s(3)then30
105 ifs(x)=s(2)then30
106 ifs(x)=s(1)then30
107 ifs(x)=s(0)then30
108 goto33
300 q(0)=s(0):q(1)=s(1):q(2)=s(2):q(3)=s(3):q(4)=s(4)
301 q(5)=s(5):q(6)=s(6):q(7)=s(7)
302 goto55
400 q(8)=s(0):q(9)=s(1):q(10)=s(2):q(11)=s(3):q(12)=s(4)
401 q(13)=s(5):q(14)=s(6):q(15)=s(7)
402 goto55
500 q(16)=s(0):q(17)=s(1):q(18)=s(2):q(19)=s(3):q(20)=s(4)
501 q(21)=s(5):q(22)=s(6):q(23)=s(7)
502 goto55
600 q(24)=s(0):q(25)=s(1):q(26)=s(2):q(27)=s(3):q(28)=s(4)
601 q(29)=s(5):q(30)=s(6):q(31)=s(7)
602 goto55
700 q(32)=s(0):q(33)=s(1):q(34)=s(2):q(35)=s(3):q(36)=s(4)
701 q(37)=s(5):q(38)=s(6):q(39)=s(7)
702 goto55
800 q(40)=s(0):q(41)=s(1):q(42)=s(2):q(43)=s(3):q(44)=s(4)
801 q(45)=s(5):q(46)=s(6):q(47)=s(7)
802 goto55
900 q(48)=s(0):q(49)=s(1):q(50)=s(2):q(51)=s(3):q(52)=s(4)
901 q(53)=s(5):q(54)=s(6):q(55)=s(7)
902 goto55
1000 q(56)=s(0):q(57)=s(1):q(58)=s(2):q(59)=s(3):q(60)=s(4)
1001 q(61)=s(5):q(62)=s(6):q(63)=s(7)
1002 goto70
1010 print:print"The program will request :-"
1011 print:print"1..Week Number"
1012 print:print"2..Number of Games"
1013 print:printspc(3)"(1 to 8)":fort=1to3000:nextt
1014 print"{clr}":print:print:print
1015 print"The program will then":print
1016 print"random select numbers":print
1017 print"and then  printout a":print
1018 print" copy  for each synd-":print
1019 print"icate member.":
1020 fort=1to3000:nextt
1021 return

ready.
```

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Max. RAM on Board	32K	5K	32K	48K
Professional Typewriter Keyboard	YES	YES	NO	NO
R.F. with sound modulators built-in	YES	NO	YES	YES
Built in Power Supply	YES	NO	YES	YES
RS-232C Built-in	YES	NO	YES	NO
Sound	YES	YES	YES	YES
Screen Display	24 x 40	22 x 23	16 x 32	24 x 40
Programmable Characters	YES	NO	NO	NO
Upper/Lower Case Characters	YES	YES	YES	NO
Dedicated Graphics	YES	YES	NO	YES
User-Programmable Function keys	8	YES	NO	NO
CPU	Z80	6502	6809E	6502
Clock Speed	2.2MHz	1 MHz	0.89MHz	1.8MHz
Baud rate	1200	300	1200	1200
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TURTLE GRAPHICS — A very clever program allows the student to use the MicroBee to draw using high resolution turtle graphics. A booklet of procedures is available from the N.S.W. Department of Education. This is a very powerful graphics program which uses the PCG facility of the Microbee to its full extent. **$14.95**

WORK-A-BEE — A new release. Work-A-Bee is a program which can actually write educational programs almost automatically! Any teacher with little or almost no knowledge of **BASIC** can insert details as to question and answer, number of tries, marks per question and other controls. Any **CAI** program can be saved and reused and subroutines have been included to enable the student to go back over his work, printing answers, avoid error traps etc. **$14.95**

CONCENTRATION — A real family favourite for 1 to 4 players to test your memory skills. If you call one player Merlin, the computer will play that turn so watch out! **$9.95**

BUSY-CALC — Yes, an electronic spread sheet running under microworld **BASIC**. Accepts text and numbers with easy cursor control. Commands include:— Average; Sum; Compute; Format; Recalculate; Load and Save. Ideal for cash flow projections, bill of materials and even classroom data. **$14.99**

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Z TREK — Captain! The warp drives are disabled, the Klingons are closing in on us, what will we do? In Z Trek you are the captain of the starship Enterprise, your five year mission to search out the Klingons and destroy them. There are ten levels of difficulty (0 - 9). Beware of this game — it is strangely addictive. **$9.95**

SEARCH AND DESTROY WUMPUS — Have you ever played the game Wumpus? If you liked it then you'll like this! The object is the same as the earlier version except that it's a lot harder. To say any more would spoil the fun. Good Hunting! **$14.95**

ESC KEY — This is a program for all of the two fingered typists in the world. The program allows you to enter BASIC key words in an abbreviated form. For instance, instead of typing 'list" the user would press the "ESC" key and then "1". The computer then types out the rest of the word for you. Suitable for 16K and 32K machines. Only. **$14.95**

GRAPHIC GAMES PACK — This cassette contains five programs, 'Poker', 'Slots', 'Dodgem', 'Picture', 'Richochet'. 'Poker' is the main program on the cassette. In this game the computer is the bank and you have to beat it at Draw Poker. Warning — the computer plays a cunning game and is quite prepared to bluff! 'Slots' is a one armed bandit and for 20c a go you can try your luck. In 'Dodgem' the player must guide his car through a forest to the bottom of the screen — this game allows you to drive a car without the random breath tester getting you!! 'Picture' is an excellent game for the children. The final program on the cassette is 'Richochet', where the player has to decide where to fire a bullet through a hole in the wall. If you hit the wall you're dead. **$14.95**

PCG TUTORIAL — The PCG Sampler cassette has eight programs on it. These programs show you how the graphics work and demonstrates their capabilities by way of games etc. The cassette is excellent for both beginners and experts. It allows you to design your characters on the screen, so you can see exactly what you are creating. Suitable for all MicroBees. **$9.95**

STARSHOOT/HANGMAN — Starshoot is perhaps one of the most deceptive games available on computer. It appears to be very easy: it isn't. Hangman is based on the popular school game that everybody knows. **$9.95**

ELIZA — Want someone to talk to? Eliza is possibly the person for you. (If you can get her to shut-up). Eliza is a program that demonstrates artificial intelligence. Eliza is prepared to talk about life, the universe and everything. **$9.95**

NEW **BUSY BEE CAI SYSTEM** — Easy to use computer aided instructions similar to the very popular Work-A-Bee, a two sided program with students and teachers versions. **$14.95**

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TARGET — Target is a game of hit and miss. Your task is to aim the cannon at the bottom of the screen and shoot down the U.F.O.'s (ET watch out). There are nine levels of play to this entertaining game thus making it suitable for any player. Suitable for all Microbees. **$9.95**

LEARNING CAN BE FUN — This set of 3 cassettes combines graphics with text to produce highly motivated teaching games. Uses variations of well known arcade games to enhance the learning process.
Volume 1A: GRILLA — Answer questions to avoid the barrels Kong is rolling.
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Volume 1B: MUNCH — Tests your knowledge by eating the right answer.
TNT — Answer before the dynamite fuse burns down.
Volume 1C: ADSTAR — Avoid the invaders. Shoot the space ship with the right answer. **SQUARE** — The Enterprise can save the Galaxy. You arm the laser cannons. **$9.95 each or $24.95** for the set of three.

PILOT — Pilot is a very easy programming language to learn, and ideal for preparing CAI (computer-aided-instruction). Microbee Pilot supports several enhancements including full integer arithmetic. **$14.95**

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NEW **MICROBEE BASIC TUTORIAL** — Teaches familiarity with Keyboard Self Pace Learning of Microworld Basic. Ideal for real beginners. **$9.95**

NEW **INVENTORY SYSTEM** — Personal business software. **$14.95**

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NEW **LEARNING CAN BE FUN — Volume 2A:**
A · C — This is a maths revision program, based around a well known little Alien Creature. All questions, including the opening selection, are answered by moving the hand of the alien to point to the required answer. Correct answers score points and also cause a plant to grow on the screen.
M-RACER — Similar to A · C but without the graphics. The main variation is that a pre set time limit is placed on answering each question. **$9.95**

NEW **MICROBEE CHASE PLUS — CHPLUS** — A menu driven collection of 6 BASIC programs featuring excellent use of PCG graphics. The first 3 items on the menu are pattern drawing programs. The **TIMEHOLES** program can produce a superb display. **BANNER** allows large character displays on the screen. **KNOCKOUT** is a variation of single player Ping Pong. **CHASED** is a game where you attempt to avoid robots which are chasing you around an enclosure with electrified fence. **$14.95**

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PRINT ROUTINE

Tim Parish, Myrtle Bank S.A.

This subroutine provides an easy way of coding a number of multi-line messages for printing on the screen during execution of a CHIP 8 program on the '660. It features: • 13 characters per line • long messages flow onto new lines as required • equal spacing between characters of different width (making more natural-looking words).

The memory requirement in any program calling the subroutine is just seven bytes per message plus one byte per character — that's pretty economical.

The routine occupies the last 1/3K of a 3K machine, equivalent in memory requirement to about 58 characters, and is most useful in message oriented games (such as 'Guessing Game', reproduced here).

The subroutine leaves all registers unchanged, except V0 and V1. Here's an example of how to use the subroutine:

Call: (prints HELLO)

0720	A831	points to start of message
0722	A720	points to above instruction
0724	2EA8	call PRINT

Data:

0830	0506	length of message/'H'
0832	0408	'E'/'L'
0834	0809	'L'/'O'

There are two approaches to using PRINT with various programs: (1) record it separately and load it into RAM before or after the main program is loaded — saves space on tape; (2) treat the program and subroutines as one program — convenient.

GUESSING GAME

This is a simple game demonstrating use of the PRINT subroutine. The program itself explains the game, which is left with hexadecimal output for variation.

If your '660 is not called 'Little Zen' (which becomes clear when you run the program), you might like to change the first message! Don't forget to load the PRINT subroutine.

