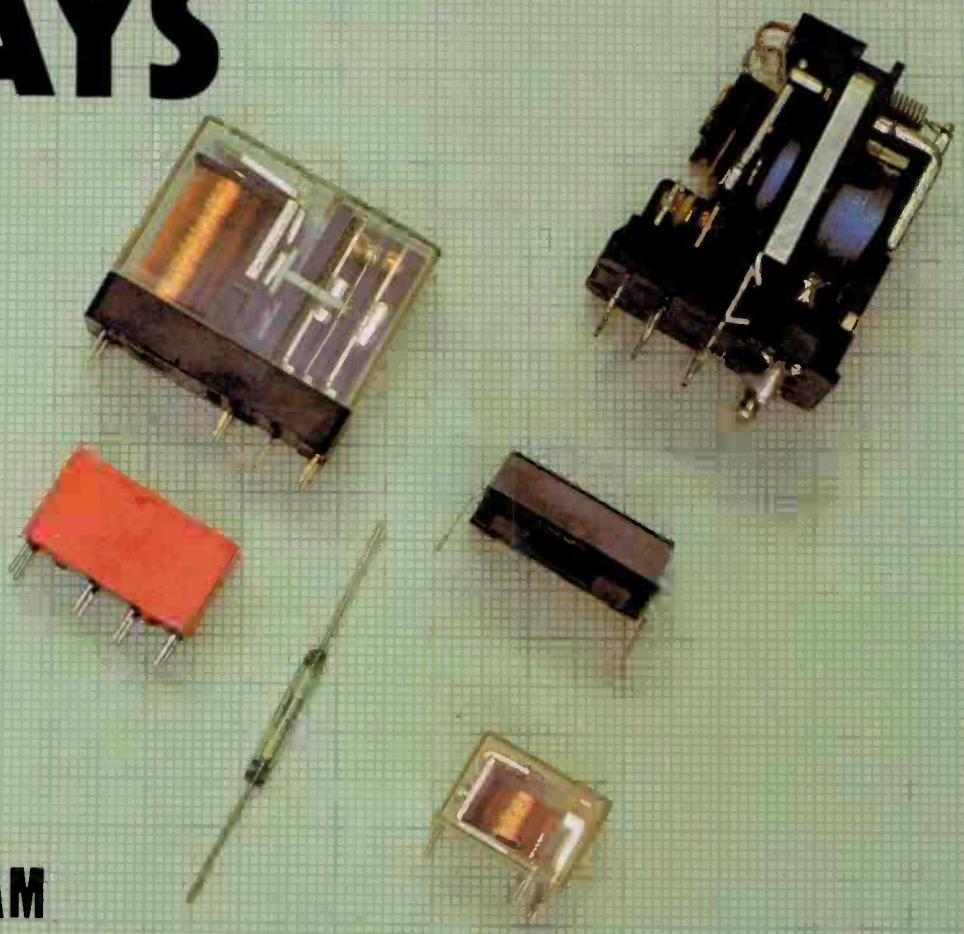
FEBRUARY 1984 **$2.35*** NZ $2.75

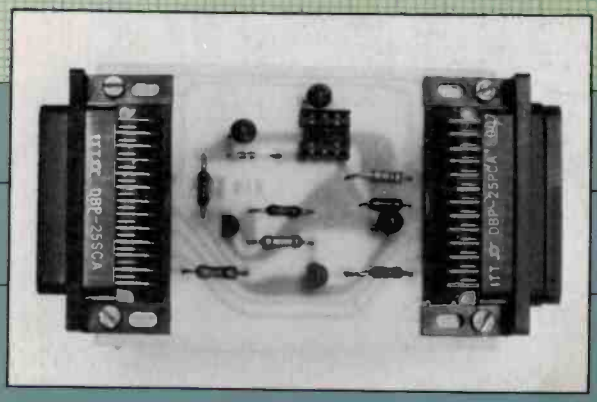
eti
ELECTRONICS TODAY INTERNATIONAL

RELAYS

TECHNOLOGY
TECHNIQUES



HAM RADIO:
A DX BEAM HEADING PROGRAM



TO BUILD:

- MICROBEE TRUE RS232 INTERFACE
- DIRECT-CONNECT MODEM REVISED
- 'DAMN FAST' NICAD CHARGER

HI-FI: TECHNICS • PHILIPS • MARANTZ • CD PLAYERS REVIEWED

SPHERE COMPUTERS

PRESENTS AN INTELLIGENT TERMINAL

FANTASTIC VALUE

ONLY $799 + S.T. if applicable F.O.B. Ex Sydney

OEM DEALERS WELCOME

SPECIFICATIONS

Keyboard
- Detachable, capacitive, typewriter-style keyboard
- N-key rollover with auto repeat capability
- 4 LED indicators for caps lock, on line, block mode and keyboard lock/protect
- Audible keyclick enable/disable
- Auto repeat enable/disable
- Keyboard lock enable/disable
- Repeat rate 20 characters per second
- 5 cursor control keys, 10 editing function keys with 14-key numeric key-pad

Communication
- Code: 128 ASCII characters
- Baud rate: 75, 110, 150, 300, 600, 1200, 1800, 2400, 4800, 9600, 19,200
- Parity: Odd, even, mark, space
- Operating Mode: Full duplex, half duplex or block mode
- Interface: EIA RS-232C or 20-mA Current Loop

Emulation
- LEAR SIEGLER ADM-3A, HAZELTINE 1500, ADDS VIEWPOINT

Screen Presentation
- Display format: 24 lines x 80 characters
- Display unit: 12-inch, non-glare Green CRT
- Character type: 7 x 9 dot matrix
- Refresh rate: 50/60Hz
- Character set: 96 ASCII characters, 15 graphic symbols, 32 control character symbols
- 5 screen attributes: Blink, underline, blank, reverse, dual intensity
- Cursor type: Selectable slow, fast blinking or steady cursor, block, underline or invisible cursor

Editing Function
- Cursor: up, down, left, right, home
- Insert character, delete character, insert line, delete line, erase to end of line, page and field, field tab, field back tab, column tab, column back tab, block mode on/off, protect mode on/off, graphic mode on/off, clear unprotected.

External Control
- Power on/off
- Contrast adjustment
- Baud rate
- Parity and data format
- End of message
- Emulation mode
- Refresh rate
- Half duplex or full duplex
- Auto line feed
- Auto new line
- EIA or 20-mA Current Loop
- Reverse video or standard video

ENQUIRIES FROM: AVAILABLE FROM OFFICES AND SHOWROOM PARIS RADIO ELECTRONICS, SHOP 1, 165 BUNNERONG ROAD, KINGSFORD, NSW 2032. TEL. (02) 344 9111. TELEX AA22579.

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SERIES 5000

PRICES SLASHED

As designed by ETI

INDIVIDUAL COMPONENTS TO MAKE UP A SUPERB HI-FI SYSTEM. DIRECT IMPORT AND A MORE TECHNICALLY ORIENTED ORGANISATION BRING THESE PRODUCTS TO YOU AT LOWER PRICES THAN OUR COMPETITORS.

EXTRA FEATURES OF OUR KITS

POWER AMPLIFIER **Only $449**

KIT PRICE $319 P&P $12.00

• 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 400 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 amplifier puts out. This is done on a per order basis delivery approx. four weeks after placement.

PREAMPLIFIER **Only $449**

KIT PRICE $289 P&P $12.00

• 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 PA.

PREAMPLIFIER Kit Price $289, P&P $12.00

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.

On Special at $259
Normally $289

**All parts available separately for both kits.*

POWER AMPLIFIER Kit Price $319, P&P $12.00

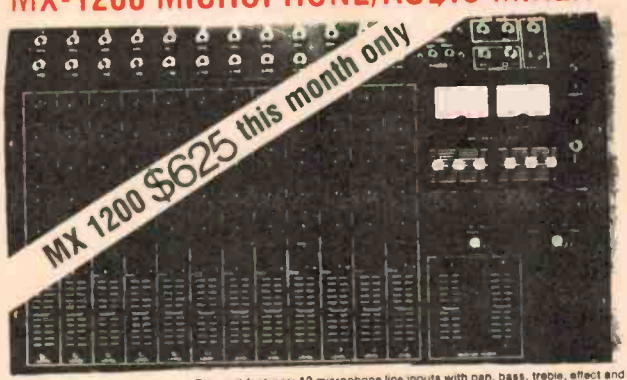
Please note that the "Superb Quality" Heatsink for the power amp was designed and developed by Rod Irving Electronics and is being supplied to other kit suppliers. This product cost $1,200 to develop so that your amplifier kit would have a professional finish as well as sound.

SPECIFICATIONS 150W RMS into 40hms

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 55 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

On Special at $299
Normally $319

MX-1200 MICROPHONE/AUDIO MIXER



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; 80mm; 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, 58DB
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: 620 (W) x 380 (D) x 108 (H) mm (supplied complete with carrying case)

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

SERIES 4000 SPEAKERS.

- 8 speakers with crossovers $499
- Speaker boxes (assembled with grill and speaker cutout) ... $299
- Crossover kits $199
- Complete kit of parts (speakers, crossovers, screws, inner-band boxes) $799
- Assembled, tested, ready to be hooked up to your system ... $849

WE BELIEVE THAT WE ARE NOW THE ONLY ONES TO SUPPLY COMPLETE SPEAKER KITS ASSEMBLED AND TESTED FOR THOSE WHO HAVEN'T GOT TIME $849 EX STOCK.

PLEASE WRITE FOR CONSTRUCTION NOTES, THESE COMPLIMENT THE SERIES 5000 AMP RANGE AND ADD THE FINAL TOUCH.

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COMMENT

The wise and prudent conquer difficulties by daring to attempt them.

— Rowe

RADIO AMATEURS have been involved in satellites and space communications experimentation since the very earliest satellites were launched. Their record of achievements in this area is something of which the amateur radio fraternity can be justifiably proud. Many 'firsts' have been established since OSCAR 1 (Orbital Satellite Carrying Amateur Radio) was launched in December 1961. The world's first free access active communications satellite was Oscar 3, launched in March 1965, one month before *Early Bird*, the first of the International Telecommunications Satellite Consortium (INTELSAT) satellites. The oscars were all largely the result of the efforts of a small group of US and European radio amateurs. A group of radio amateurs from Australia, all students then of Melbourne University, designed and constructed OSCAR 5 in the late 1960s which flew in January 1970. OSCAR 5 incorporated an innovative magnetic attitude stabilising scheme, another first; it was ground-controlled, was the first amateur satellite to have multi-channel telemetry, and established that the coefficient of solar energy absorption, then used by scientists for many years, was wrong!

Subsequent OSCARS have carried multiple transponders aboard and lasted years beyond their design lifetime. The latest, OSCAR 10, is in a highly elliptical orbit, permitting across-the-world contacts, between Australia and Europe, for example.

The latest amateur radio space venture though, is a whole new ball game. Owen Garriott, one of the scientists aboard the STS-9 mission Space Shuttle 'Columbia', happens to be a radio amateur and obtained permission to operate a VHF transceiver aboard the mission which flew late November last year. He managed to contact hundreds of amateurs in countries throughout the world during the few passes he was able to operate in the crowded scientific program. However, a group of Canberra amateurs, with the cooperation of Dr Garriott, the Department of Science and NASA, have achieved a commendable 'first' with the beginning of this new phase of amateur radio and space communications. They set up an experiment to prove that amateur radio could provide a viable backup communications system for manned space missions. They successfully established contact with Dr Garriott and, via a telephone 'patch' hookup, enabled him to talk with colleagues in the Lyndon B. Johnson Space Centre in Houston, Texas USA. There's a small news item on their achievement in *News Digest* this month and we'll bring you the full story next month. Don't miss it!

Roger Harrison VK2ZTB
Editor

NEXT MONTH

CONTROL FOUR ROOM LIGHTS OVER A TWO-WIRE PAIR

It is probably a not-uncommon problem to want to replace the single ceiling light in a room with a more exotic dimmable arrangement only to find that the control wires to the switch are concreted in!
This project fixes that and provides two dimmable outputs plus two switched outputs, controllable over the existing two-wire pair between ceiling and wall switch.

DIGITAL EXPOSURE METER FOR PHOTO ENLARGING

Have you ever been caught with indecent exposure? Well, with this project you'll get a much higher yield of decent exposures from your darkroom. The project uses readily available components, is low in cost, simple to build and operate and includes a three-digit LED readout. The sensor provides 'cosine error' correction to account for the different illumination between the centre of the enlarger baseboard and the edge.

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.

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GREAT NEW PRODUCTS

60-KEY COMPUTER KEYBOARD

- AS USED IN THE FAMOUS MICROBEE
- SPST CONTACTS
- FRAME MOUNTED - QUALITY UNIT

Cat XE-3522

ONLY $29.95

WHAT ARE STICKIES?