● PRINT ROUTINE

```
0e90                                              ----
0ea0  ---- ---- ---- ---- f165 ae9e f955 aeca
0eb0  f155 aeba 6401 8145 f155 a--- f065 8800
0ec0  00e0 6600 6200 6700 6900 a--- f21e 7901
0ed0  7201 390e 1edc 6700 7607 6901 f065 8300
0ee0  8034 8034 8034 8034 af10 f01e d765 6f1f
0ef0  8035 3f00 1f02 6024 8035 3f00 1f00 7701
0f00  7701 7704 9280 1f0a 1eca ae9e f965 00ee
0f10  e0a0 e0a0 a0e0 a0c0 a0e0 e080 8080 e0c0
0f20  a0a0 a0c0 e080 c080 e0e0 80c0 8080 a0a0
0f30  e0a0 a040 4040 4040 8080 8080 e0e0 a0a0
0f40  a0e0 e0a0 e080 80e0 80e0 20e0 e040 4040
0f50  40a0 a0a0 a0e0 e020 e000 8080 8080 0080
0f60  0000 8000 8000 0000 0000 2040 4040 2040
0f70  2020 2040 4040 0000 00a0 a000 0000 0000
0f80  0000 80e0 20e0 80e0 e020 e020 e0a0 a0e0
0f90  2020 e080 e020 e0e0 80e0 a0e0 e020 2020
0fa0  20e0 a0e0 a0e0 e0a0 e020 20e0 2040 80e0
0fb0  f080 8090 f070 2020 a0e0 90a0 c0a0 9090
0fc0  d0b0 9090 f090 f0a0 9050 a8a8 a888 f090
0fd0  90b0 f888 8888 5020 8888 a8a8 5088 5020
0fe0  5088 8850 2020 2050 f850 f850 a870 f870
0ff0  a800 00e0 0000
```

Note : memory used by subroutine is denoted by ' ---- '

CODE FOR CHARACTERS :

A - 00	L - 08	W - 28	9 - 1e	• - 2c
B - 01	M - 25	X - 29	? - 0e	- - 2d
C - 02	N - 23	Y - 2a	! - 0f	
D - 03	O - 09	Z - 1f	: - 10	
E - 04	P - 0a	2 - 17	blank - 11	
F - 05	Q - 26	3 - 18	(- 12	
G - 20	R - 24	4 - 19	) - 13	
H - 06	S - 0b	5 - 1a	' - 14	
I - 07	T - 0c	6 - 1b	" - 15	
J - 21	U - 0d	7 - 1c	. - 16	
K - 22	V - 27	8 - 1d	# - 2b	

● GUESSING GAME

```
0600  a6c4 a600 2ea8 26a6 6200 c6ff a6ee a60c
0610  2ea8 26a6 a724 a614 2ea8 26a6 a754 a61c
0620  2ea8 26b2 8430 8444 8444 8444 8444 6a1f
0630  6b07 f329 dab5 6d0f fd15 fd07 3d00 163a
0640  26b2 f329 7a04 dab5 26a6 8030 8044 7201
0650  9060 165e 8760 8705 4f00 1696 169e a79c
0660  a65e 2ea8 641f 680e f229 d485 26a6 a7bf
0670  a66e 2ea8 600f f00a 400f 1676 4001 160a
0680  3000 168e a809 a684 2ea8 26a6 0000 a7ff
0690  a68e 2ea8 1674 a76a a696 2ea8 161a a783
06a0  a69e 2ea8 161a 6d60 fd15 fd07 3d00 16aa
06b0  00ee 6c0f 63ff 7301 83c2 e39e 16b6 00ee
06c0  00ff 0028 0604 0808 0911 1011 1111 1111
06d0  1108 070c 0c08 0411 1f04 2311 1111 0b0a
06e0  0400 2207 2320 1611 1111 1111 0034 0711
06f0  0600 2704 110a 0702 2204 0300 1124 0023
0700  0309 2511 0604 2911 230d 2501 0424 1105
0710  0924 1111 112a 090d 110c 0911 200d 040b
0720  0b16 002e 0607 230c 1110 110c 0604 1111
0730  1123 0d25 0104 2411 070b 1101 042d 0c28
0740  0404 2311 1f04 2409 1111 1100 2303 1105
0750  0516 0014 0423 0c04 2411 2a09 0d24 1111
0760  1120 0d04 0b0b 1110 0017 0c09 0911 0607
0770  2006 112d 1111 110c 242a 1100 2000 0723
0780  16ff 170c 0909 1108 0928 112d 1111 1111
0790  0c24 2a11 0020 0007 2316 0021 0c06 000c
07a0  140b 1107 0c11 0f11 1123 0d25 0104 2411
07b0  0905 1111 1111 0c24 0704 0b11 10ff 3f03
07c0  0911 2a09 0d11 2800 230c 1111 0c09 110c
07d0  242a 1100 2303 1111 1120 0d04 0b0b 1100
07e0  2309 0c06 0424 230d 2501 0424 110e 1111
07f0  1111 112a 040b 1007 1111 2309 1009 0907
0800  1109 2411 0911 0f0f 0920 0909 0301 2a04
0810  110f ----------------------------------
```

Colour TV Game

All the excitement of the big, expensive TV games – without the big expense! This colour TV game console lets you decide which games you want to play – at a suprisingly low cost. The console comes complete with two individual joystick controllers, readily accepts any of the plug-in microprocessor games modules. All you have to do is connect the console to your TV antenna input, plug in the game and you're away! The game is absolutely safe: it's battery operated so it cannot harm you or your TV in any way if used according to instructions.

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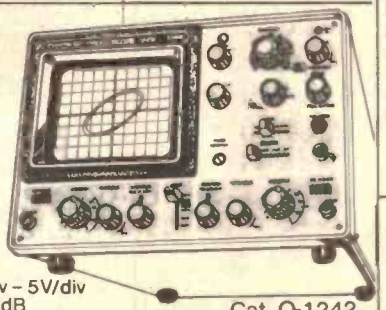

Cat. Q-1242

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Rise Time: 24ns
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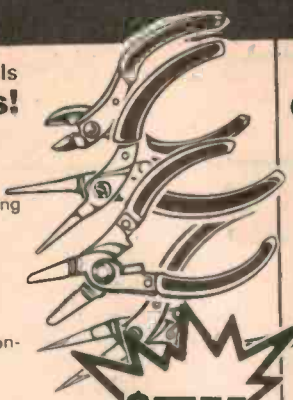

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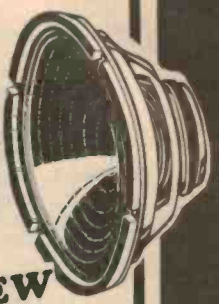

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These handsome units will perform as well or better than units costing much more. Simply plugs into the AC mains . . . No wiring required for your home, office or factory! What could be easier? Cat. F-1012

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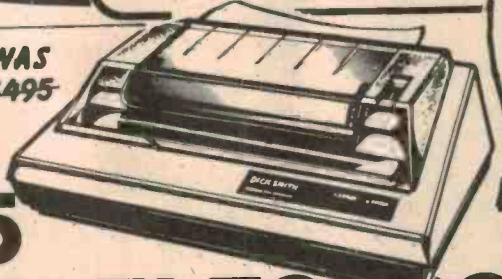

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MICROBEE COLUMN

WE TRUST you enjoyed last month's April Fools funny. If you're still attempting to work it out or de-crash your 'Bee, the answer's on page 137 of the April issue (ho, ho, ho . . . hee, hee . . . har, har).

Enough levity, back to the serious business. Every programmer gets into random numbers at some time or another. If you haven't, then Tom Moffat has an interesting demonstration program for you. Nonetheless, if you're an old hand with random numbers, Tom's contribution this month will hold you fascinated . . . for minutes at a time.

If you'd like to perform a real task with your MicroBee, M.J. Hennessy has something useful for you by way of a clock-&-timer program.

CLOCK AND TIMER

M.J. Hennessy, Lae, PNG

The easy access to the MicroBee data ports and the ease with which they can be controlled in software holds great promise for use in controlling a host of external peripherals or receiving data from external sources.

As an applications microcomputer, the MicroBee could be readily programmed to act as an alarm clock, turn on the coffee percolator . . . etc, by sending data on the RS232 output or by using the parallel PIO port.

For a timed sequence of events one usually needs a clock and this program uses the MicroBee as a digital clock and timer where any number of conditional statements can be set up in the program for the MicroBee to act upon them at the time required.

The program is straightforward and illustrates use of some of the graphics commands in generating the display, plus use of the sound facility for the alarm.

The clock is set up in the 24 hour mode. However, this may be changed to 12 hours by changing the reference to the variable Z at lines 180, 240 and 500.

In operation, the program asks for the input of the time in hours, minutes and seconds to set the clock and the alarm. Invalid time entry, i.e: 25 hrs 67 mins, is checked for each input and if an invalid entry occurs there is a branch to line 630 where you are politely taken back to the start again.

To finally start the clock, use is made of the return key for verification and curiously, with the MicroBee, the ASCII value for the return key is decimal 128 and this is used at lines 290 and 660 where a verified entry is required.

In setting up the display the CURS statement positions the cursor where you want it using X — Y addressing.

CURS 8,3 : PRINT "Digital Timer . . ."

prints out at column 8, VDU line 3.

Similarly, at line 370 the display is printed out at column 18, VDU line 8.

Use of CURS 18,8 at line 380 is a simple trick to turn off the flashing cursor while the program is running and it leaves the cursor where we want it for our next print out.

One feature of MicroBee BASIC that has to be admired is the use of logical AND and OR conditional statements. I have used AND to show how it can be combined with IF-THEN at line 390 so that when hrs. min. sec of the clock and alarm are identical the statement is true and our alarm goes off.

It is at this point that conditional statements of your own choosing could be inserted to activate external devices using the OUT instruction.

The alarm is a loop that runs for one minute starting at line 570 and randomly plays each of the MicroBee's 25 notes, including the rest . . . enough to wake up the deepest sleeper!

When the alarm finishes the time is advanced by one minute and the clock continues. I should mention that, for any event that you ask the MicroBee to do, after it occurs the time must be adjusted. As clever as it is, the MicroBee can only do one thing at a time.

While on the point of adjusting the time, the speed of the clock is controlled in the subroutine from line 530. This is a one second loop.

Finally, to brighten up the display, I opted for a border around the hrs. min. sec.

I drew a border using the low resolution graphics initiated by LORES at line 320 followed by a series of PLOT statements.

What else does the program do? . . . it gives a BEEp every hour on the hour!

```
00100 CLS
00110 REM ...Clock and Timer...  for MICROBEE  OS 5.10
00120 REM     M.J.HENNESSY.....
00130 REM
00140 CURS 20,3:PRINT "Clock and Timer."
00150 PRINT
00160 PRINT"Enter time to start clock..........."
00170 PRINT
00180 INPUT" Hours = ",Z;:IF Z => 24 THEN 630
00190 INPUT"     Minutes = ",Y;:IF Y => 60 THEN 630
00200 INPUT"     Seconds = ",X1:IF X1 => 60 THEN 630
00210 PRINT
00220 PRINT"Enter time for alarm or function to occur."
00230 PRINT
00240 INPUT" Hours = ",W;:IF W => 24 THEN 630
00250 INPUT"     Minutes = ",V;:IF V => 60 THEN 630
00260 INPUT"     Seconds = ",U1:IF U1 => 60 THEN 630
00270 PRINT
00280 INPUT" Press RETURN to start clock.";A1$
00290 IF ASC(A1$) <> 128 THEN 280
00300 CLS
00310 CURS 8,3 : PRINT"Digtal Timer....."
00320 LORES
00330 PLOT 28,30 TO 100,30
00340 PLOT 100,30 TO 100,18
00350 PLOT 100,18 TO 28,18
00360 PLOT 28,18 TO 28,30
00370 CURS 18,8 :PRINT "hrs ";Z;"  :  min ";Y;"  : sec ";X1
00380 CURS 18,8
00390 IF X1 = U1 AND Y = V AND Z = W THEN 580
00400 GOSUB 540
00410 X1=X1+1
00420 IF X1=60 THEN 440
00430 GOTO 370
00440 X1 = 0
00450 Y = Y + 1
00460 IF Y = 60 THEN 480
00470 GOTO 370
00480 Y = 0
00490 Z=Z + 1
00500 IF Z = 24 THEN LET Z = 0
00510 PLAY 16
00520 GOTO 300
00530 REM ...SECOND COUNT LOOP...
00540 FOR B = 1 TO 383
00550 NEXT B
00560 RETURN
00570 REM...ALARM OR FUNCTION...
00580 FOR N = 1 TO 370
00590 PLAY INT(RND*25)
00600 NEXT N
00610 Y=Y + 1
00620 GOTO 370
00630 REM ...INVALID ENTRY STATEMENT...
00640 PRINT:PRINT"The last time entered was invalid.":PRINT
00650 INPUT"Press RETURN to start again...";B1$
00660 IF ASC(B1$) <> 128 THEN 640 ELSE 100
00670 END
```

Learning is Fun

Green Screen Monitor pictured is an optional extra.

16K PLUS

The 16K PLUS has built in features such as music generation, PCG high and low resolution graphics, with a screen display of 16 lines each containing 64 upper and lower case characters. When you also consider all of the standard extras like continuous memory, built in printer and input/output interfaces and parallel port, 4.5 volt battery back-up and self testing BASIC in ROM, the Microbee 16K PLUS is unbeatable in its class.

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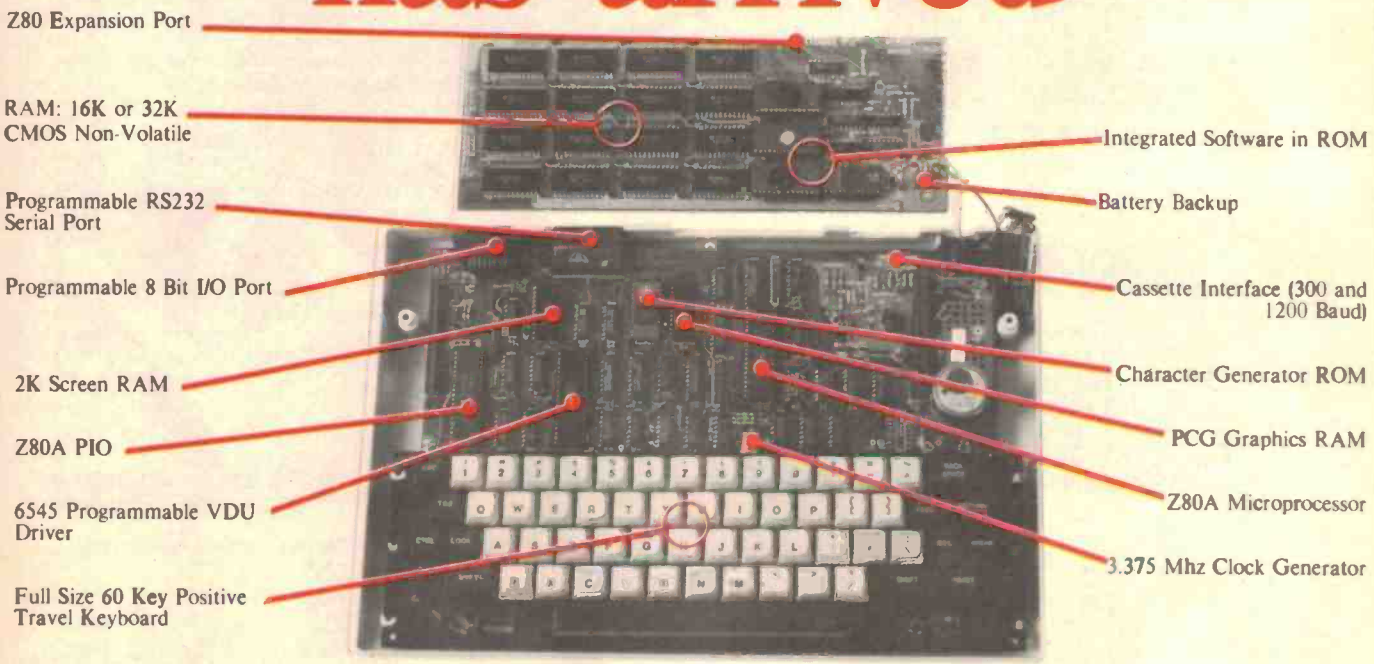
CEAT2933

The Microbee IC has arrived



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RANDOM NUMBERS

Tom Moffat, Fern Tree, Tas.

One of any computer's more interesting features is its random number generator. Without it, games would be very dull and many statistical operations would be impossible. The random numbers so generated aren't really random, they're pseudo-random . . .they follow a pattern, but it's so complicated the results look like pure chance.

The best practical way to get true random numbers out of a computer is to use a noise diode or some other noise source and store the highs and lows so generated as ones and zeroes in the computer. The technique would be worth some experimentation. The MicroBee's random number generator develops real numbers between 0 and 1 which are then multiplied by some factor to provide the range of numbers required.

How random are the numbers? Does the MicroBee play with loaded dice, or stack the deck against you? This program lets you see the random number generator working, then displays a statistical distribution of the numbers generated.

A total of 4096 numbers are generated, ranging from 0 to 127. These are displayed in 128 stacks of pixels across the bottom of the screen. Zeroes are stacked on the left, 127s on the right, and everything else in between.

If the random number generator were perfectly random there would be an equal quantity of each number generated. For 4096 numbers that would be 32 of each. Each stack shown on the screen would be of equal height.

But things don't work that way, as you'll soon see . . . watching the program is like watching the grass grow! When the 4096 numbers are complete, the computer beeps, clears the screen and then shows a graph of how many stacks got 32 numbers, how many got 33, 34, 31, 30, and so on. The big vertical line represents the 32 mark.

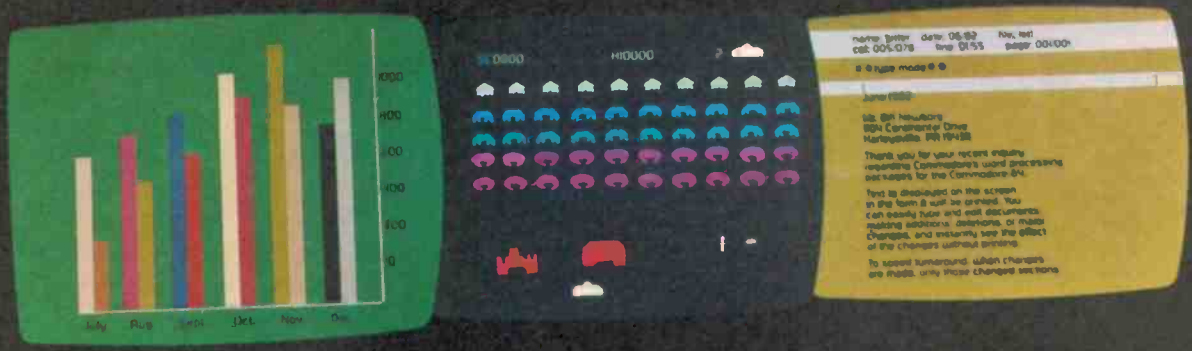
If one particular stack gets to 47 before the total of numbers reaches 4096 a graphics error will cause the statistical result to be displayed early. In this case there will be no beep.

You may sometimes notice that one number is heavily favoured. At other times some number may badly miss out. But this is all part of the game of randomness. If you would watch the program for an infinite length of time you would possibly see them all even out.

You'd certainly develop a nasty case of eyestrain! ●

```
00100 REM Random number distribution study,
00110 REM Tom Moffat
00120 CLEAR: CLS: LORES
00130 ON ERROR GOTO 210
00140 DIM X(127), Z(127)
00150 FOR A=1 TO 4096
00160 Y=INT(RND*128)
00170 SET Y,X(Y)
00180 X(Y)=X(Y)+1
00190 NEXT A
00200 PLAY 1
00210 CLS
00220 FOR A=0 TO 127
00230 P=X(A)
00240 SET P,Z(P)
00250 Z(P)=Z(P)+1
00260 NEXT A
00270 PLOTI 32,16 TO 32,47
00280 GOTO 280
```

THIS IS THE COMMODORE 64 ONLY $699.



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"THE COMMODORE 64 COULD BE THE MICROCOMPUTER INDUSTRY'S OUTSTANDING NEW PRODUCT INTRODUCTION SINCE THE BIRTH OF THIS INDUSTRY."

–SHEARSON/AMERICAN EXPRESS

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If, on the other hand, you're a person whose livelihood depends on a personal computer – or whose leisure time revolves around one – what follows should impress you even more than it impresses investors.

MIGHT MAKES RIGHT.

The value of a computer is determined by what it can do. What it can do is largely determined by its memory.

The Commodore 64's basic RAM is 64K. This amount of power is unusual enough in a micro at any price.

At $699, it is astonishing.

Compared, with the Apple II+,® for instance, the Commodore, 64™ offers 33% more power at considerably less than 50% of the cost.

Compared with anything less, it's even more impressive.

And it can effectively double your computer-equipped work force.

PILE ON THE PERIPHERALS

Because the basic cost of the 64 is so low, you can afford more peripherals for it. Like disk drives, printers or even printer-plotters.

This means you can own the 64, disk drive and printer for a little more than an Apple II+ computer alone.

HARD FACTS ABOUT SOFTWARE

The Commodore 64 will have a broad range of custom software packages including an electronic spreadsheet; business graphics (including printout); a user-definable diary/calendar; word processor; mailing lists, and more.

With BASIC as its primary language, it is also PET BASIC compatible.

The Commodore 64 will also be programmable in USCD PASCAL, PILOT and LOGO.

And, with the added CP/M® option, you will have access to hundreds of exciting software packages.

THE FUN SIDE OF POWER

The Commodore 64 can become very playful at a moment's notice.

You can use Commodore's plug-in game cartridges or invent your own diversions. All will be enhanced by brilliant video quality and high resolution graphics (320 × 200 pixels, 16 available colors, 3D Sprite graphics), plus outstanding sound.

The 64's built-in music synthesizer has a programmable ADSR (attack, decay, sustain, release) envelope, 3 voices (each with a 9-octave range) and 4 waveforms. All of which you can hear through your audio system and see in full color as you compose or play back.

NOW'S YOUR CHANCE

If you've been waiting for the "computer revolution," consider it as having arrived.

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Today, the company's vertical integration has resulted in the Commodore 64's price performance breakthrough heralded by Shearson/American Express.

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No matter how good your sound system is, you are limited by one major thing: the record. Every normal record is severely limited in musical range. Compression during cutting results in half the dynamic range being eliminated. The excitement of the music is lost. This applies to digitally mastered and direct to disc recordings. The other problem is something you hear every time the stylus enters the groove: surface noise. We went to the source of the problem, the cutting of the record. We encode the record by compressing it 2:1. The decoder expands back in a mirror fashion. In this way, the vinyl record can achieve a staggering 90dB dynamic range, compared to 50dB achieved on normal high quality recordings. Only through dbx can you truly appreciate digital recordings. The range of dbx discs is growing. There are now over 150 titles available,including a wide variety of Classical, Popular and Jazz discs. Hear "The Empire Strikes Back" by John Williams, Vivaldi's "Four Seasons" and artists such as Oscar Peterson, Dave Brubeck and Almeida.