As you can see, "stickies" are stick-on templates. Attach the template to a panel (note the crosshairs for accurate alignment) and proceed to cut out a perfect hole! The plastic film also protects the panel from scratches while you are working on it.
Stickies are available for the common irregular hole cutouts i.e. Cannon DB-25, XL series chassis plug and socket and IEC-320 chassis (mains) plug.

Cat No.	DESCRIPTION	Price
NL-4010	25 way 'D' template - Pkt of 6	$1.95
NL-4014	XLR-31 series template - Pkt of 6	$1.95
NL-4018	XLR-32 series template - Pkt of 6	$1.95
NL-4020	IEC 320 chassis plug - Pkt of 6	$1.95
NL-4024	DIN chassis socket - Pkt of 6	$1.95

GAMES JOYSTICK

New low price! This unit, which is similar to our competitors units offers a huge saving. Why? Direct Import! The unit is not fitted with a connector either because a specific connector limits its use to specific computers. Fit the connector yourself and save a fortune!
DON'T PAY $49.95

Cat XE-7032

ONLY $19.95

MINI BREADBOARD

Just the right thing for many small projects. This board has the same features as our larger breadboards but measures a compact 80 x 60mm. It has 420 holes. Perfect for the occasional project.
Cat. PB-8808

ONLY $6.95

BARGAIN!

SPEEDO-CABLE TYPE SPEED SENSOR

This unit is designed to fit into a standard speedometer cable. It then provides a steady train of TTL-compatible pulses.

- As used in the EA Car Computer
- Used by State Police Force for electric speedo's.

A BARGAIN FEB ONLY $12.50
NORMALLY $29.95
SAVE NEARLY 60%!!

SEALED PCB MOUNT ROTARY SWITCHES

We have decided to discontinue our range of open "skeleton" switches for these. The new switches have contacts enclosed in a fully molded plastic housing - reminiscent of European design rotaries. The silver plated contacts are terminated with PCB pins instead of the usual eyelet. You can solder to the pin, of course, but the pin also inserts straight into the PCB. Another feature of the switch is its programmability. A removable ring with tab can be inserted into the switch several ways to yor particular requirements. For example, if you purchase a 1 x pole 12 way (max) switch you could convert it to, say, 1 pole 7 way between stops. Versatile! Naturally the switches feature ⅜x32 TPI bush mount and a ¼" shaft with standard flat. The shaft is hard nylon moulded to help reduce signal capacitance problems. They are almost the same price as the inferior wafer units.

Cat. No.	Description
SR-1210	1 pole x 12 way
SR-1212	2 pole x 6 way
SR-1214	3 pole x 4 way
SR-1216	4 pole x 3 way
SR-1218	6 pole x 2 way

1-9 ONLY $1.95 ea
10« ONLY $1.75 ea

TRADE PACKS OF SCREWS & NUTS etc.

By popular demand. Now you can get commonly used hardware in bulk and save a fortune!

Cat. No.	DESCRIPTION	Price
HE-0736	Rubber feet stick-on 12mm Pkt. 100	$9.60
HE-0738	Rubber feet stick-on 20mm Pkt 100	$11.50
HE-0913	TO-3 Mica insulator kit Pkt 100	$12.50
HE-0922	TO-220 Mica insulator kit Pkt 100	$9.80
HP-2742	6BA Flat washer Pkt 500	$6.95
HP-2752	4BA Flat washer Pkt 500	$6.95
HS-1521	6BAx½" Cheesehead screw Pkt 500	$7.50
HS-1522	4BAx¼" Cheesehead screw Pkt 500	$5.95
HS-1527	4BAx½" Cheesehead screw Pkt 500	$6.95
HP-2712	6BA Hex nut brass Pkt 500	$12.50
HP-2722	4BA Hex nut brass Pkt 500	$12.50
HS-1607	No.4x¼" Self tappers Pkt 500	$4.50
HS-1609	No.4x½" Self tapper Pkt 500	$5.50

MICROBEE KITS

ETI 733 RTTY CONVERTOR. Ref: ETI April 1983
This simple project allows you to hook-up your MicroBee to a HF receiver and print radio teletype messages on a monitor screen. Listen to the world news FREE!!
Cat. KE-4654 ..... **ONLY $17.95**

ETI 668 MICROBEE EPROM PROGRAMMER Ref: ETI February 1983
This simple, low cost EPROM programmer just plugs into the Bee's I/O port and enables you to save programs in any of 5 different common EPROMs available (2716, 2532, 2732, 2732A, 2764). Kit comes complete with 'Personality' plug and all IC sockets.
Cat. KE-4650 ..... **$39.95**

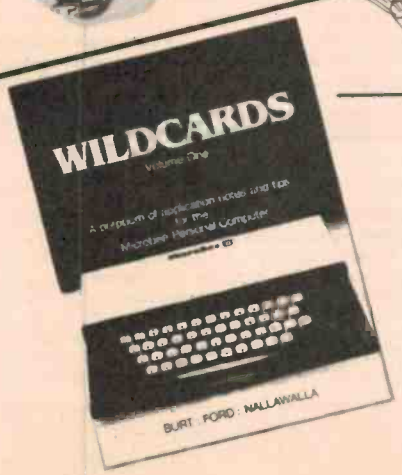
ETI 649 MICROBEE LIGHT PEN Ref: ETI Aug '83
This simple, low cost device plugs into the Bee's 8 bit port. The "pen" gives you an entry into the world of light pens and interactive software.
Cat. KE-4656 ..... **SHORTFORM $19.50**
SPECIAL PROBE CASE TO SUIT (as specified in ETI article)
Cat. HB-6400 ..... **$19.95**

PARALLEL INTERFACE KIT FOR THE MICROBEE
Includes 15 pin 'D' plug - add $15 if Centronics plug required.
Cat. KE-7017 ..... **$15.00**

TECHNICIANS LIGHT PROBE

This N.Z. made unit enables you to place a spot of bright light in the most awkward places. Ideal for servicemen or kit assemblers. A flashlight or lamp always seems to cast a shadow where you need to see! The exclusive design allows you to "poke light" around corners!! The unit is solidly made (Aluminium) and takes two penlight cells. A two function switch (lock-on and press-on) is also a feature.
Cat. TH-1838

ONLY $12.95



WILDCARDS II

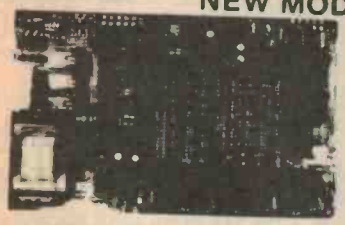
This book is the sequel to Wildcards Vol.1. It contains much, much more information and a memory map of 7 pages. If you liked the first volume you're going to love the second even more.
Cat. XE-8016 ..... $16.00

ETI644A See ETI Jan '83!!

DIRECT CONNECT MODEM

Ref: ETI October 1982

NEW MODEL



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

SHORTFORM KIT	COMPLETE KIT
Cat. KE-4600	Cat. KE-4601
ONLY $169	**ONLY $199**

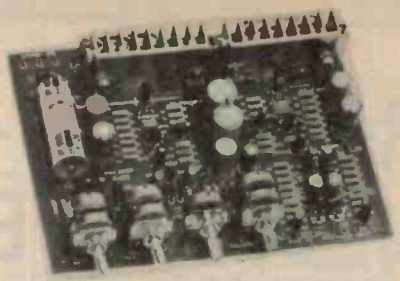
LESS FEBRUARY SPECIAL DISCOUNT OF 10%

30W « 30W Stereo pre-amp STEREO AMPLIFIER

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

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

ONLY $34.95



SYNTOM

Original design from the U.K. magazine "Electronics and Music Maker" April 1981. Self-contained unit produces a variety of fixed and falling pitch effects. Trigger by tapping the unit itself or by striking the drum to which the unit is attached. The Jaycar "SYNTOM" comes complete with high quality pre-drilled moulded all ABS box 152 x 80 x 47mm with professional silk-screened front panel.
FEATURES: Decay from less than 0.1 second to several seconds, pitch control, sweep control and volume on/off.
Cat. KJ-6502

ONLY $36.50

INFRA RED DIMMER KIT $25.95

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

DIGITAL DELAY LINE KIT

The Digital Delay Line is designed to produce a huge variety of electronic effects. It works very well but the amazing thing is the low, low price! The effects depend on the time delay selected and some of those included are: Phasing, Flanging, Chorous, ADT (Automatic Double Tracking), Echo, and Vibrato. The delay time can be varied from 0.32ms to 1.6 seconds! Because the signal is stored in digital form there is, unlike analog systems, no degeneration of the signal with time and unlimited repetition is provided by use of the freeze control. All the controls mount directly upon PCB's to eliminate wiring and to further simplify construction the main board is 'plated-thru' i.e. there are no wire links or link-thru pins. The whole of the memory whether for the basic 400ms machine or the fully expanded 1.6 second model all fits on the main board. The cabinet which is free standing but also suitable for 19" rack mounting, is fully finished to a very high standard. The panel is deep blue whilst the cover is sprayed with a durable black enamel. The kit is available for only $449 - compare with inferior units that can cost over $2,000!!
Cat. KJ-6621

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$449

VK POWERMATE NEW MODEL

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Ref: EA December 1982
Get up to 13.8V @ 10 amps to run those mobile rigs at home! The Jaycar kit is complete.

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Cat. KJ-6511

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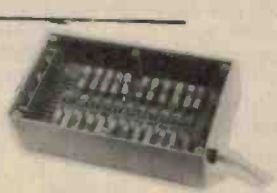
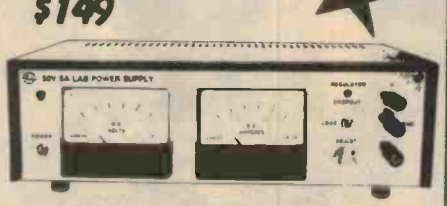


50V/5A LABORATORY POWER SUPPLY

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

$149



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- low power consumption
- produces high intensity electric field
- output around 7.5kV
- will not necessarily produce ozone in standard form
- Ideal for those who wish to 'try' an Ioniser at an economical price.

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Cat. PP-2420

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ROBOTS — OUR NEXT STEP?

AUSTRALIA'S long-term employment prospects in the manufacturing industry will benefit by the introduction of robotic systems says Dr Jim Fox, a senior consultant with PA Technology.

Dr Fox said the large-scale introduction of robots could well mean a small rise in unemployment in the short term. He said, however, over the long term, robots would mean a saving of jobs because Australian manufacturing would be more competitive.

Without such an improvement in competitiveness, the rate of job loss in the manufacturing sector would increase over the next few years, he said.

His statement coincides with the distribution in mid-December last year of a top level New South Wales Government report on robotics. The report, "Opportunities For Robots in Industrial Processes," is the most extensive such report ever commissioned by an Australian state government. Dr Fox said it could lead to a rejuvenation of some sectors of the Australian manufacturing industry.

The report was prepared for the NSW Government Department of Industrial Development and Decentralisation by PA Technology and PA Management Consultants.

PA Technology, a core division of the international management and technology consulting group, PA is one of Australia's foremost independent suppliers of industrial research and development services.

Dr Fox said the robotics report analysed material ranging from the cost effectiveness of using robots through to opportunities for their local manufacture.

He said the distribution of the report by the NSW Government to approved applicants comes at a time "when the Australian manufacturing industry is finding it increasingly difficult to compete on the international market.

"It is imperative for more local companies to embrace robotics technology where applicable so as to keep pace with manufacturing developments in North America, Europe and Asia.

"The report will play an important role in helping local manufacturers determine whether a robotics system could be integrated into their production line and if so, what type".

Dr Fox said more Australian companies had to determine what areas of technology they should invest in, assess the present and likely competitive factors and then plan an appropriate marketing strategy.

One of the most significant findings of the report is that despite strong competition from foreign companies, there is an opportunity for the development of robotics technology in Australia.

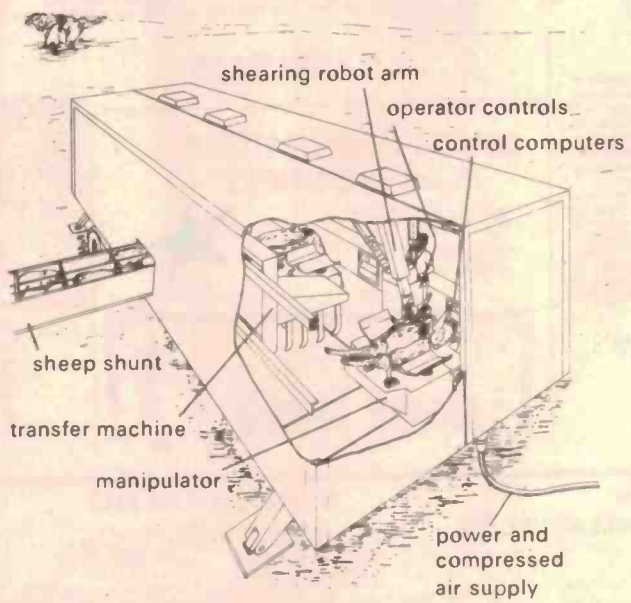
"As the Australian market is very small in world terms it is essential to consider the export potential of any such developments." Dr Fox said any Australian robotics manufacturer would have to concentrate on producing a 'next generation robot'. He cited examples such as a sheep-shearing robot or a de-boning robot for use in abattoirs.