MODELS 222 AND 224. The benefits of dbx for both disc playing and home recording. Your cassette deck's dynamic range increased from 50dB to a staggering 80dB. The 224 further provides simultaneous encode/decode for three head recorder off tape monitoring. Both models provide decoding for dbx discs.

MODEL 228. This new model provides the noise reduction and disc decoding capabilities of the 222/224 with dynamic range expansion for your non encoded discs and tapes. Restore the dynamic range of records, tapes and radio broadcasts.

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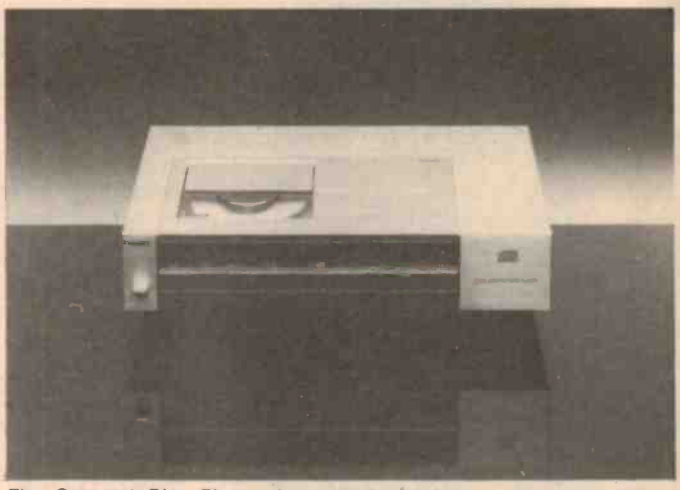
Glover & Assoc AE/9

So you're thinking of buying a CD system?

The Compact Disc player and software on laser-scanned 12 cm discs should appear on the Australian market this month.



The Compact Disc Player. Approaching perfection in the reproduction of recorded music.

Compact disc software. Few discs, as yet, are 'direct to digital'.

Heralding its arrival are some amazing claims — the greatest technological development in audio since stereo, you can make mud pies on the disc, you can play frisbee with them, the sound quality is perfect, and so on.

Many of the claims are true; the CD system is approaching perfection and has many advantages over the traditional stylus-in-groove system. But some of the claims are outrageous and before you rush off and buy the first system you listen to you should have a few facts to back you up.

There are not expected to be many digital discs available early in the piece, probably 200 titles or less, because there are still only three pressing plants in the world that can produce them: a PolyGram plant in West Germany and one each for Sony and Denon in Japan.

Sony and CBS announced that CBS would be setting up a US pressing plant to be operating in 1984 but the outlook still looks bleak.

One reason for the dearth of discs is that the pressing plants disc yield (the percentage of usable discs from each press run) is still low. Figures vary between 50-80 per cent but they are not yet up to the 90% average yield typical of vinyl record pressings.

The discs are difficult to manufacture. A disc has an incredibly high 'information density' which stems from the 'pit track' engraved on the embedded 'signal surface' (the aluminised reflective layer which the laser in a CD player actually scans).

The thickness of the disc must be 1.2 ±0.1 mm; flatness must be within 0.6 degrees; the edges of the engraved pits must be within 50 nanometres of their ideal positions; pit depths must be 12 ± 10 nanometres.

With such tight tolerances and minuscule dimensions lots of things can go wrong, and not only with the discs. The CD player is subject to defocusing of the laser-optical system, 'mistracking' when the laser servos 'lose track' of the pits, noise in the electrical circuitry and variations in the rotation rate of the disc.

It is possible that if any of these problems occur the results will be errors in the data as interpreted by the digital circuitry. But the quality of the players is so high that the Compact Disc system's error correction circuitry effectively conceals the errors so you won't hear any defects; unless, of course, you deliberately damage the discs.

Warp, fingerprint and scratch tests have shown that, with reasonable care, a compact disc is much more durable than an analogue record. The damage may look bad but you won't be able to notice any audible defects.

According to overseas reports, when non-standard, uncalibrated, greasy thumbprints were applied to the scanning side of the disc the number of digital error indications increased.

However, there were no error concealment indications which meant that the rise in errors due to the fingerprints was still within the system's ability to make a complete correction.

Making a scratch which follows the embedded track for several millimetres is the easiest way to make a CD pressing unplayable or at least audibly defective, according to reports.

Concentric scratches can obscure so much interrelated data beneath them that the otherwise well-informed error-concealment circuits are at a loss for reasonable interpolations.

To minimise the possibility of concentric scratches, PolyGram recommends that CDs be cleaned from centre to rim.

Extensive radial and tangential scratches seem to have no effect on the tracking or sound of a disc unless they are very wide or very deep.

So if you handle digital discs in the same way as you would treat analogue records, taking care to minimise dust, fingerprints and scratches, your Compact Disc should provide exactly the same performance decades from now, regardless of how many times it is played.

It may be that you are not overwhelmed by the sound quality of the first CDs you hear, but don't immediately blame the CD system. There have been so few digitally mastered recordings of popular music that most of the early non-classical CD releases are derived from analogue master tapes of extremely variable quality.

Of course, the CD will have much less background noise but even this advantage may be obscured by high hiss levels if (conventional) master tapes were made without noise reduction.

No matter how good CD technology is, and it is spectacular, it cannot significantly change the sound of what is on analogue, or conventional, master tapes.

For performances directly digitally encoded and then transferred to CD, the dynamics of the reproduced sound are truly breathtaking.

While many recent recordings have been made 'direct to digital', CDs of these number less than a third of titles to be released. But this will grow.

Sight and Sound NEWS

Magnat's omnidirectional plasma loudspeaker

In 1981 Magnat won the German Hi-Fi prize for developing the world's first electronic omnidirectional plasma loudspeaker.

The plasma loudspeaker consists of a needle electrode surrounded by an earthed electrode in the form of a sphere made from very fine wire mesh. A 27 MHz signal is delivered to the needle electrode. The electrical field developed between the electrodes induces a corona discharge which produces an intense ionisation of the air molecules around the point of the needle.

The plasma loudspeaker is an almost massless, inertialess sphere. As there is no traditional cone there is no resonance of the cone material to colour the sound.

The Plasma MP-02 tweeter, at a cost of around $899 each, has a built-in amplifier with volume control and can be matched into any high quality loudspeaker unit. A full range speaker with the MP-02 plasma tweeter is in the final stages of production and the price is estimated to be at $4500 a pair.

At a more affordable price are the Magnat 2A speakers at $499 a pair and the Magnat 3A speakers at $599 a pair. Both these speakers use flat ribbon technology.

In the budget price range are Magnat's Sonobull 10 speakers at $299 a pair and the Sonobull 20 at $399 a pair. These three-way systems have ferro fluid cooled tweeters and specially treated cones.

Duratone Imports, the Australian distributors of Magnat loudspeaker systems, can be contacted at **3A Botany St, Phillip ACT 2606. (062)82-1388.**

Lightweight professional audio equipment

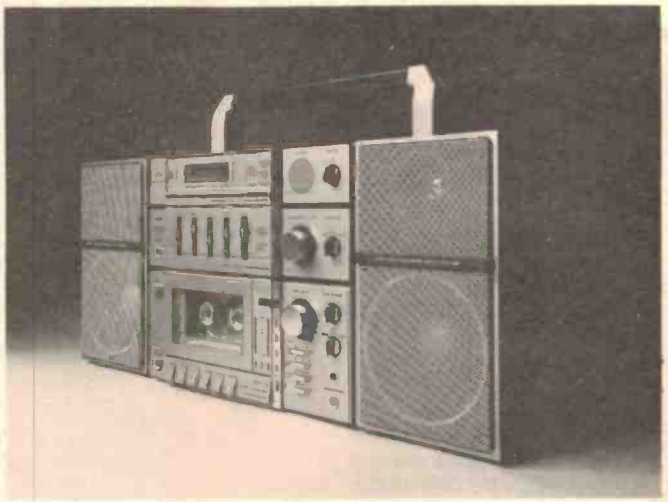
Hill Audio's range of audio equipment, for musicians and users of high power PA systems, is claimed to be ideal for the professional as it tends to be smaller and lighter than comparable products with the same output power.

The range, including mixing consoles, amplifiers, electronic crossovers, powered stage boxes and speakers, is manufactured in England by Hill Audio and distributed in Australia by Q Sound.

Now available is a range of FOH mixing consoles from 16 into 2 up to 32 into 8, monitor mixers from 12 into 4 up to 32 into 10, stereo amplifiers and tri-amplifiers with a total power output of 1000 W.

The Hill DX 901 amplifier, an entirely new model, has a power output of 900 W per channel into two ohms. The Hill DX 701 has a power output of 625 W into two ohms per channel. They have a 12% larger heatsink than previous Hill amplifiers and a thermostatically controlled fan. Other features include a 12-way LED display with separate error indicators and parallel input and output XLRs.

For further information on the full range of Hill Audio equipment contact **Q Sound Pty Ltd, 150 Lawrence St, Alexandria NSW 2015. (02)516-1671.**



Marantz portable units

Two micro component systems, the Marantz PH32 priced at $499 and the PH52 priced at $549, can be mounted on a shelf or assembled into portable units.

The tuner in the PH52 features digital frequency display and press button memory recall. The amplifier in both systems has a built-in five-band graphic equaliser and the cassette deck has metal tape facility and a track search function.

Another portable radio cassette recorder, Marantz PMS5 priced at $209, has a quick music select system and a choice of mono, stereo or 'stereo wide' which gives an illusion of spaciousness of the sound heard from the built-in speakers.

The mic mixing facility requires an optional external microphone. The cassette recorder can use metal tapes.

Marantz (Australia) Pty Ltd can be contacted at **19 Chard Rd, Brookvale NSW 2100. (02) 939-1900.**

Sanyo's car sound system

Sanyo has released a new combination car radio/stereo tape player.

The FT 420M features 20 watts per channel output, AM/FM stereo radio and an auto reverse tape player. Other features include tone and balance controls, mono/stereo switch, tape play/direction indicators, fast forward control and separate left/right LED power output indicators.

Its recommended retail price is $163. More information can be obtained from **Sanyo Australia Pty Ltd, 225 Miller St, Nth Sydney NSW 2066. (02)436-1122.**

close enough is just not good enough

We live in an age where compromise is so often the norm.

Manufacturers compromise performance to gain a price advantage and people accept it, so it continues.

This philosophy is evident in the manufacture of some sound equipment, particularly in the choice of the cartridge supplied as original equipment.

Regardless of the quality of the rest of your system, it is the cartridge that has the complex task of translating the intricate combination of signals in the record grooves to the sound that is music to your ears.