The report lists six Australian industries where automation and robots should be seriously considered: Clothing and footwear; Heavy fabrications, including steel and concrete framed buildings, pipelaying and road making; Educational and consumer robots; Abbatoirs and the meat industry; Agriculture, fruit picking, forestry; Mining-related tasks.

The report states: "In all industries there are problems associated with the introduction of robots. However, the development in control and sensor technology currently occurring provide an opportunity for those more difficult applications to be seriously considered."

The report is believed to provide the only complete lists of Australian suppliers of industrial robots.

Further information is obtainable from Dr Jim Fox, Senior Consultant, PA Technology, **35 Winterton Road, Clayton, Vic 3168. (03)543-4333.**



Schematic automated shearing concept. This mobile complex is one possible method for using automated shearing technology for commercial wool harvesting.

STC ENTERS SATELLITE TECHNOLOGY

Precisely on contract schedule, STC has completed the first stage of its entry into satellite technology with the delivery to Hughes Aircraft Company in the US of an intricate and delicate wiring system for incorporation into AUSSAT — Australia's domestic communications satellite.

The systems were assembled at STC's Liverpool Plant in a 'space age' factory built to manufacture submarine repeater units for the transoceanic cables. These, together with satellites, will form Australia's future communications links with the outside world.

"It is no coincidence," said Tony Cobden, STC's Manager in charge of defence and offset projects, "that Australia's first contributions to both these competing technologies are being undertaken in the same factory."

STC was awarded contracts to build the wiring systems for two AUSSAT satellites as part of Hughes' programme to meet its offset commitments to the Australian Government.

Mr Cobden said that, as a result of this offset contract, Australia would benefit from the technology transfer and increased job opportunities.

AMTEX MOVES

Amtex Electronics, which describes itself as a leading company in the solar electricity field, is relocating its head office to Fairfield in Sydney's western suburbs, effective from this month.

Formerly based in Chatswood, the solar company which is a division of the national electrical wholesaling group Telcon Australia, will expand into larger offices within the Telcon operation in Lisbon Street, Fairfield.

Both Telcon and Amtex come under the umbrella of the Metal Manufacturers group of companies. Amtex solar systems are distributed through Telcon agents around Australia as well as independent outlets.

TWO-CHANNEL TV SOUND APPROVED

The Minister for Communications, Mr Michael Duffy, announced in December that he had approved the European dual sub-carrier system as the Australian standard for dual-sound television broadcasts in this country.

Mr Duffy said: "As a result of this decision, Australian broadcasters who wish to transmit dual-sound broadcasts are now in a position to provide this enhanced service."

It also cleared the way for production of assembly of dual-sound television receivers to begin in Australia.

Mr Duffy said ordinary household television receivers would not be able to pick up the dual sound transmissions and new receivers would be required. It was considered that they could prove an attractive proposition, particularly for people interested in upgrading their existing sets.

"Dual-sound television is really another example of the general advance in communications techniques and reflects the wide range of choice being offered to consumers today," Mr Duffy said.

Dual-sound television will enable programmes to be broadcast in stereophonic sound. The second sound channel could also be used for transmitting programmes in an alternative language to that on the video version, or for providing spoken data.

The Minister said technical standards for dual-sound television transmissions had been established by the Department of Communications. Broadcasters wanting to introduce the new service would be required to obtain the Department's authorisation to modify technical equipment. These modifications would be required to meet the new technical standards.

Mr Duffy said that the Government had not yet considered whether the ABC and Special Broadcasting Service networks would move to the new system.

Mr Duffy said his approval of the European system followed laboratory tests by his Department and on-air tests conducted by Channels 7 and 9 in Sydney and Melbourne. Results were circulated to the broadcasting industry for comment before the new system was adopted.

SHUTTLE TO HOUSTON VIA HAM RADIO

Using 144 MHz equipment, a group of Canberra radio amateurs, under the callsign VK1ORR, were able to talk to Dr Owen Garriott, a mission specialist aboard the STS-9 Shuttle which flew in December, and patch him through to the Johnston Space Centre in Houston, Texas USA.

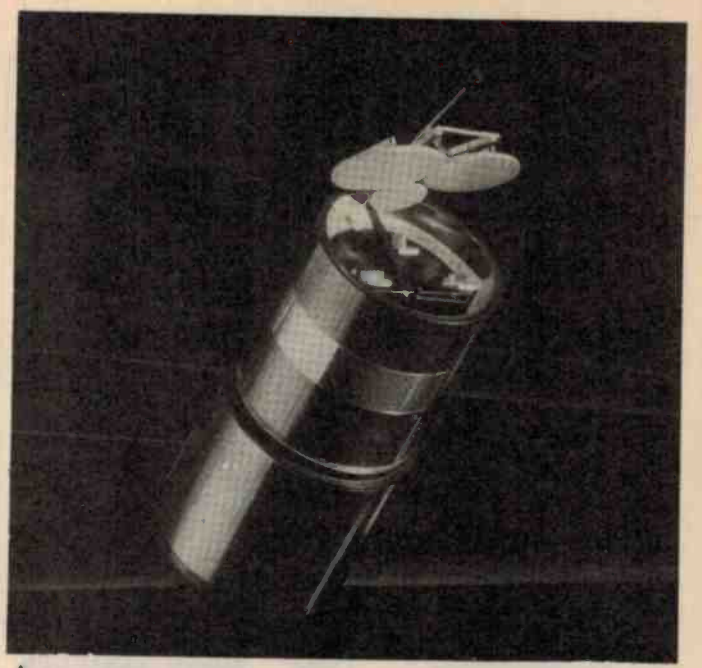
Using a special phone-patch hookup, Dr Garriott (a ham himself) was able to speak with mission control in Houston via the amateur radio link, proving that amateur radio can provide a valuable backup communications system for manned space flights. (See feature story in next month's ETI).

NOTES & ERRATA

Project 166, Part 4, October 1983: The following errors crept into the parts list; C17 should be deleted, C18 — 22p ceramic, C19 — 470p ceramic, C20 — 4n7 greencap, C21 — 47n greencap, C22 — 470n greencap, C23 — 4μ7/16 V RBLL, C24 — 47μ/16 V RBLL. A C24 shown on the circuit as 100n was not put on the pc board. It may be soldered on the copper side between pins 1 and 14 of IC4. There are two R40s on the overlay. The one next to R54 is actually R58. Some relays may not match the board and it will be necessary to drill extra holes and wire them in with links.

Project 175, Part 2, October 1983: Q1 and Q2, shown in the parts list, do not exist.

Project 1517, September 1983: There are two errors in the wiring diagram of the Video Distribution Amp. On page 148, the two yellow wires from the 2851 transformer are shown going to the top and bottom tags of the tagstrip — this is incorrect. They should both be moved one tag toward the centre of the tagstrip.



▲

SATELLITE PACKAGE

The government has decided to give all suppliers of commercial television and radio programs equal opportunities to distribute their programs via the domestic satellites to commercial stations throughout Australia.

The Minister for Communications, Mr Michael Duffy, said: "Using Satellite Program Services (SPS), regional television and radio stations will have a wider choice of program sources, including programs taken in real-time from metropolitan stations."

Mr Duffy said that the government's decision had been taken in the context of ministerial guidelines he would be giving Aussat regarding broadcasting uses of the satellite system.

"The guidelines will effectively prevent commercial direct broadcasting from the satellites, but will otherwise simply provide a framework within which interested parties can negotiate direct with Aussat," the minister said.;

Both the 30 W and the 12 W transponders will be available for supply of program services to broadcasters, as well as for other uses, but neither will be available for commercial direct broadcasting.

RESISTOR STANDARDS

The Standards Association of Australia has published a standard in the series on fixed resistors for use in electronics equipment.

AS 1352.2 was prepared as a Sectional Specification for use in the qualification of low-power, non-wirewound resistors according to the requirements of the International Quality Assessment System for Electronic Components (IECQ) of which Australia is a participating member.

The purpose of the standard is to establish ratings and characteristics for such resistors, to select appropriate methods of test (currently given in AS 1352.1 which is also under revision) and to give general performance requirements for this type of resistor.

The standard applies only to resistors with a dissipation of 4 W or less for use in electronics equipment. Copies of AS 1352.2 can be purchased from any SAA office at a cost of $9.20 plus $1.50 postage and handling.

TEKTRONIX EXPANDS

Tektronix has appointed Mr Philip Chaney as the new Australian managing director — part of a plan to expand the company's services and products here. He was formerly its sales manager.

Following his appointment, Mr Chaney forecast that Tektronix could increase it's size by up to a third in Australia. He also said that he expected further growth in the graphics area in particular, as more Australian companies turn to high resolution graphics and colour copiers to aid their design and reporting procedures.

One of the changes likely to occur under it's new managing director, is a new emphasis on marketing. Recent Tektronix activities, such as a 'road show' operation which recently toured Australia with a new range of technical equipment, were an example of good marketing in the high technology areas, said Mr Chaney.

IS FAIRCHILD RECOVERING?

Four years ago, hardly anyone in the US semiconductor industry believed that Schlumberger, which had just acquired Fairchild, was going to rescue the integrated circuit pioneer. It not only paid $425 million to acquire Fairchild in mid-1979 but also had to invest $680 million more in research and engineering, and in plant and equipment.

Fairchild is about to suffer it's fourth consecutive loss, but there are faint stirrings of hope at Schlumberger that the company has hit rock bottom and is now on the rise. According to Fairchild's president, Thomas C. Roberts, they now have a stable and capable management team, he has shed inefficient plants, and production has been dispersed away from California's high-cost Silicon Valley. Operating units have also been given more autonomy so that they can respond faster to market trends.

Only after Schlumberger took control did it discover how grossly Fairchild had been underinvesting in product development and in modern manufacturing facilities. Starting in the mid-1970s, Fairchild diverted IC research and development funds to a disastrous attempt to diversify into consumer electronics.

The past four years have been so wracked with changes that even Schlumberger now wonders if it has administered an overdose of medication and it has been criticised for trying to do too much all at once. Roberts really appears to many industry observers to be building a brand new company within the shell of the old, which may be a good deal easier than turning it around.

MORE TECHNICAL TRAINING FOR WOMEN

Women should plan their careers to take advantage of opportunities in technical areas.

That was the message of 'Technically Speaking' — a vocational videotape package introduced at a special screening in Canberra late last year by Mrs Ros Kelly MP, on behalf of the Federal Minister for Employment and Industrial Relations, Mr Ralph Willis.

Launching the campaign, Mrs Kelly announced the Government's intention to ensure improved participation by women in Federal employment and training programs with a view to increasing female employment in non-traditional areas of the economy.

"The videotapes show women in jobs such as metallurgical technician, draftsperson, Telecom technician and quantity surveyor. It's our hope that 'Technically Speaking' will act as catalyst for more women to enter these and similar technical occupations."

The program will be distributed through the ACT Schools Authority, TAFE Colleges, Careers Reference Centres and the CES, as well as the Women's Bureau in Canberra.

For more information on 'Technically Speaking' contact **Tina Faulk, Womens Bureau, Department of Employment and Industrial Relations, Parliament House, Canberra ACT (062)45-9518.**

ANZCAN CABLE

The Minister for Communications, Mr Michael Duffy opened the Norfolk Island Cable Station and shortly afterwards, made an inaugural telephone call to the Prime Minister, Mr Hawke in Canberra, last December.

Their discussion marked for the first time, the use of the ANZCAN cable between Australia and Norfolk Island.

The ANZCAN cable system is a $400 million submarine cable that allows Australia to communicate with New Zealand and Canada via Norfolk Island, Fiji and Hawaii. It has 1380 telephone circuits or approximately 18 times the capacity of the 20 year old Compac cable which ANZCAN will replace.

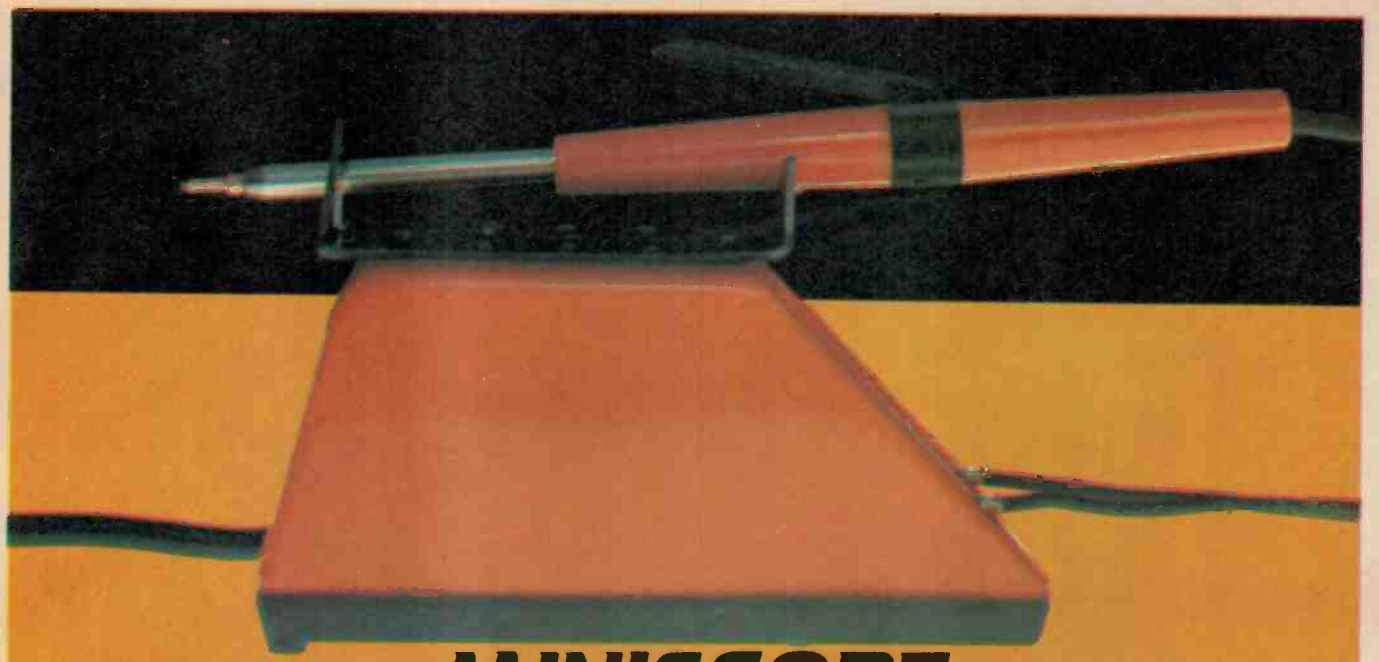
Opening the Norfolk Island Cable Station, Mr Duffy said the ANZCAN cable system represented one of the greatest ever co-operative telecommunications projects. The enterprise has brought together 22 international telecommunications organisations from 14 different countries, of which Australia's OTC was the major shareholder.

The cable will provide Norfolk Island with a new high quality telephone service and allow telex and data communications services to Australia and other countries connected to the world network.

Prior to ANZCAN, all communications to and from Norfolk Island were possible only using high frequency radio.

The ANZCAN project provides evidence of the government's committment to cable communications, said Mr Duffy.

Australia could not afford to rely on one mode of communication such as satellites and with the advent of optical fibres, the development of cable communication was fast catching up with satellite technology, he added.



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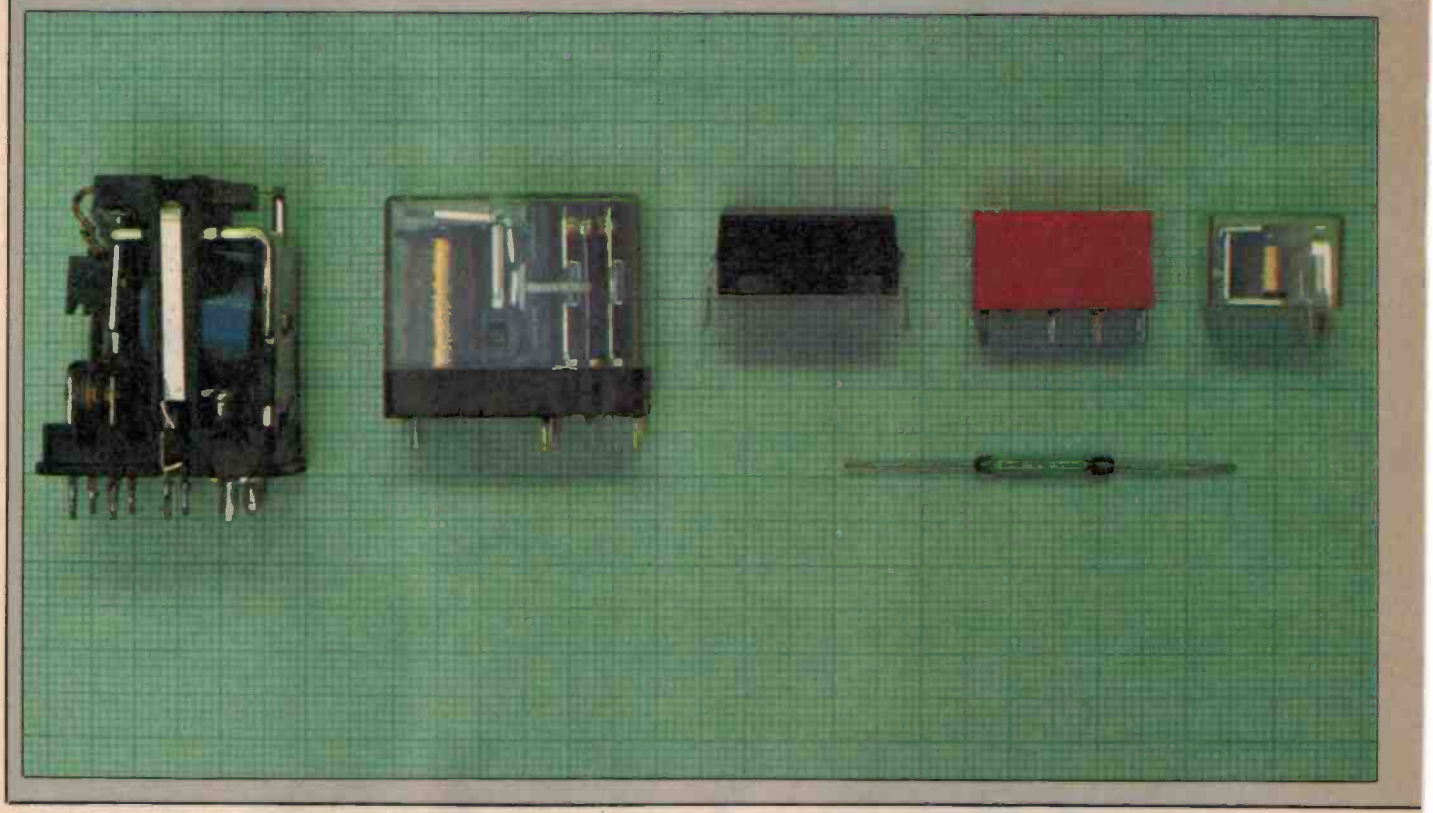

While solid-state switches have now replaced electromechanical relays in many applications and types of service, there are still innumerable areas where the old-fashioned (?) relay still reigns supreme — and is likely to do so for many years to come. This feature covers all the theoretical and practical aspects of relay technology and includes a survey of all forms and types, from the common to the bizarre.

Collyn Rivers

UNTIL a decade ago, one of the most common electric and electronic circuit components was a partially mechanical device. That component was the electro-mechanical relay — typified by the Post Office type 3000. Tens of millions of these relays were made. They were, and indeed still are, used in applications as diverse as telephone network switching, industrial timers, burglar alarms, even computers.

The original Chain Home (CH) early warning radar systems — the vital system which helped the Battle of Britain pilots locate their enemy in World War II — each used thousands of relays in elementary computers which calculated the range of returning echoes. Those radar systems (still with relays) remained in active service until the early to mid-1960s.

Solid-state switches have long since replaced electro-magnetic relays in many applications and types of service, but there are nevertheless innumerable areas where 'old-fashioned' relays still reign supreme — and are likely to continue doing so for many years to come. Indeed the recent development of the printed circuit board mounting relay, directly drivable by TTL and CMOS ICs, and the hybrid relay (incorporating a solid-state input amplifier) has given the technology a new lease on life.

Relays (as we shall call them from here on) have a number of admirable characteristics. These include:

(1) Complete electrical isolation between input and output circuits.

(2) A huge range of resitance between switch-on/switch-off. When contacts are open circuit resistance is effectively infinite — when the contacts are closed resistance is a few milli-ohms.

(3) Many independent isolated outputs may be associated with one input.

(4) Physical ruggedness. Most relays can withstand massive short-term overloads across both actuating and switching components.

(5) Relays are largely immune to electrical, radio frequency, and other forms of radiation — even at high levels. Mechanical vibration causes problems with most relays, but vibration and shock resistant models are commercially available — and used extensively in military applications.

(6) Actuating voltages and currents are relatively uncritical. Most relays will continue to work satisfactorily with coil voltage varia-

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SCOPE

to know about relays

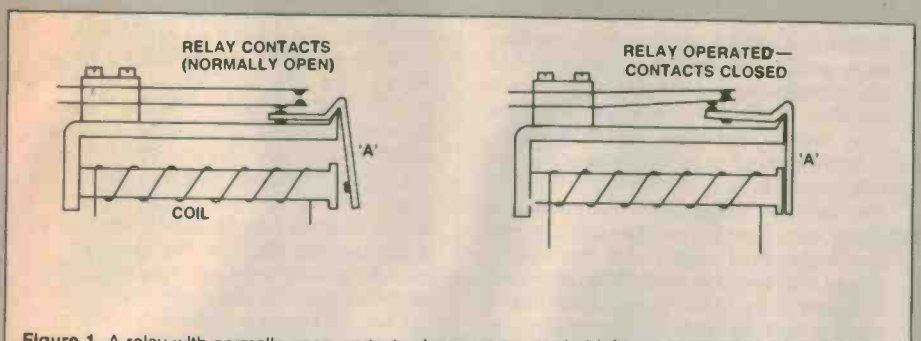


Figure 1. A relay with normally open contacts shown unoperated at left and operated at right. Note the over travel of the contact leaves. The armature is stopped by the core here.

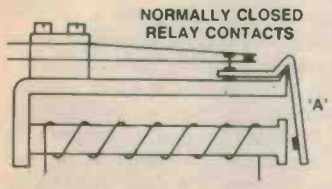


Figure 2. A relay with normally closed contacts. Note that the contact leaves are pre-loaded and the plunger on the armature operates the upper contact leaf.

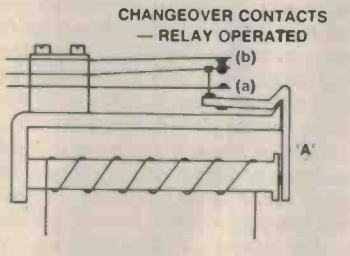
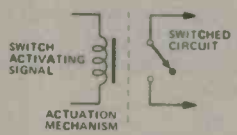
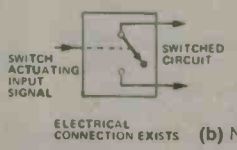


Figure 3. Relay with changeover contacts — one set of normally open contacts and one set of normally closed contacts. The armature is shown here in the operated position.

but never found in one place before





Unlike electromechanical switches, most solid-state electronic switches do not provide ideal isolation between the actuating signal source and the controlled source.

tions at least plus/minus 50% of nominal. Contacts too will generally withstand severe short-term overloads.

(7) Innumerable switching configurations are possible. Single actuators may be used to switch multiple sets of contacts — any of which may be 'normally open' or 'normally closed' as required.

(8) The operation of relays is largely self-evident and, for this reason alone, they are commonly used in equipment which must be maintained by non-electronically-trained staff. Fault finding too is simpler than with solid-state devices.

HOW RELAYS WORK

A relay is an electrically operated switch. The US Standard's Definition of Electric Terms defines a relay as "An electrically controlled device that opens and closes an electrical contact to effect the operation of other devices in the same or another electrical circuit".

The type of relay with which most electronics people will be familiar consists of an electromagnet, which, when energised, causes a movable armature to open or close one or more sets of contacts. The contacts in turn open or close external circuits.

There are however a vast range of relay types. The writer noted over 135 clearly definable types during the preparation of this feature. And most of those were available in an equally wide range of power ratings and contact configurations.

In the simplest of relays (one pair of contacts), one contact will usually be located semi-rigidly — it will have some degree of compliance. A second (moving) contact will be mounted on a moving arm — or on the end of a deflectable spring.