Fortunately, a number of dedicated cartridge manufacturers have developed cartridges incorporating the latest technical know-how that will allow you to upgrade your system quite inexpensively.

We at Goldring Audio Industries believe that there are still a few of us left who are simply not prepared to accept compromise when it comes to sound reproduction so we have searched out those dedicated manufacturers and offer their products nationally.

Our huge range of cartridges will suit just about every hi-fi system on the market today.

Contact your Goldring Stockist or Goldring Audio Industries for a copy of our twelve page cartridge catalogue that further outlines the range and advantages of the various cartridges available.

Shown here are just some of the state of the art cartridges available from Goldring.

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Tasmanian Record Company, 10 Cameron St., Launceston, 7250. (003) 31 5588

Audio Dynamics Corporation

Goldring

EXCEL SOUND CORPORATION

Video cassette recorder head cleaners

Beta format: ALLSOP 3 FOR BETA
AUDIO TECHNICA AT5002 • RALMAR BCL-200
SONY L-25CL • TDK LCL-30
VHS format: ALLSOP 3 FOR VHS
PANASONIC VFK-0185 • RALMAR VCL-300

A head cleaner should be used regularly on any VCR. But there are a number of different types and numerous brands on the market. Which is effective, and under what circumstances? This multiple review sheds some light on the matter.

Louis Challis

A VIDEO CASSETTE RECORDER can make TV viewing more flexible as you can arrange a much better choice of programmes and you can chose the time to watch them. It's hard to imagine or even appreciate the performance of VCRs until you actually get 'hands on' experience in your own home. But as we all know, nothing is perfect. Like all the other equipment with which you or I will come into contact, the video cassette recorder has limitations which can degrade the quality of performance.

The most common problem is usually caused by magnetic debris being deposited on the recording heads of the machine. The amount of debris deposited increases with usage of the VCR. Obviously the better the tape you use, the better the results. But even if you use the finest quality, most expensive tapes you can't guarantee that you will not have this problem.

For those of you who do not own a video cassette recorder and are unfamiliar with the effect of 'dirty' tape or 'dirty' heads, the problem usually shows up as bursts of white light on the TV screen. The effect is like watching TV in a 'fringe area' with a lot of external electrical interference affecting your picture. As the heads get dirtier with use the effective video signal that the heads can pick up from the tape is reduced, and the quality of the picture gets worse. In time the signal may even disappear completely if sufficient magnetic material is deposited to bridge over the tiny gap in the heads. If the heads are already worn, then the impact of magnetic particles is usually more serious and this generally results in a greater likelihood of drop-outs and overall picture degradation.

I don't want to spend too much time on the physical characteristics of the two video cassette recorder systems currently dominating the Australian market (VHS and Beta). However, it is important to realise that the magnetic tape passing over the heads of the recorder during replay, and even more importantly during the original recording cycle, is subject to the same vicissitudes as your reel-to-reel and your audio compact cassette recorder.

You may already be aware of the problems which tape head drop-out creates in the audio frequency domain. It is well known that the problems of using extremely thin magnetic tape, coupled with the dynamic tape transfer problems in the recording path, are compounded by instability of the magnetic tape surface. This causes periodic drop-outs of the tape signal which may become almost continuous if the tape is of poor quality. This is worsened by the slow deposition of magnetic material on the heads, resulting in significant attenuation of high frequency, and to a lesser extent mid-frequency, content. In many early cassette recorders, this problem was accentuated by the excessive wear of some magnetic heads which utilised 'soft' materials. Extensive use led to the premature demise of these heads.

If you've ever suffered the embarrassment of having to replace the heads on your VCR, you'll appreciate that this can be a relatively expensive repair which may seem unwarranted and unfair. This is why most manufacturers of video cassette recorders now warn the purchasers of what they should and should not do in order to extend the life of their machines. Most also advise on the merits and disadvantages of the various head cleaning systems which are offered to the user through advertisements and retail outlets.

Types of VCR head cleaners

There are currently two basic types of consumer video head cleaners being produced.

- Wet or solvent-impregnated cleaners
- Abrasive cleaners

A third, minor or sub-classification is a semi-abrasive cleaner which is really only a rough, plastic tape with very light abrasive characteristics.

The characteristics of the abrasive cleaners range between moderately abrasive to lightly abrasive.

Some VCR manufacturers specifically advise against the use of abrasive cleaners, others recommend not to use any form of head cleaner and some recommend only specific brands and/or types. Some manufacturers don't give any recommendations or advice and it seems this may be because they have little knowledge of either their machines' characteristics or those of the many head cleaners available.

Developing a test method

To assess the available head cleaning tapes we wanted to evaluate the advantages, problems and characteristics of each of the samples to determine what they do and, more importantly, what they don't do. We decided that this review would not be purely subjective. We hoped to back up our statements with objective testing so that we would not be in any doubt as to the accuracy and objectivity of our results.

Allsop 3 (VHS & Beta models). The Allsop 3 cleaners are of the wet (non-abrasive) type. The VHS and Beta models differ in construction, apart from being housed in necessarily-different cassettes. Both, however, are constructed so that they clean the audio, video and erase heads, plus the capstan and pinch roller.

The VHS model has a soft chamois-like absorbent tape which is in contact with the VCR head mechanism for about five seconds — the length of the cleaning cycle. An adjacent felt pad cleans the capstan and pinch roller. A 'specially formulated' bottle of cleaning solution comes with it and this is applied to the tape and pad. This is an isopropyl-alcohol-based solution that is totally evaporative, leaving no residue after use. The VHS Allsop 3 can be used with any VHS machine.

The Beta model just has a chamois-like tape which is in contact with the heads, capstan and pinch roller. The cleaning solution is applied through five 'windows' in the cassette. This model has a ten second cleaning cycle. The Beta Allsop 3 can be used with any Beta machine on the Australian market, but a simple adjustment needs to be made to use it on the various makes.

Both Allsop cleaners have replaceable cartridges containing the cleaning gear — the only make on the market to have this feature. Each comes with a plasticised card giving complete, detailed instructions for use.

The picture below shows a closeup of the VHS model after use on which some magnetic tape material can be clearly seen on the chamois toward the centre-top edge.

My first plans for the objective testing had been to pre-record an audio test signal on two test tapes which we would make for each of the formats. We borrowed two excellent video recorders, the AKAI model VS-2EA VHS recorder and the Sanyo model VTC 5400P Beta recorder. These recorders were used to test the measurement procedure. We then decided to produce a series of test tapes with which we would directly measure drop-out characteristics and head cleaning efficiency.

The troubles that we experienced were not with the concept, but with the implementation of a test method which is fast enough to respond correctly to the various types of drop-out likely to be experienced. This problem ▶

Beta format

ALLSOP 3 FOR BETA
Manufactured: by Allsop Inc, USA
Distributor: Allsop Fidelity Accessories, P.O. Box 246, Double Bay NSW 2028. (02)357-2022.
Price: Rrp $39.95 for complete cassette and cleaning solution; $12 for replacement kit.

AUDIO TECHNICA AT5002
Manufactured: by Audio Technica Corp, Tokyo, Japan
Distributor: Rose Music, 17-33 Market St, South Melbourne Vic. 3205. (03)699-2388.
Price: Rrp $29.95

RALMAR BCL-200
Manufactured: in Hong Kong
Distributor: Ralmar Agencies Pty Ltd, 4 Carlotta St, Artarmon NSW 2064. (02)439-6566.
Price: Rrp $27.50

SONY L-25CL
Manufactured: by Sony Corporation in Japan
Distributor: Sony, 453 Kent St, Sydney NSW 2000.(02)266-0655.
Price: Rrp $15

TDK LCL-30
Manufactured: by TDK in Tokyo, Japan
Distributor: TDK (Australia) Pty Ltd, Unit 5, 100 Harris St, Pyrmont NSW 2009. (02)660-4955.
Price: Rrp $17.95

VHS format

ALLSOP 3 FOR VHS
Manufactured: by Allsop Inc, USA
Distributor: Allsop Fidelity Accessories, P.O. Box 246, Double Bay NSW 2028. (02)357-2022.
Price: Rrp $39.95 for complete cassette and cleaning solution, $12 for replacement kit.

PANASONIC VFK-0185
Manufactured: by National Panasonic, USA
Distributor: GEC Australia Ltd, 2 Giffnock Ave, North Ryde NSW 2113. (02)887-6222.
Price: Rrp approx. $50

RALMAR VCL-300
Manufactured: in Hong Kong
Distributor: Ralmar Agencies Pty Ltd, 4 Carlotta St, Artarmon NSW 2064. (02)439-6566.
Price: Rrp $32.10

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SANYO

That's Life!

M7880K

M7770K

M-W25F

M7000

M1600

was further compounded when we discovered that not only do the drop-outs occur in both the audio and the video signal paths, but there are also many types of drop-outs, ranging between microseconds to milliseconds in duration.

I discovered, to my chagrin, that the simple theory and practice did not quite agree and that there is "many a slip twixt the cup and the lip". Suitably impressed by my initial lack of knowledge of the problem, I continued to look for a practical and objective solution.

As luck would have it I found two possible avenues by which a solution could be obtained. The first related to the advice I received from a very knowledgeable Melbourne recording firm, AAV, whose laboratory manager provided me with background data on a machine which they had built to evaluate the problem. The second advice and assistance I received was from Star Video, one of Australia's largest software producers, which had purchased a commercial tape drop-out analyser, the DOM4, which was specifically designed to provide objective data in what was rapidly proving to be a very complex task.

With the help of Star Video I set out to analyse the characteristics of VCR head cleaners. As it turned out I also produced other useful data which may help you to keep your VCR running safe and sound.

Figure 1. Drop out test signal.

Sony L-25CL (Beta). This is an abrasive-type cleaner, similar in construction to the Audio Cleanica, but employing a different type of cleaning tape. This looks not unlike video tape, being a matte brown material on a plastic tape backing.

Instructions are supplied in four languages! Recommended cleaning time is 30 seconds and the instructions say not to repeat the cleaning process more than four times in a session, to prevent excessive head wear.

The L-25CL can be used for about 200 'cleans', or 100 for 'B1' mode, Sony say.

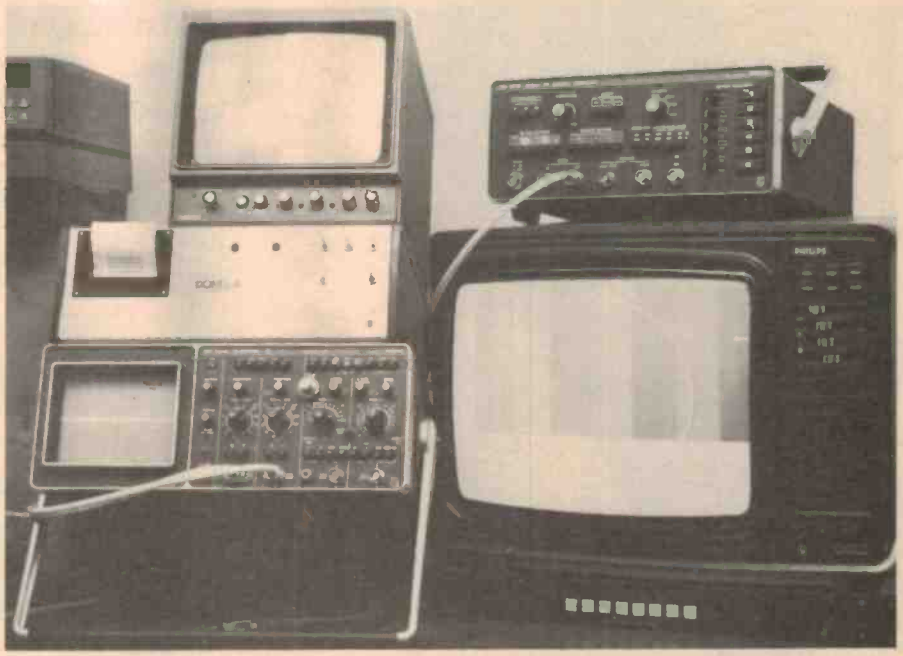
Objective testing

With Star Video's assistance I recorded a special test signal as shown in Figure 1. This test pattern, with black background and superimposed white circle, provides an excellent format for both instrumental and visual checking of tape drop-out incidence. The evaluation procedure that we used was to pre-record a series of special signals on a group of test tapes provided in both formats by TDK, Sony, 3M and BASF.

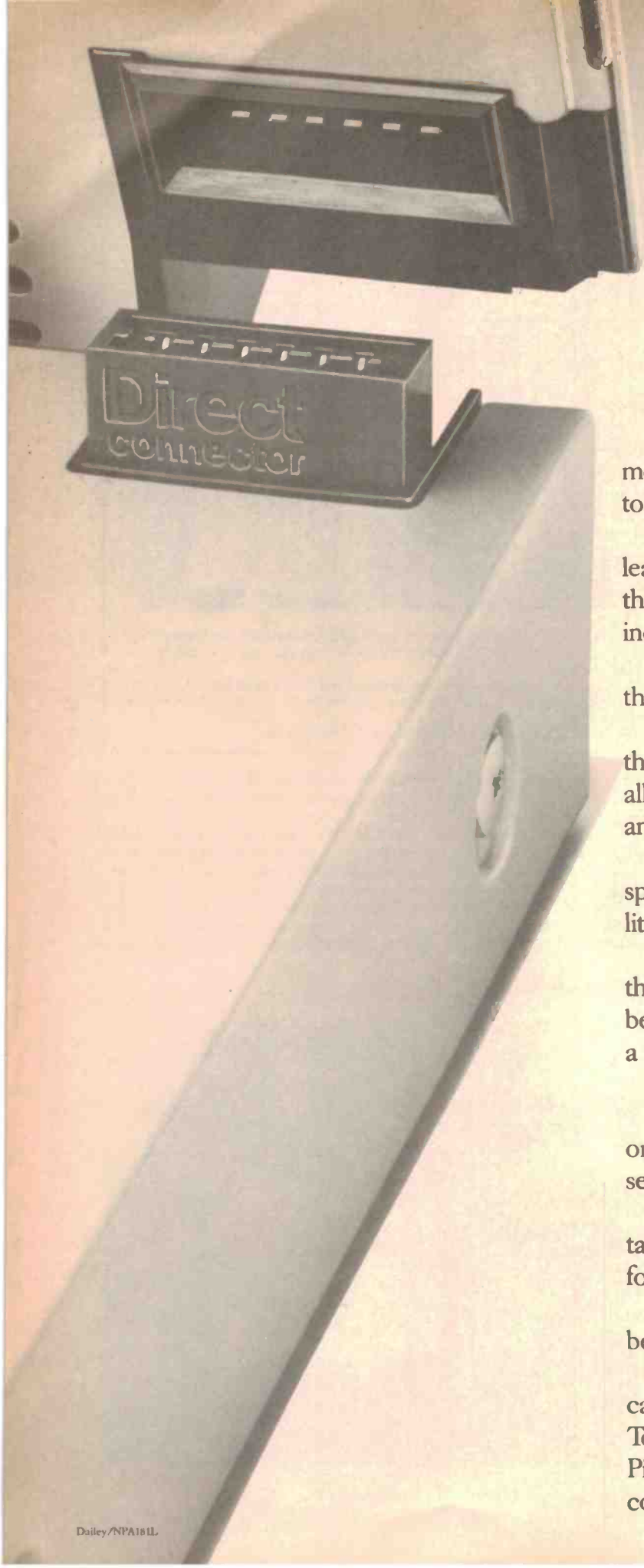
The first phase was an instrumental assessment using the DOM4 video drop-out recorder to assess the drop-out performance of a series of the consumer head cleaners. The DOM4 has to have a 'dedicated' electrical connection to one or more video cassette recorders in order to collect the drop-out data which it records and then prints out on its internal printer. The concept is simple as each video recorder already incorporates a video drop-out detector as part of the video circuitry. This drop-out detector is usually followed by a compensation circuit. By connecting the DOM4 video drop-out recorder before the compensation circuit, the data on the drop-out phenomena can be directly recorded. Testing with the DOM4 was reasonably fast. The results were also displayed on a video monitor and a CRO screen.

The data recorded by the DOM4 may be either extremely short transients which are detected individually or the more important 'bursts' of drop-out phenomena which your eyes can 'see'. The DOM4 prints out the time history of the drop-outs and the number of significant bursts which result in total transient loss of vision on your television screen.

With a good clean tape and clean heads these drop-outs are virtually invisible. With bad tapes or dirty heads the results are, as I soon discovered, visually *devastating*. One problem that we observed was that poor tapes can create more drop-outs than the limited digital memory in the DOM4 can cope with. ▶



Recording drop out performance. The DOM4 recorder is at upper left.



Why Direct

Don't tangle with Technics.

The majority of audio systems – even the most beautifully designed – have something ugly to hide.

It's that mass of jumbled-up connecting leads that you find, all too easily, at the rear of the equipment. Not only are they ugly, they're inconvenient, too.

And as audio components become smaller, the problem becomes bigger and more unsightly.

To solve this problem, Technics developed their Direct Connector systems, which eliminate all audio connecting leads between the tuner, amplifier, graphic equalizer and cassette deck.

Each of these components features a special flip-up connector to allow them to be literally plugged in to each other!

It's an elegant piece of Technics technology that results in a stylish, neat installation that can be put together or taken down for re-location in a matter of seconds.

The 315 Series.

But Direct Connector capability is not the only innovative feature in this new and compact series from Technics.

The SL-5 direct-drive, linear-tracking turntable employs its own plug-in connector system for the pickup cartridge.

This unique Technics development has been adopted as a World Standard.

It means you can compare and evaluate cartridges from leading manufacturers like Audio Technica, Ortofon, Shure, Stanton, Empire, Pickering, ADC and, of course, Technics without conventional setting up procedures.

Technics developed Connector systems.

No adjustment of tracking weight or bias correction is needed.

The innovations continue in the rest of the components: the SU-5 amplifier includes a Super Bass switch to enhance the bass response of a speaker system without inducing bass boom; the ST-5 quartz synthesizer digital tuner provides random access memory for 16 pre-set stations; the SH-E5 graphic equalizer – offers adjustment of 12 audio bands from 16Hz to 32Hz on each channel; whilst the RS-5 cassette deck – has soft touch controls, auto selection of metal, CrO_2 and normal tape settings plus convenient Cue and Review functions.

Finally, a pair of SB-F5 speakers with horn-type tweeters and bass reflex porting turn the high quality electrical signals of the rest of the system into the high quality sound you expect.

Compact components, full-size warranty.

All components in this series are perfectly matched in styling and performance.

And all are covered by a full 2-year warranty backed by Technics' reputation. Visit your Technics stockist soon and experience the superb styling and brilliant sound of Technics' compact Series 315 for yourself.

Technics 2 Two Year Warranty

Technics

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Dailey/NPA181R

Allsop does it best with award winning VCR cleaners!

In *Video Review* magazine's "Best Gear of the Year" roundup for '81, the **ALLSOP 3** non-abrasive video cassette cleaning system for **VHS** and **BETA** was the *only* cleaner named. The Allsop 3 VHS cleaner is recommended by Akai America Ltd. The new Gen II/for **BETA** is compatible with all Beta VCRs. **ALLSOP 3** is the safe way to help maintain video and sound quality and to avoid costly repairs.

It cleans the critical VCR parts with exclusive, non-abrasive cleaning material and **ALLSOP 3** cleaning solution. Both systems give extra-long service and are designed with easy-to-install replacement cartridges. VCR cleaners are part of **ALLSOP 3** high fidelity care products respected throughout the audio, record and video industries.

World Leaders In Fidelity Cleaning.

ALLSOP 3

Dealer inquiries invited.

ALLSOP FIDELITY ACCESSORIES,
PO Box 246 Double Bay, NSW 2028. (02) 357 2022. Telex 23381 "COMPOW"

Following my investigations of this phenomena, it became particularly clear that assessments of tape cleaners' efficiency can only be reliably performed with a test tape which already has the best possible drop-out performance.

The objective measurements that followed confirmed that all blank video tapes exhibit some degree of drop-outs and that the best tapes have a much lower incidence of drop-outs than the average 'commercial grade' tapes. Some of the worst tapes which I examined exhibited continual drop-outs, to such an extent that there was not much picture left between the drop-outs.

The DOM4 test results showed that the Ralmar VCL-300 head cleaner reduced major drop-outs from 450 in 100 seconds to 430, the Panasonic VFK-0185 tape reduced drop-outs from 430 to 380 and the Allsop wet cleaner made no significant impact on the residual cleaning response of a tape recorder after the easily removed debris had been cleaned off by an abrasive cleaner.

These tests were then supplemented by a series of tests on a selection of machines which had been drawn from the Star Video production line after operating for approximately 1500 hours without cleaning. All exhibited dirty heads and either unstable performance or reduced video output. An inspection of both the machines and the heads revealed that while the use of video head cleaners may reduce the extent of recorder head contamination, they *do not* remove the contamination from tape guides or lift heavy drop-outs of oxide from the video head drum.

Clean. RF level from machine with clean heads.

Dirty. RF level from machine with dirty heads.