Figure 1 shows a typical arrangement — here the relay is 'normally open'. The contacts are separated until the relay winding is energised. When the winding is energised, the armature 'A' is attracted towards the winding core. The resultant movement causes the springs to deflect (according to Hooke's law) and the contacts to be pressed firmly together.

In practice, the springs deflect further than is required simply to make contact. This over-travel has several functions. It causes the spring/s to store sufficient energy to ensure a quick clean break when coil energisation ceases. The over-travel compensates for the increase in the gap between contacts as the contacts and other moving parts wear. The sliding motions entailed also cause the contacts to be largely self-cleaning. However, as will be described later in this feature, this sliding action introduces problems of its own in some applications.

Excessive spring tension is prevented by arranging for the moving armature to butt up against a stop (often the relay core) once the intended contact pressure is reached.

Figure 2 shows a 'normally closed' relay. In this example a mechanical pre-loading is applied to the springs so that the contacts are held firmly together in the 'off' position. Energising the coil causes the armature to push the contacts apart.

'Change-over' action is illustrated in Figure 3. Here a mechanical pre-load holds the moving contact against closed contact 'a' when the coil is not energized. Energising the coil causes the moving contact to be held against fixed contact 'b'.

The electromagnet

The force generated by the electromagnet must be sufficient to overcome all the restraining mechanical forces which include striction, friction, inertia, spring tension, sliding friction as contacts meet and close, and spring overtravel.

The generating force which is available may be shown as:

$$F = \frac{2\pi (NI)^2}{A(R_O + \frac{x}{A})^2}$$

where:

NI = ampere/turns
A = pole face area
x = distance between armature and core in unoperated state
R_O = reluctance of iron portion of magnetic circuit

It will be seen that for an electro-magnet of any given physical size the force depends upon NI^2. That is, the square of the solenoid's number of turns of wire and the current flowing through that wire.

The ampere/turns at which the relay just ▶

operates (contacts touch but springs not fully deflected) is known as the ampere/turns sensitivity. This figure has little practical value as it is independant of coil dimensions. (Having wound a coil the ampere/turns sensitivity is a measure of what you have done but gives no guidance as to how to go about it!).

A parameter of more practical value is the power required to just close the relay ($P = I^2R$). This is usually called the 'power sensitivity'. Power sensitivity depends upon the volume and proportion of available winding space occupied by the winding. As might be expected, if one thinks about it long enough, the ratio of the N^2/R is constant (N = number of turns, R = coil resistance). This ratio is known as the coil conductance and is symbolized as G_c.

Hence, $R = N^2/G_C$ and $P = I^2R = N^2I^2/G_C$ watts. Which means that the power required is inversely proportional to G_c. Coil conductance is determined by coil dimensions — as follows:

$$G_C = \frac{elh}{w\,\pi\,(d+h)}$$

where:

e = winding space factor (which = 1 except for very fine windings, then decreasing slightly thereafter).
w = winding wire resistivity.
l = length of cross section of winding.
h = depth of cross section of winding.
d = diameter of core.

The power required to close the relay varies inversely with winding length, and directly with winding depth. Which explains why energy-efficient relays (like the PO type 3000) are long and thin.

Depending upon the desired operating voltage and current, relays may be wound with many turns of fine wire, or few turns of heavy wire. The resistance may be calculated from wire tables by assessing the mean turn length. Here's a few short cuts — as long as you are using the B & S wire gauge system.

For a winding of any given dimension and density, reducing the wire size by one gauge increases winding resistance by approximately 60%. The same reduction reduces the current required (for equal ampere/turns) by 20% and the voltage by 25%.

Winding resistance tolerance will be +/- 10%. This may increase to about 15% above B & S No. 45 (depending upon wire manufacturer).

Assuming optimum dimensions, the number of turns for any given wire dimension is determined by the current density. Heat build up and dissipation must be also considered.

For most applications relays have more or less optimum physical and electrical dimensions. If a relay is made substantially smaller, here's what happens:

(1) The winding provides fewer ampere/turns of magnetic force for the same power input, but more ampere/turns are required to provide the necessary magnetic pull.

(2) The windings cannot readily dissipate the increased heat caused by the higher current density. ▶

RELAY APPLICATIONS

FIGURE A shows the simplest possible relay circuit. The winding is energised and the contacts close when SW1 is closed. A variation is shown in Figure B. Here the relay is energised when SW1 is opened.

There are many applications where the relay contacts must remain in the required position even though the initial energising signal has ceased. This may be done mechanically with a simple latch mechanism. It may also be done electrically, as shown in Figure C, by utilising one of the relay's own contacts to bypass the original make/break switch which caused the relay to be energised originally.

Electrical latching is commonly employed in security alarms. In such an application the alarm relay must remain latched on even though the actuating signal (generated for example by a microswitch on a door or window which is only momentarily opened) ceases after a second or two.

Sometimes there is a need to prevent a relay being energised via one circuit until another circuit is switched off. Figure D shows how this is done. In both instances the relay cannot be energised via SW1 until SW2 is opened.

Figure E shows how a relay and capacitor may be used to form a simple but reliable high-current oscillator or flasher.

Relays lend themselves admirably to logic operations. Figures F a/b/c illustrate the simplest forms — using switches to operate a single relay. More sophisticated logic operations can be performed using multiple windings on the same bobbin. Figure G shows one version, in which either of the two windings generates sufficient force for correct operation. Thus closing SW1 OR SW2 closes the relay.

A variation of Figure G is to have each winding alone insufficiently powerful to operate the relay. Both are required to be energised. This then is an AND circuit.

Figure H shows a differentially wound relay. Here the windings are opposed. Closing SW1 OR SW2 will cause the relay to close. Closing SW1 AND SW2 will cause it to re-open. Try that one with ICs!

Opposing windings may also be used to force a relay to open quickly. Figure I shows how this may be done to force open a self-latching relay. In this example the release winding must generate more magnetic flux than the make winding.

The configuration showsn in Figure J uses relays of differing sensitivities. Closing SW1 will energise the high sensitivity relay RL1, but not RL2. Switch SW2 shorts out the current limiting resistor R1 and brings in RL2.

Relay actuation may be speeded up dramatically by placing a low voltage tungsten globe in series — Figure K. The globe acts as a non-linear resistor — with a resistance range changing by 10:1 or 15:1 during the first 100 or so milliseconds. Both globe and relay coil should have similar working voltages. The globe must be rated such that it settles down to 90% or so of normal brilliance (for long-term reliability). The combination should be driven by a supply of approximately twice the relay's normally recommended working voltage.

Relay actuation and release may be slowed down by adding a few simple components. Figure La/b/c shows how. Triggering currents may be reduced to mere microamps by adding a simple transistor or IC amplifier — see Figures Ma/b/c. Relays such as this are also available commercially. ●

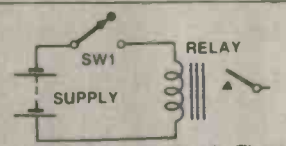


Figure A. Simple relay circuit. The relay is energised when SW1 is closed.

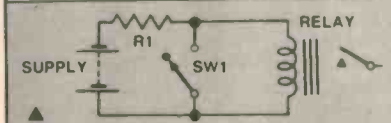


Figure B. In this configuration the relay is normally held closed and is opened when SW1 is closed.

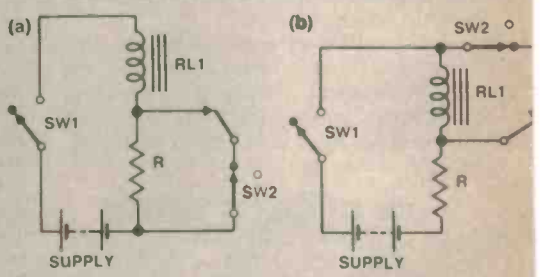


Figure D. These two configurations are commonly used safeguarding electrically powered machinery. In neither instan can relay RL1 be energised, by closing SW1, unless SW2 is fi opened.

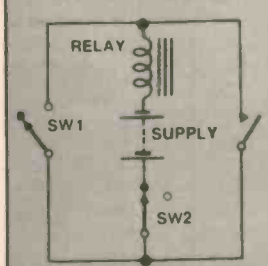


Figure C. Electromagnetic latching circuit. When SW1 is closed a second set of relay contacts close, by-passing SW1. The relay will now remain latched on until power is removed (by opening SW2). ◀

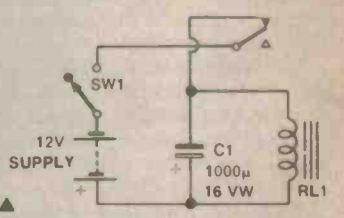


Figure E. Ultra-reliable low frequency oscillator/flasher.

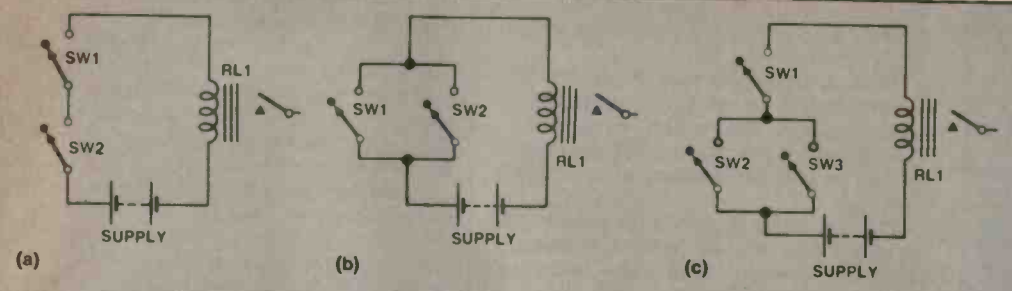


Figure F. Relay logic circuits, (a) relay closes when SW1 AND SW2 are closed, (b) relay closes when SW1 OR SW2 are closed (c) relay closes when SW1 AND SW2 OR SW3 are closed.

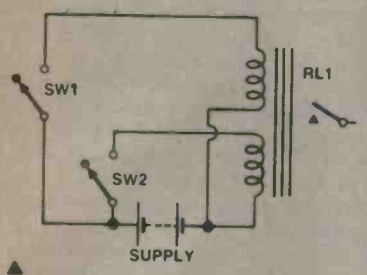


Figure G(a). Either of the two windings can generate sufficient force to close the relay contacts — hence closing SW1 OR SW2 will actuate the relay.

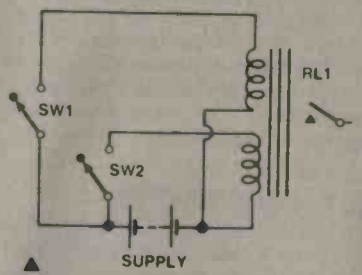


Figure G(b). In this variation neither winding alone is sufficiently powerful to operate the relay. Both are required for actuation. Thus SW1 AND SW2 must be closed.

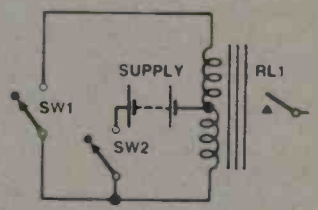


Figure H. Here the two coils are wound in opposing directions and either has enough power to close the relay. Thus closing SW1 OR SW2 will close the relay, but as the windings are in opposition closing SW1 AND SW2 will cause the relay to open again!

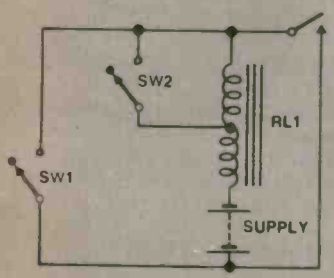


Figure I. An opposing polarity winding is used to force the relay open (overcoming the self-latching function) when SW2 is closed.

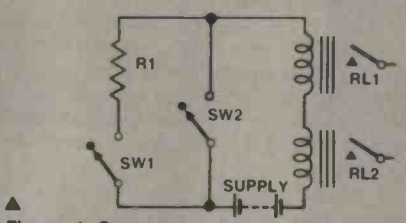


Figure J. Sequential switching. Closing SW1 will energise the sensitive relay RL1 but not the general purpose relay RL2. Switch SW2 shorts out the current limiter R1 and closes RL2.

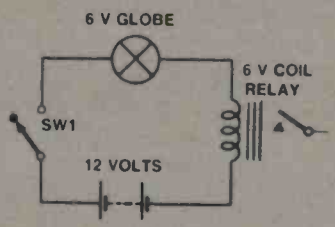


Figure K. Speeding up relay actuation — see text.