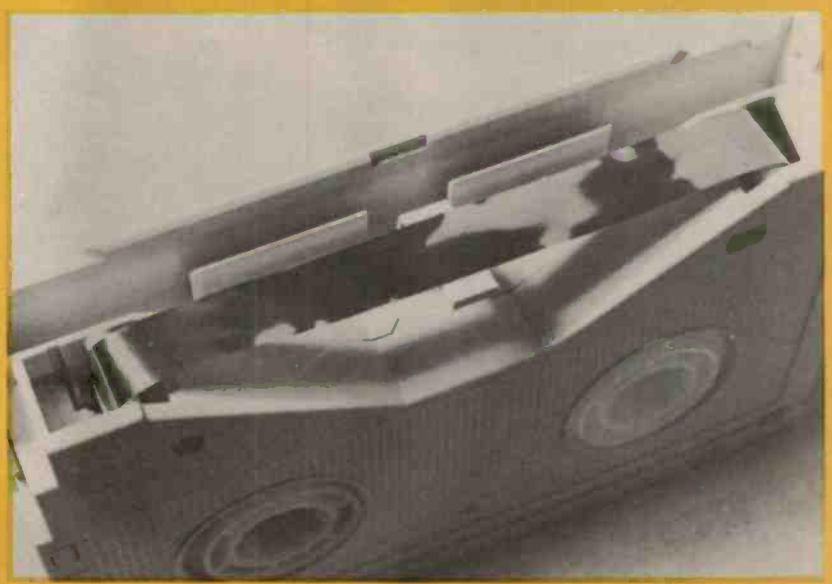
Only the abrasive cleaners lift substantial quantities of oxide from the drum and heads and then only at the risk of causing further wear on the heads and tape guides.

From this I concluded that if a head cleaner is to be used at all, it should be used before the contamination reaches serious proportions and preferably on a regular basis at intervals of between 50 and 100 hours of playing time.

Audio-technica Video Cleanica AT5002 (Beta). This is an abrasive type cleaner employing a non-magnetic metallic silvery cleaning tape that contacts both the heads and tape transport mechanisms in the VCR.

The instructions, printed on the plastic packet, indicate that 'normal' cleaning time should be 30-40 seconds, 60-90 seconds in severe cases.

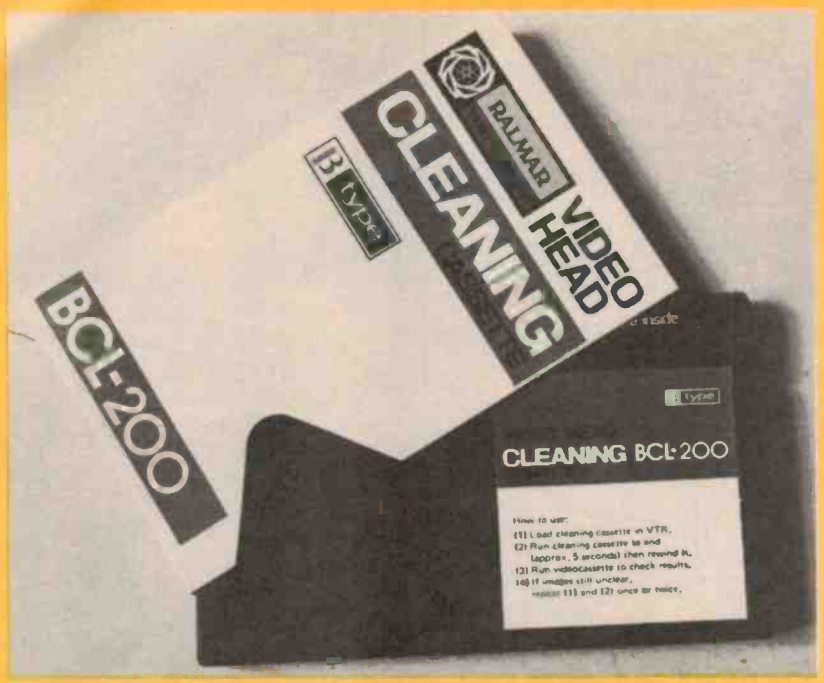
The cassette contains a panel on which you can record the number of times you've used the cleaner against hours of VCR usage. No indication is given of how many 'cleanings' can be obtained.



I also discovered that the recording heads of the Beta system are somewhat more susceptible to premature damage than the VHS heads, if reasonable care and precautions are not taken in normal usage. This comment is not meant as a condemnation of Beta recorders, but rather as a caution to avoid unnecessary and unwarranted manoeuvres such as heavy use of the slow motion or 'still frame' (stationery picture) facilities. This can cause premature head damage.

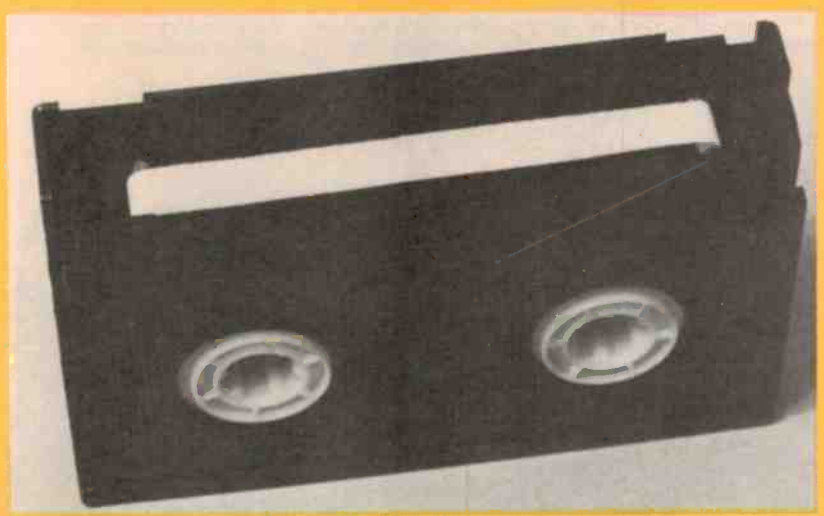
To provide objective data to support my suppositions, I proceeded to disturb all of my friends and neighbours who already own video recorders, particularly those who had not cleaned the heads of their machines for a while.

The procedure was first tested on the ▶



Ralmar BCL-200 (Beta) and VCL-300 (VHS). These employ what seems to be a lightly abrasive, white cloth-type tape with a course fibrous surface. Instructions are brief, printed on the cassette label. Cleaning time is about five seconds and the tape is rewound for successive uses. No information is given on how often the cleaner can be used.

This self-same cleaner seems to be available under other 'brand name' labels. The photograph below shows the Beta cassette opened up, displaying the coth-type tape.



Sanyo VTC 5400P recorder which had, by this time, sufficient magnetic debris on the heads to reveal the classical early signs of video tape drop-outs. By turning the colour balance to black with maximum contrast, it became very easy to detect the drop-outs, which then show up as bright white individual flashes or lines of intermittent white streaks on the video screen.

The pre-recorded test tapes produced by Star Video then made it relatively easy to assess the readily observable drop-outs and count them over a fixed period of 10 minutes.

Filth! The Ralmar VCL-300 cleaner after use, showing tape oxide material taken from a dirty VCR head.

Test results

The results of these measurements are not, however, accurate or even directly comparable, as no two machines are identical, either in terms of age or degree of contamination. We found that some poor tapes deposit debris easily which lifts off almost as easily during the cleaning cycle. Other tapes do not necessarily deposit the magnetic material quite as easily, but once down it takes either an abrasive tape cleaner or a scrape with a finger nail to remove it. These variable conditions are not conducive to accurate measurements and so all of the tabulated results must be treated with caution. ▶

LC Video Recorder Tape Head Cleaners — The Results of the testing — E109/2885/106

A. VHS CLEANING TAPES

Brand	Dropouts before use in 10 minutes	Dropouts after use in 10 minutes	Indicative % Reduction
Alsop 3	157	103	34
Panasonic VFK0185	201	88	56
Ralmar VCL-300	106 *	94	11

B. BETA CLEANING TAPES

Brand	Dropouts before use in 10 minutes	Dropouts after use in 10 minutes	Indicative % Reduction
Alsop 3	402	128	68
Audio Technica AT5002	279	89	68
Ralmar BCL200	186	129	30
Sony L-25CL	378	79	79
TDK Super 30	245	72	70

* Machine cleaned 2 weeks before test.

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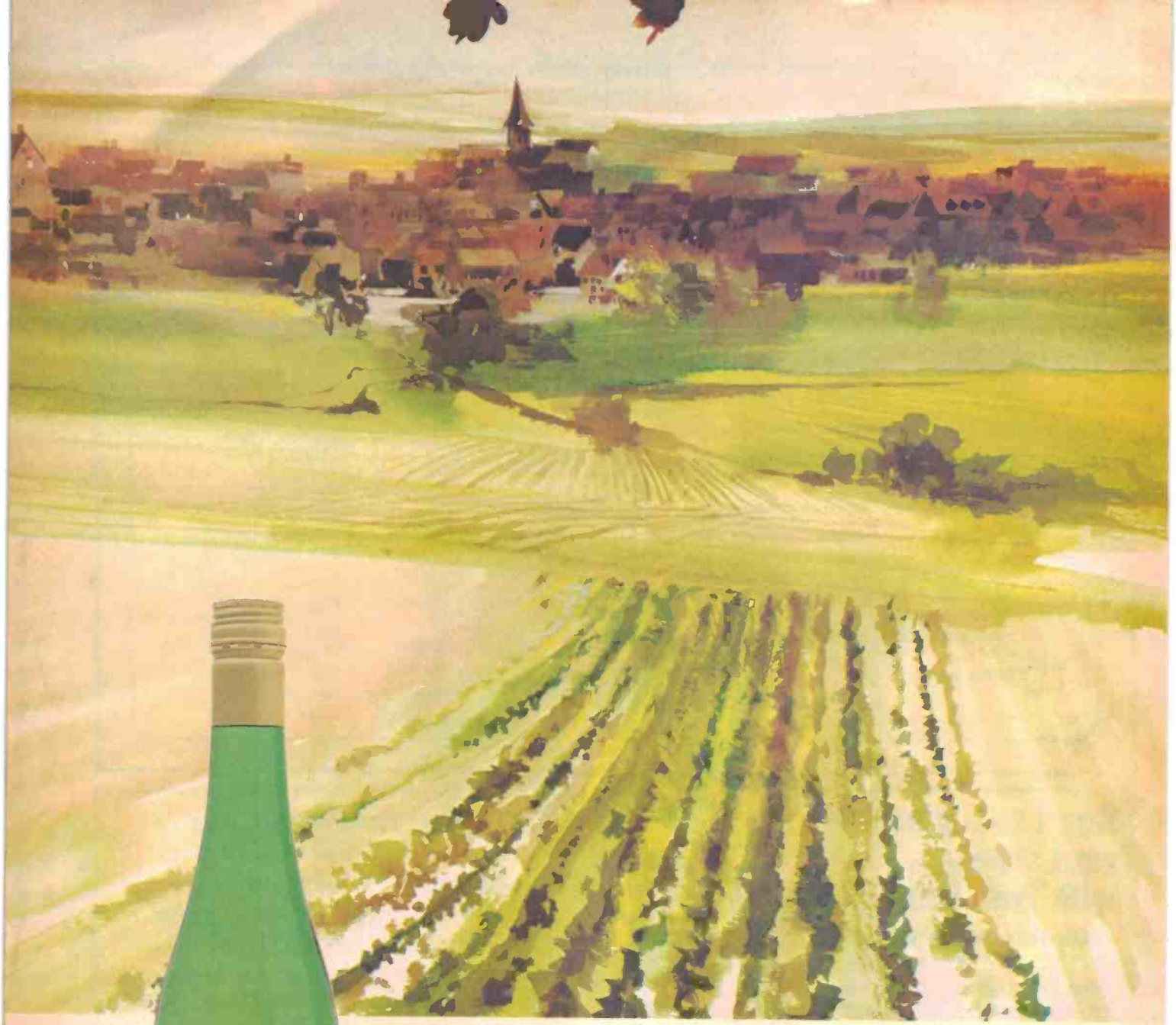


For over a thousand years the people of Alsace have been making Traminer Riesling remarkably like ours.