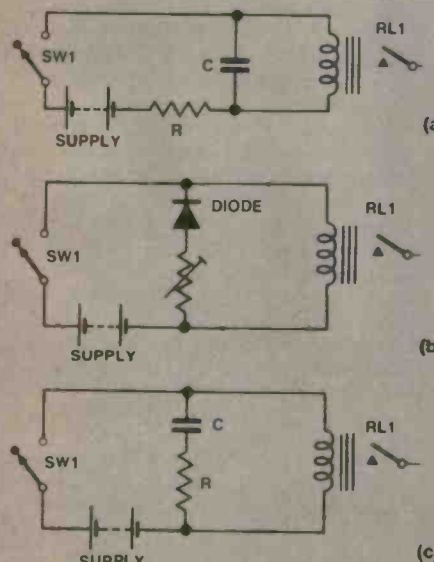


Figure L. Adding a few components slows down relay operating time. (a) slow to operate, (b and c) slow to release.

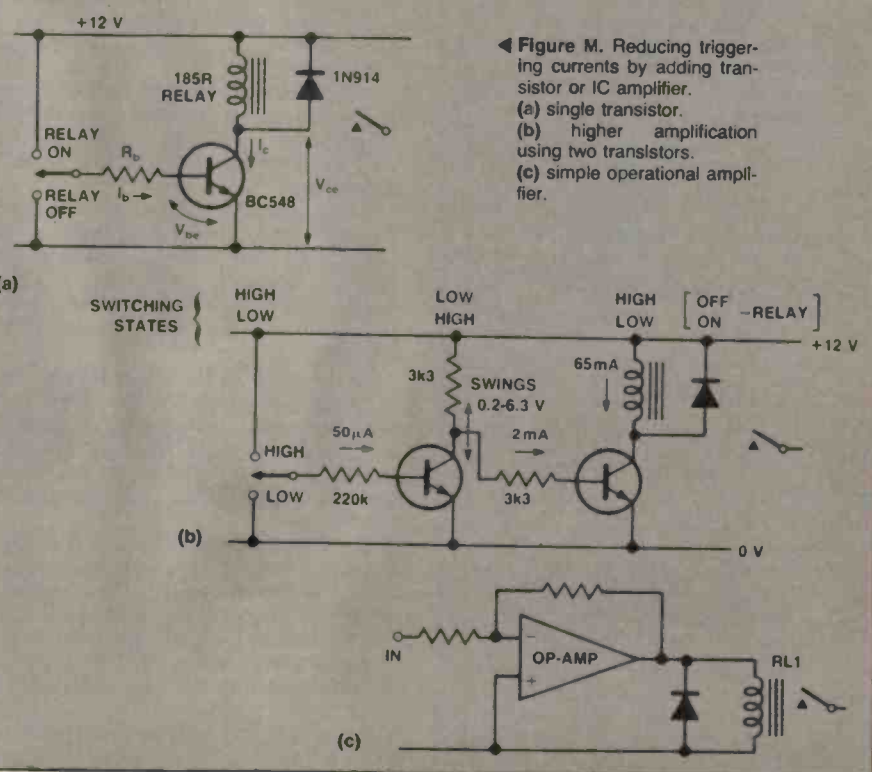


Figure M. Reducing triggering currents by adding transistor or IC amplifier.
(a) single transistor.
(b) higher amplification using two transistors.
(c) simple operational amplifier.

RELAY CHARACTERISTICS

Normally open relays are fairly predictable. Their pick-up levels can be adjusted accurately and will be maintained over long periods. Drop-out performance is less stable and cannot be predicted or sustained with any real accuracy.

There will be some bouncing as contacts come together — this may cause RF interference, and will introduce problems in counting applications (overcome by using a monostable). Relay designers attempt to minimize contact bounce by introducing a damping wiping motion — which also serves to clean the contacts.

Normally-closed relays are less predictable. They become unstable as the winding current approaches the pick-up level and may 'hunt' around the just-operated point.

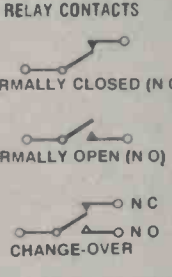
Both types of relay will exhibit erratic pick-up and drop-out behaviour if the circuits switched have large current transients. These may cause the contacts to stick.

Closing time is determined almost entirely by the time required for winding inductance to build-up the field — five to 50 milliseconds is typical of sensitive relays. The time required for the hardware to move is usually negligible by comparison (1-5 milliseconds).

Operation may be sped up by increasing operating voltage; increasing operating voltage yet further and adding series resistance (this reduces the circuit inductance/resistance ratio); and by reducing spring tension and contact gaps.

For **drop-out** there's normally a delay of a few milliseconds after winding current falls below the hold level. This will be decreased by as much as ten times if the coil is shunted by a diode (for instance to eliminate back-emf).

Most general purpose relays will operate reliably over a voltage range of at least 2:1. Many will tolerate even wider variations. Many aspects of performance however become less predictable and less accurately repeatable as the upper and lower limits of acceptable operating levels are approached. ●



Relay contacts. There are three fundamental relay contact arrangements: normally open (N/O), normally closed (N/C) and changeover.

(3) The armature is magnetically saturated at lower levels of force thus preventing any further increase in pull.

There is a plus however. Compact, high current-density relays are less affected by high frequency mechanical vibrations — their moving parts are smaller and lighter due to their lower moment of mechanical inertia.

We have so far discussed the power level at which a relay will operate — usually called the 'pull-in' level. The 'drop-out' level too needs to be considered.

A relay drops out at that level of power which is insufficient to carry the mechanical load required to maintain contact. This is much less than the level required for energisation and is best determined empirically, there being a number of non-electrical factors (measure it you turkey! — Ed).

RELAY CONTACTS

There's no such thing as a universal relay contact. Contacts used for switching high currents rely upon an opening and closing arc to keep them free of contaminants. Were that same contact material to be used for dry load switching, the contacts after only very few cycles, would close physically but not electrically.

Fine silver is often perceived as the best of all contact materials — certainly it has the best electrical and thermal properties of all common metals. Unfortunately silver is seriously affected by sulphidation which forms a high resistance film on the contact surfaces.

A further problem with fine silver contacts is that they tend to stick and weld together — ending the life of the relay — and sometimes that which the relay was controlling!

The problems of sticking and welding are largely overcome by combining fine silver with a small quantity of cadmium but this does nothing to reduce resistance to sulphidation.

Minor arcing, and high contact pressure can be advantageous. Arcing burns off the sulphidation, and high contact pressures (and the resultant sliding action) scrubs off the residue.

Silver and silver cadmium contacts are primarily used for switching loads of a few amps at 12 volts and above. The material has fairly high contact resistance — a potential drop of 0.2 volt is typical for normally sulphided silver and silver-cadmium contacts.

These types of materials should not be used for audio circuits. The sulphide film tends to capture dirt particles — which generate noise as signal voltages attempt to break them down. The inexorable sulphide build up renders these contacts unsuitable for intermittent operation.

Gold-flashing silver contacts reduces sulphidation to levels which are acceptable for more low-level switching — intermittent or otherwise. However, this flashing is destroyed if the contact ratings are exceeded — even for a short time. The initial resistance is lower than with most other unplated materials.

Solid gold contacts are sometimes used for low level and dry switching but are very prone to sticking if cleaned to the degree required to obtain low resistance contact.

Low level switching is probably best accomplished using gold-platinum-silver; gold-silver-nickel; or gold-diffused silver alloys — in that order of excellence and price. The maximum rating for all three alloys is about one ampere.

Palladium (from the platinum family of metals) contacts have excellent low-noise properties. They are not subject to sulphidation or oxidisation and have good longevity — about ten times that of fine silver.

On the other hand, palladium is particularly susceptible to the formation of insulating polymers if the contacts are used in very low level or dry switching circuits.

The conductivity of palladium is poor and because of this palladium contacts are limited to switching currents of less than five amps or so. Palladium contacts are used extensively in telephone-type relays.

An excellent general-purpose combination is to have one pure palladium contact and a second palladium contact coated with a 0.025 mm (0.001") 22 carat gold overlay. This combination is as equally suitable for low level and dry loads as for medium levels of power.

Tungsten is commonly used for high voltage/high current applications. It is however prone to oxidisation and for this reason (particularly in dc circuits) one tungsten contact is often paired with one palladium alloy contact.

Paralleling contacts hugely increases reliability for low and medium loads. This should not be done though for heavy loads — where single contacts tend to give better all-round peformance.

The switching action

As relay contacts close, a number of tiny areas of metal deform, elastically or plastically, until the total area is sufficient to support the contact force. (This initial deformation is one of several factors that cause contact bounce).

And, if the contacts are switching any but very light loads, the initially contacting metal areas will for a brief instant be heated to the point where the metal will boil — or be vapourised.

A microscopic weld or 'bridge' may even be formed, and with dc circuits this will break asymmetrically when the points next open (and causing a minute transfer of material from one contact to the other). With ac circuits there is usually a nett loss of material in the form of metallic vapour.

The heating effects described above also occur as contacts open.

Controlled arcing can be advantageous for some contact materials in some applications. The arcing burns off sulphur, oxides and other contaminants which build up on some contact materials.

Nevertheless, whilst useful for this purpose, arcing for more than a few milliseconds is destructive and must be quenched as rapidly as possible to prevent contact material loss (to atmosphere) and contact material transfer from one contact to the other. These problems are minimised by using the arc suppression techniques described elsewhere in this supplement.

Whilst contact arcing cures some prob-

KH miniature relay has 2, 4 or 5 pole contact arrangements. Various contacts switch loads from dry circuit to 5 amps. Many mounting and termination options.

RK printed circuit board relay is available with 5, 10 or 16 amp contacts. Enclosed and immersion cleanable models are offered.

KRPA enclosed relay offers high performance at a low cost. Contacts for 5 or 10 amps are available. Indicator lamps are also offered.

K10 miniature power relays are available with a variety of mounting and termination options and have either 10 or 13 amp contacts. Neon indicator lamps are also offered.

R10 relays feature switching capability up through 8 poles. Both enclosed and immersion cleanable models are offered with a variety of contacts for loads from dry circuit through 7.5 amps.

Relays that other companies call specials, P&B ship from stock.

Potter & Brumfield manufactures the broadest line of relays in North America. In many cases, specifying Potter & Brumfield can save you valuable time since you won't have to wait for a "customer special" to be tooled. Hundreds of thousands of units, everything from printed circuit board relays with dry circuit contacts to contactors with 50 amp contacts are available. And literally thousands more are tooled and can be built within standard OEM leadtimes.

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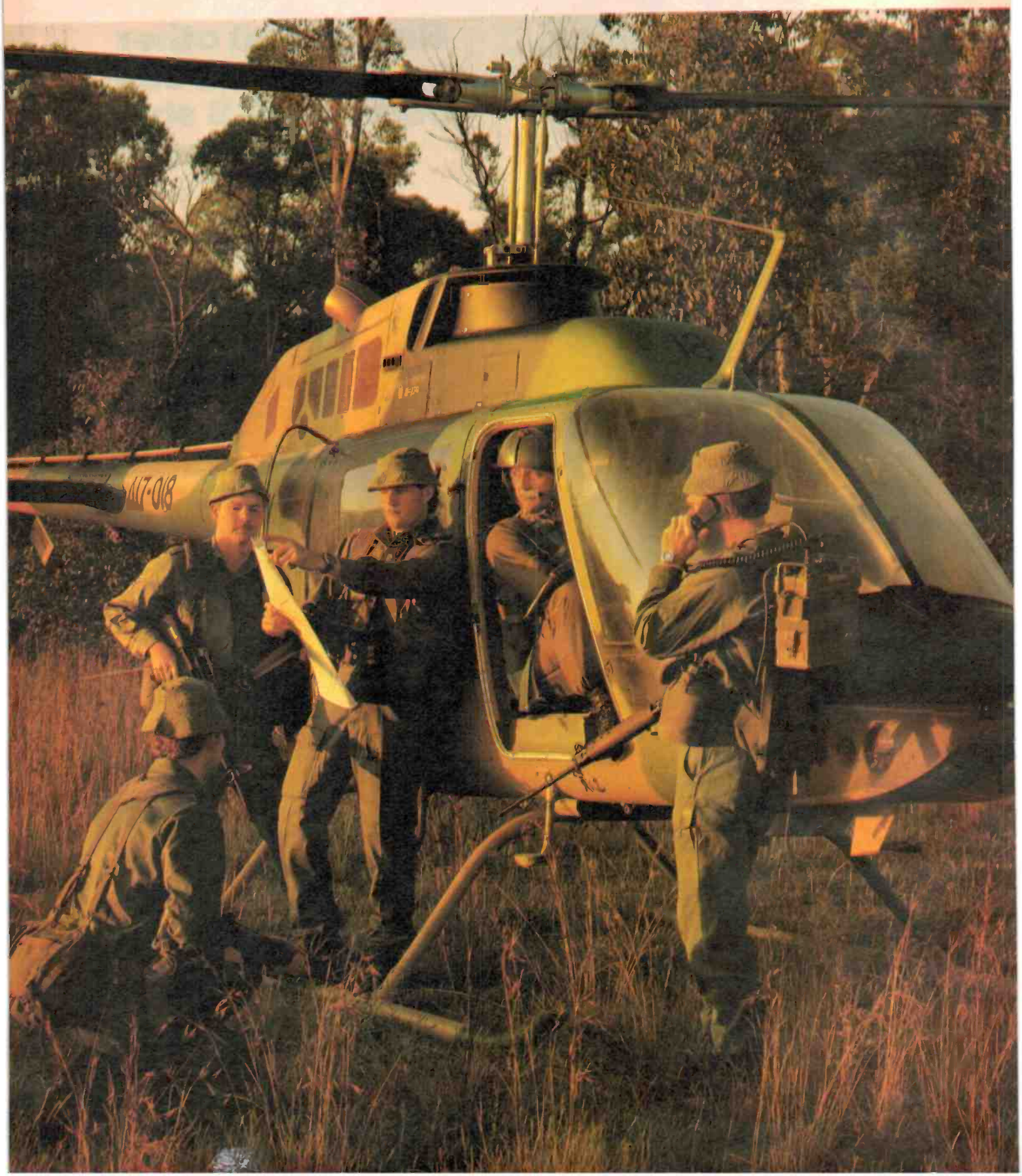
AHEARN TEC 8

What's a bright young lad



like you doing in the Army?