Now we're not suggesting that the good people of Alsace have in any way stolen our idea.

We do, however, suggest that Oliver de Serres' idea that "the essence of wine lies in the grape" is correct.

And that our Traminer and Riesling grapes produce wine every bit as delicate and heady as those of Alsace. **McWILLIAM'S**

AB 1730/82 MC 1205

What is clear is that the 'wet cleaners' (Allsop 3) and the very mild abrasive cleaners (Ralmar VCL-300) are most effective on light deposits of magnetic debris or on heads that are cleaned fairly regularly. *They are, in my opinion, the safest cleaners to use on a regular basis.*

By contrast the abrasive cleaners — Audio Technica, Panasonic, Sony and TDK are the only cleaners that you can effectively use with really dirty or caked heads.

I recommend that you consider using the wet Allsop 3 cleaners or the soft Ralmar cleaners every 30 — 50 hours. *The abrasive cleaners should only be used either when the drop-out becomes severe or on the occasion the other cleaners are ineffective.*

In the long term, the best solution to drop-out problems is to use the best possible tape. But remember, even the best tapes aren't perfect, so you're going to need that video head cleaner. ●

Panasonic VFK-0185 (VHS). Another abrasive-type cleaner, this unit employs a fine-grained matte black coating on an opaque black plastic tape. Abbreviated instructions are printed on a label on the cassette and a slip of paper in the plastic case gives more detailed instructions.

The 'normal' cleaning time recommended is 15 seconds and the instructions advise that cleaning time should not be longer than 45 seconds.

The cassette contains enough tape to clean 20 heads without rewinding. The cleaner may be used up to 100 times by rewinding, according to the instructions.

TDK LCL-30 (Beta). This abrasive-type cleaner employs a tape having a fine-grained matte deep-brown material on a plastic substrate. The recommended cleaning time is 30 seconds, which the makers say should not be repeated more than four times in a single cleaning session. They also recommend the cleaner not be used for more than 90 seconds at a time — which is a total of three cleans. Confusing.

The LCL-30 can be used for about 200 'cleans', TDK say, and 80 little boxes are provided on the cassette label so you can mark off how many times you've used it.

From the 'Super 30'' on the label, one assumes there's 30 inches of tape inside the cassette (about 760 mm).

A sheet of illustrated instructions, in English and German, is included.

WHAT DISTRIBUTORS SAY

In order to find out something of what VCR distributors in Australia advise with regard to head cleaning and head cleaners, we rang around seven major companies and spoke to either the video products manager or the service manager at each; in some cases, both. We asked what their company policy or recommendation was regarding head cleaning and head cleaning products. Summarised below is what we found.

Akai (VHS). Akai Australia recommend that, if trouble occurs, their equipment should be professionally serviced and definitely *do not* advise the use of a head cleaner.

Curiously, Akai America *endorses* the Allsop 3 head cleaner.

National Panasonic (VHS). National take much the same position as Akai — they do not recommend the use of any head cleaner and advise that their equipment should be returned for service. They have a service technician pull the machine down and clean the heads with a fluid.

Curiously, G.E.C. Australia, who market certain National video machines to the 'non-consumer' market here, themselves use and sell the Panasonic VFK-0185 head cleaner reviewed here.

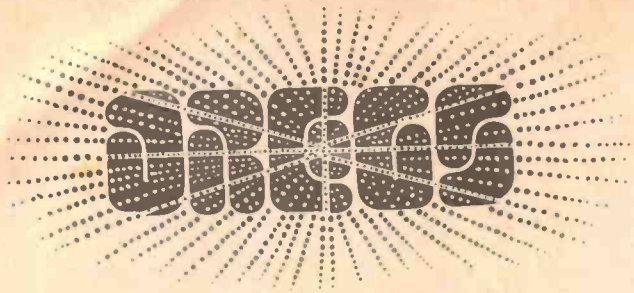
Philips (VHS). Philips' position is simple. They sell and recommend the Allsop 3 video head cleaner.

Sanyo (Beta). Regular professional servicing is one recommendation Sanyo make, but they also sell the 'Fuji' and 'Soundtrack' brands of VCR head cleaners. The gentleman we spoke to said they found the Fuji cleaner easiest to use. Both are made in Japan.

Sharp (VHS). Simple; they take the same line as Akai and National.

Sony (Beta). They sell and recommend their L-25CL.

Toshiba (Beta). Firstly, Toshiba *don't* recommend the use of a VCR head cleaner and *do* recommend that their equipment undergo regular servicing and maintenance. They advise that, if a head cleaner is used, then the manufacturer's directions as to time of use should be followed carefully.



NO DOUBT you're all acquainted with the various 'dial-a-(whatever)' services you can find in the 'phone book. Dial-a-Prayer was famous when such things started up. Now you can 'phone such diverse services as Dial-a-Bubbly, Dial-a-Car or Dial-a-Date (which is quite distinct from Dial-a-Girl, nudge-wink and say no more!). You can even Dial-a-Flower or Dial-a-Fruit Basket. There's Dial-a-Minstrel (serenading services perhaps?), Dial-an-Angel (home help) and even Dial-a-Jewish Story!

There was once even a Dial-a-Joke service! But the one to eclipse them all must be one we spotted on the latest Altronics catalogue. It's called "JESTSERVICE".

Jack O'Donnell, the peripatetic proprietor of Altronics, is known to be fond of a joke. He's also known for walking on water (see ETI, April '81, page 11). Page 2 of his catalogue lists his 'overnight jestservice'. Not wishing to spoil a bit of fun by deducing what it obviously means,

the dilatory dilettantes of the Dregs Department dallied awhile with this dicky little dictum.

They asked 'What would happen if you ordered the Altronics jestservice?'. Would Jack O'Donnell arrive on your doorstep the next morning in full court jester's outfit with an Irish joke for the day?

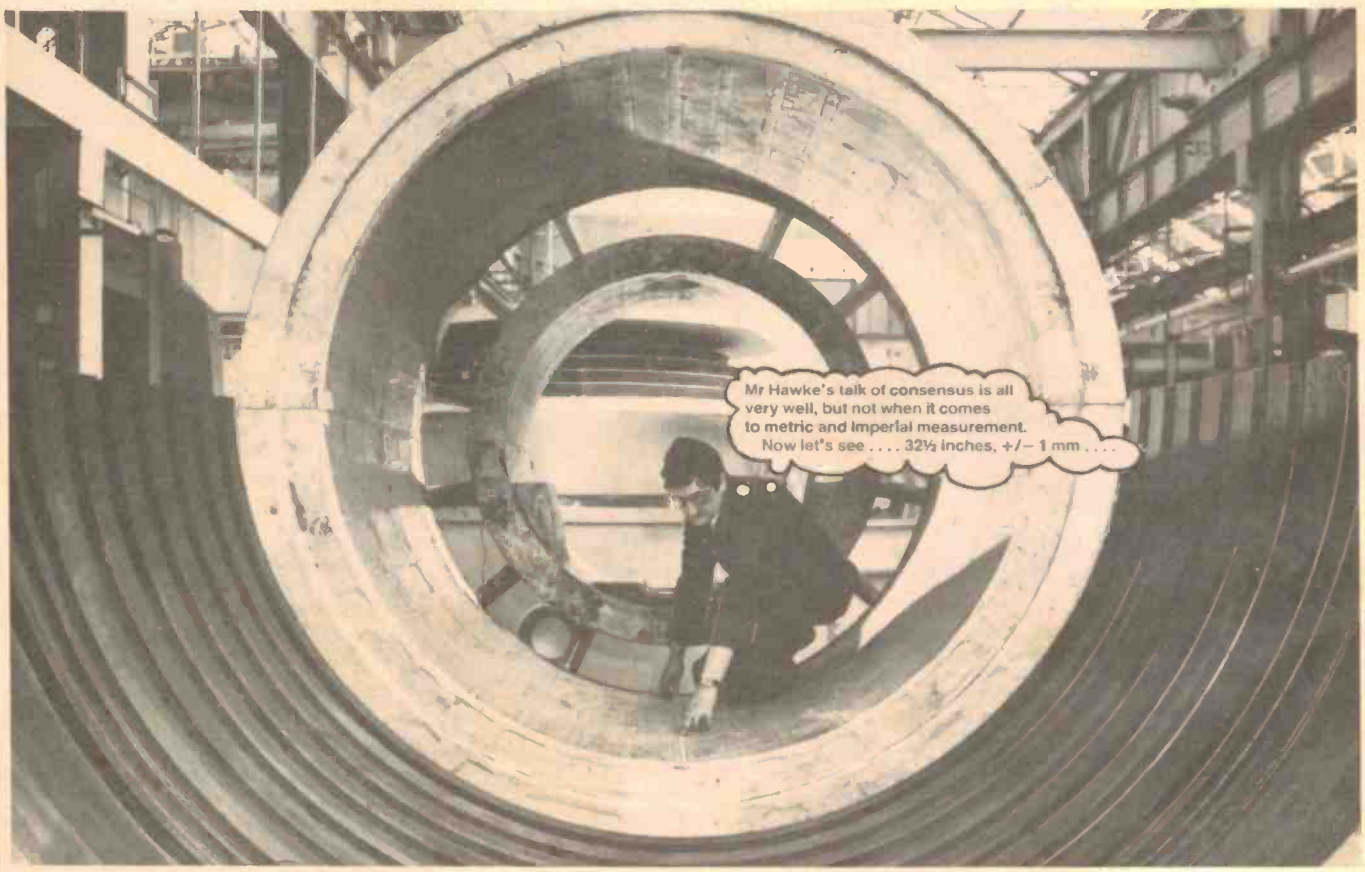
Guarding your rear

It has been said that Alexander the Great firmly believed in guarding his rear, keeping a small force in reserve to make sure none of the enemy snuck round the back of the main force to distract them with a little sabotage.

It seems that latter day master of battle tactics, ex-Prime Minister Malcolm Fraser (retired), had been reading the thoughts of Commander Alexander, according to a story we heard from our sister magazine, Sonics.

It seems that a Sydney firm called the Fat Road Company was contracted to provide the sound for one of Mal's pre-election speeches in Martin Place, Sydney.

Apparently, the contract called for the power outlet to be guarded! ●



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IS THE MARANTZ CD73 REALLY ANY DIFFERENT? David Prakel for Hi Fi Answers magazine (UK) who did hear the difference said: "I have been surprised by the quite audible difference between different CD players and have already stated a preference for the sound of the Marantz machine in terms of its handling of 'ambience' and its sheer unfatiguing listenability. Other players I've heard in direct comparison have shown a bright veiling effect with more up-front presentation and a fatiguing quality."

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