The simple answer of course, is that he's busy taking on all the responsibilities that come to young men bright and dedicated enough to succeed as Army Officers.

After that it gets a little tricky. Largely because once a young man completes his initial 44 weeks training at Officer Cadet School, Portsea, and graduates with a commission, his career can take a multitude of directions.

He might for example choose to enter an Infantry Battalion and become a Platoon Commander in charge of 30 men. In which case he'll obviously learn and be involved in different things to a man who flies a helicopter and commands a smaller crew. The same applies in areas like Armour, Artillery, Signals, Survey, Transport and Intelligence to name just a few.

There is, however, common ground on which every Officer stands. Irrespective of his rank or career choice.

All Officers are constantly involved in improving their ability to make rational decisions, bring out the best in their men and achieve professional results. They're regularly faced with new situations, new problems to solve and challenges that test them both mentally and physically. So they can ill-afford to rest on their laurels. Once you become an Officer, the learning process never stops. There's always something to do and a better way of doing it.

In short, life as an Army Officer is exhilarating, varied and very satisfying. You're given every opportunity to realize your potential as a leader, and be recognised for your achievements.

If you're aged between 18½ and 23 on the first day of the month in which the course commences (or up to 25 with a degree or diploma), have your HSC or equivalent (at a level acceptable to the Army) and would like to know more about what bright young lads do in the Army, contact your nearest Army Careers Recruiting Centre or fill in the supplied coupon.

There are two courses per year: Applications close mid-March for a July entry and early August for a January entry.

Authorised by Director-General Recruiting, Department of Defence.

For more information post coupon to GPO Box XYZ, in your Capital city. Sydney 219 5555, Newcastle 2 5476, Wollongong 28 6492, Albury 55 2248, Lismore 21 6111, Canberra 82 2333, Melbourne 61 3731, Geelong 21 1588, Bendigo 43 8008, Ballarat 31 1240, Brisbane 226 2626, Townsville 72 4566, Adelaide 212 1455, Perth 325 6222, Hobart 34 7077, Launceston 31 1005.

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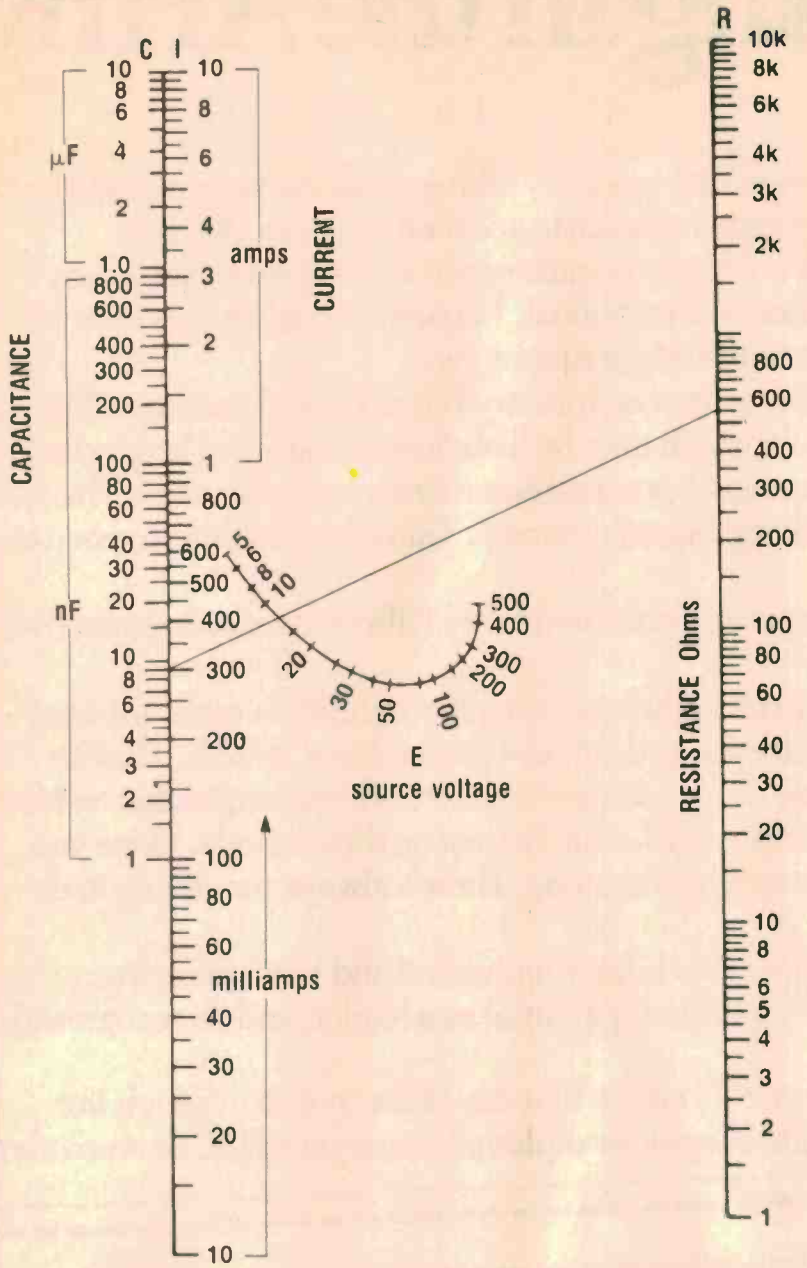


R-C QUENCHING

This nomogram will give you the resistor and capacitor values for simple series R-C quenching of relay contacts for dc and ac sources switching resistive or inductive loads.

For dc applications with resistive loads the source voltage, E, is the supply voltage and the current, I, is the current flowing in the load immediately prior to opening of the relay contacts.

For ac applications with resistive loads, the source voltage, E, is the peak value of the supply and the current, I, is the peak value of the load current.

For inductive loads E is the overvoltage produced by the current interruption (can be measured with a CRO) and the current, I, has to be calculated from this voltage and the resistance of the load.

To use the nomogram, run a straightedge between the load current and the source voltage, right across to the resistance scale. The capacitance to use is adjacent to the load current, the resistance to use can be read from the scale. The example shows a 300 mA load current being switched from a 12 V source. The capacitance indicated is 9 nF (use 10 nF) and the resistance about 550 ohmss (use 560R).

Minimum resistance to be used is half Ohm, minimum capacitance is 1 nF. For E less than 70 V, R may be three times the indicated value; for E between 70 and 100 V, R may be ±50% of the indicated value; for E between 100 and 150 V, R may be ±10% of the indicated value and for E greater than 150 V, R may be ±5% of the indicated value.

$$C = \frac{I^2}{10}\ \mu F \text{ (dc; for ac, use peak values)} \qquad R = \frac{E}{10\ I^x} \text{ where } x = \left(1 + \frac{50}{E}\right)$$

Nomogram from AMF Inc.

Figure 5.

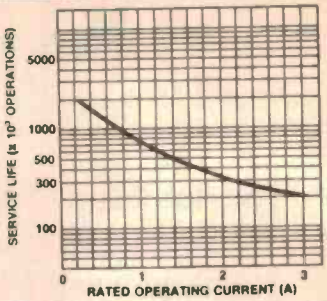
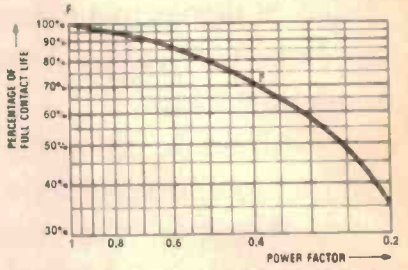
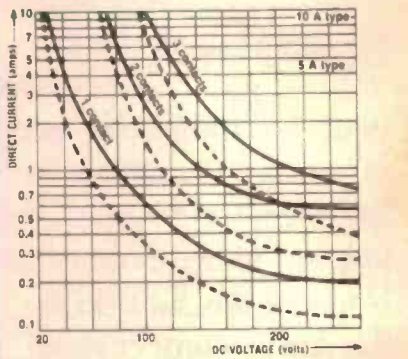


Figure 4. Graph shows how contact life can be extended by reducing contact load for a typical power relay. This relationship does not necessarily exist for low current relays — nor necessarily for power relays used at voltages or loads insufficient to generate slight arcing.



CONTACT LIFE, INDUCTIVE LOADS

Where a relay is required to switch inductive loads, increased contact wear due to arcing reduces contact life. This reduction is shown in the diagram here. You can obtain the actual contact life compared to the full contact life (quoted for operation on resistive loads) from this diagram if you know (or can calculate) the power factor of the load.



CONTACT BREAKING CAPACITY

This diagram shows the maximum dc breaking capacity for two differently rated relays versus circuit voltage for resistive loads (solid line) and inductive loads (broken line, L/R ratio less than or equal to 40 ms). The 10 A type, rated to break 10 A at 24 V, can only break 0.5 A at 100 V where a single contact and a resistive load is involved. On an inductive load with a time constant of 40 ms it can only break 5 A at 30 V, 330 mA at 100 V. If the relay has several contact sets, connecting the contacts in series can greatly increase its braking capacity at voltages above the rated voltage, but not the maximum breaking current. With two contacts in series, the 10 A relay will break over 2.5 A at 100 V (resistive) or 1.5 A (inductive). With three contacts in series, the 10 A relay, initially rated at 24 V, will break 100 V.

lems it introduces another. It carbonises organic material that has become adsorbed or condensed on the contact surfaces.

At most relays' designed ratings the levels of voltage and current being switched are high enough to break through these carbonised deposits and contact/contact resistance will remain more or less constant throughout the relay's rated life. But these deposits can and do cause problems if a relay is used to switch (low current) loads substantially below the relay's rated level.

Softening voltage

Once the contact points have closed the voltage drop across them causes their temperature to rise. This causes the contact area to soften and increase, and any molecular thicknesses of material trapped between them is vapourised.

At this point, resistance is reduced to fractions of a milli-ohm and becomes stable regardless of further increases in current up to and beyond the relay's maximum load rating. This phenomena begins to occur at quite low temperatures — for gold it begins at about 100 °C, and for silver at about 180 °C. The respective voltage drops are about 0.09 V and 0.08 V respectively, dropping as temperature increases.

Dry loads

Some applications involve switching circuits in which power is not made or broken by the contacts — that is, current flows and ceases flowing after the points close and before they open again. Circuits such as these are known as 'dry'.

The majority of problems with such circuits are likely to be found where very low levels of current are switched. Organic film and particulate contamination are the primary cause of these problems.

Light loads

Light loads present slightly different problems, particularly with platinum contacts. As with all relay contacts, microscopic sliding occurs as the contacts are pressed together. Here, the heat thus generated is sufficient to polymerize the organic material adsorbed or condensed on the contact surfaces. The resultant substance (a powder) causes high and varying levels of resistance. The only solution is frequent cleaning.

Platinum contacts are best avoided for these applications: gold or gold-palladium alloys are much better. They are almost totally immune from polymer formation.

Intermediate loads

Switching intermediate loads is undesirable. The voltage and current is insufficient to break down deposits and in such conditions contact/contact resistance will increase almost immediately. Many circuits will be able to tolerate the resistance build up but it can cause problems in marginal applications. The worst possible conditions are where the contacts must switch both high and low levels of voltage and current.

Heavy loads

Most relay manufacturers quote contact ratings at their product's designed maximum loads (or close to them). Minor derating may increase contact life, but not dramatically. Reducing the load to 20% of nominal rating typically increases contact life 10 times for power relays — see the accompanying graph, Figure 4.

It is important to note that the total current switching capacity of multiple contact *power* relays cannot be increased by paralleling contacts. The individual contact sets will not pick up and drop out simultaneously.

As contact loads and operating termperatures increase, there is an accompanying increase in the precipitation of solid carbon or carbonaceous debris on the contact surfaces. However the switching currents and voltage that cause this buildup to occur are usually also high enough to maintain relatively clean low-resistance contact in local contacting areas.

Cleanliness will also be assisted if the relay (ideally just the contact area) can be housed separately from the remaining components. This reduces exposure to volatile hydrocarbons, the liberation of which is assisted by the heat generated by high power equipment.

Gold and gold alloy contacts should be avoided for switching loads higher than 0.5 ampere unless ultra-low contact/contact resistance is essential — their erosion rate accelerates over such loads. Silver, silver alloys, silver cadmium oxide and palladium are best.

Protecting contacts

Relay contacts generally operate most satisfactorily at or close to their designed rating. But this is not always possible. In some applications current surges will occur at the worst possible time — just as the contacts initially open or close.

This will occur when switching tungsten lamps, ballasts, solenoids, relay windings(!), electric motors and capacitors. With such loads, the initial surge current may be from five to twenty times the steady state load and relays must be specified accordingly.

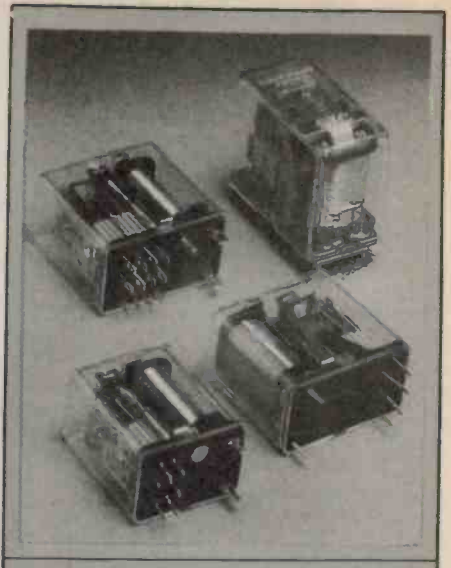
In these applications it is particularly necessary to use heavy duty contacts and/or high contact pressures, and with actuating mechanisms that inhibit contact sticking or welding.

Contact protection with *resistive* loads is relatively simple. A capacitance wired across the contact points (and as close to them as is practicable) will prevent any appreciable arc from forming as the contacts open. A low-value resistor placed in series with the capacitor prevents the capacitor being discharged rapidly through the contacts (and thus causing an arc) as the contacts reclose.

The accompanying nomograph (Figure 5) shows the optimum values of resistance and capacitance for various applications.

Inductive (dc) loads cause quite severe problems when the circuit is opened, for much of the stored energy will be dissipated as heat (in the form of arcing) unless an alternative path is provided.

The most common method of protection is to connect a diode across the inductive load — Figure 6 — with polarity arranged so that the diode blocks the current at con-



HISTORY

THE electromechanical relay was developed in the mid-1830s — for 'relaying' telegraph signals over long distances.

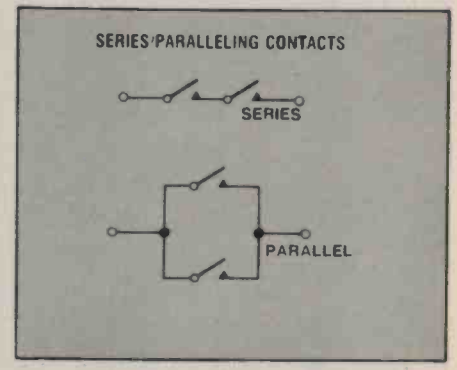
In 1837 Cooke and Wheatstone patented an electromagnetic relay for remote actuation of a signal bell (British patent No. 7710).

Edward Davy gained a patent (No. 7390), for a 'telegraphic relay' a year later. Davy opposed the granting of the Cooke and Wheatstone patent, but his objection was overthrown. Nevertheless, J. J. Fakie in his book *'A History of Electrical Telegraphy in the Year 1837'* London 1884, noted that Davy was working on electrical telegraphy as early as 1836.

In the USA, Morse was granted a patent (substantially similar to Davy's) in 1840 — US Patent No. 1647.

Davy in his patent wrote "I claim the mode of making telegraph signals or communications from one distant place to another by employment of relays of metallic circuits brought into operation by electric currents."

That's how relays came to be so-called.



Series. You can connect contacts in series to reduce the effects of arcing and to improve voltage rating; however, contact/contact resistance increases and may affect current rating.

Parallel. Connecting relay contacts in parallel should only be done to improve reliability. It will not affect current rating as the contacts will not open and close simultaneously. Thus, the rating of one contact alone will apply.

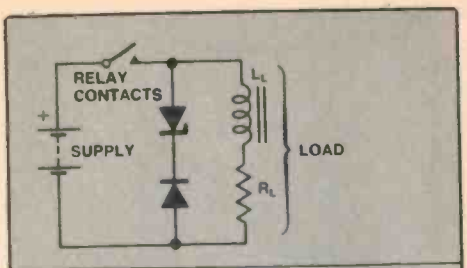


Figure 6. Protecting contacts against inductive loads (optional), Zener diode speeds up release time. ▲

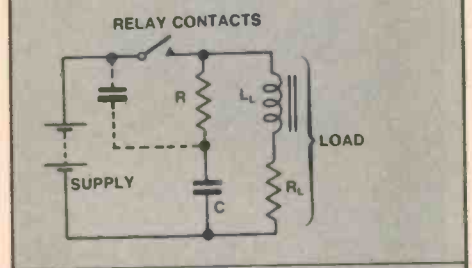


Figure 7. One method of protecting contacts against inductive loads — see main text for values. ▲

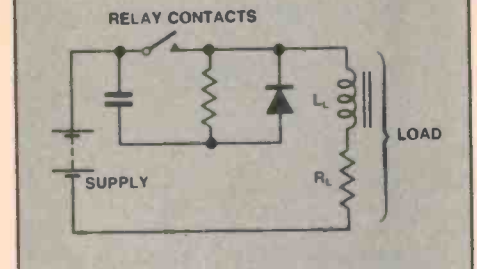
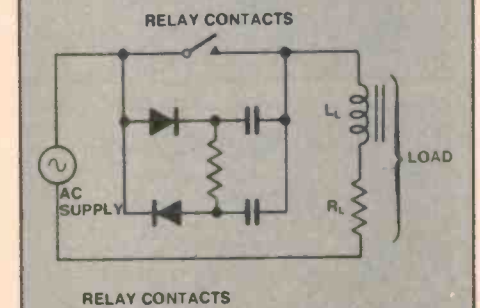


Figure 8. Alternative method of protecting contacts against inductive loads. ▲



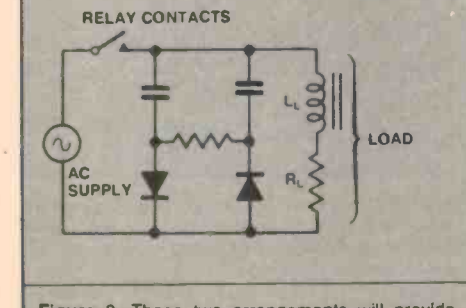


Figure 9. These two arrangements will provide almost 100% protection, even with massively inductive loads. ▲

tact closure but allows the stored energy to be conducted through it when the relay contacts open. This arrangement will usually speed up release time. An even faster release may be obtained by wiring a zener diode in series with the protection diode.

Another method is to connect a varistor across the contacts or the load. This switches from a very high resistance to a very low resistance when the back emf exceeds the varistor's clamping voltage.

Yet another alternative is to wire a resistor/capacitor network across the load or the contacts. The capacitor should be about one microfarad per ampere switched, and the resistor should either match the load (but not exceed it) or be about 0.5 to 1.00 ohm per volt switched — see Figure 7. The resistor should be a bit higher in value for small load currents (insufficient to cause a stable arc).

In critical applications the combination of resistor, capacitor and diode (Figure 8) will provide virtually 100% protection. In this arrangement the capacitor charges via the diode and discharges via the resistor. Circuit values remain as for the simpler resistor/capacitor combination but care must be taken to ensure that the capacitor and diode are of adequate working characteristics.

A further technique, used occasionally with relay coils, is to add a second but short circuited winding. The resultant damping effect attenuates the rate of change of magnetic flux in the iron core and thus the level of induced voltage.

Another nasty to watch out for is distributed line capacitance. Problems may occur if a relay is located remotely from the load to be switched. Here the line will act as a capacitor and will charge up the instant the relay contacts close. This capacitance will be seen by the contacts as an initial short circuit and contact current will flow accordingly.

Alternating current circuits

Particular care needs to be taken when switching electric motors. Starting currents are commonly 500-600% of running on-load currents. Thus a ⅓rd horsepower motor, requiring an amp or so on load, may draw over six amps during start-up.

Transformers can be especially tricky during circumstances which inevitably will occur from time to time. When power is removed, the transformer core may retain remanent magnetism. If power is re-applied at such a point on the ac waveform where voltage is of the same polarity as the remanent magnetism, the transformer core may saturate during the first half-cycle of that re-applied power. Because of this, inductance will be virtually non-existent, impedance will drop to little more than the dc resistance of the winding. The resultant in-rush current may be 1000% or more of normal and will continue until the core comes out of saturation some few cycles later.

There's *worse* yet! It happens when power is re-applied at or near the zero cross-over point. If that occurs *and* the increasing voltage is of the same polarity as the remanent magnetism, both the core *and* the air gap may saturate. And if that happens the in-rush current may be as high as 4000%.

Surges of such magnitude generate severe electromagnetic and RF interference — which can destroy or damage other circuit components. The surges also stress the transformer windings and laminations both mechanically and thermally.

The above comments may assist those misguided folk who've used zero-voltage switches to control inductive loads. For, totally contrary to general belief, the best point at which to switch a transformer is at the peak of the sine-wave.

The above phenomena has only recently been noted. Readers who wish to pursue it further should read *Inductively Loaded SCRs Control Turn-on to Eliminate First-Cycle Surges,* Electronic Design, March 15, 1979. Also, *Controlling Transformer Inrush Currents* EDN, July 1966; and *The Great Zero Cross-over Hoax* NARM Proceedings, May 1974. (Further features on this and allied problems associated with SCRs, Triacs, and zero-voltage switching, also written by Collyn Rivers, will appear in ETI shortly).

Contact life in inductive alternating current circuits may be significantly extended by connecting a resistor/capacitor across the load for low voltage circuits (up to 48 volts), and across the contacts for voltages higher than that. The time constant should approximate that of the load. Note though, that for this form of protection to be effective, the impedance of the load must be substantially lower than that of the capacitor/resistor.

Better protection will be afforded by the arrangement shown in Figure 9. Diodes must be 800 volt peak inverse rating, and the capacitors (about 1 μF/amp) 400 volts dc. The resistor should be 100k/2W or thereabouts. This arrangement is also particularly effective for reducing RF hash.

As has been shown, the life of a relay is not necessarily related to the switched load. Power relay life is generally extended by derating (a reduction of 500% in load current switching will typically extend life from 10^5 to 10^6 operations). However for many other applications, derating may actually *decrease* reliability.

Where load conditions are unusual it is best to obtain advice from the relay manufacturer. Correct maintenance helps. Here again, the manufacturers' advice should be followed. Different contact materials require quite different cleaning methods and fluids. Each will absorb mono-molecular layers of volatile molecules.

As a general guide, avoid the use of lubricants, abrasive cleaners and files unless specifically advised to do so. Don't even *think* of adjusting spring tension or gap size unless you have exact instructions or work for Telecom!

In critical (non-power switching) applications, reliability will be enhanced enormously (typically five or more orders of magnitude) by wiring two separate contacts in parallel.

A really worthwhile tip (where circuits allow) is to arrange such that the most frequently touched parts are at earth or zero potential. This should reduce damage if your screwdriver slips! ▶

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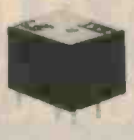
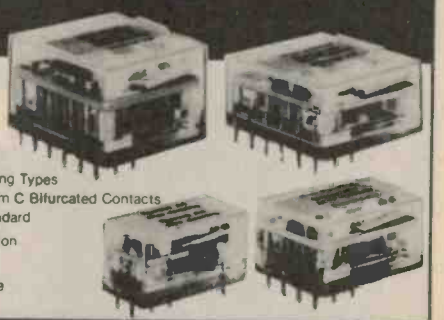
- UL File No. E57102 And E60816
- CSA File No. LR35577 And LR35579
- Pilot Duty Rating



PZ — 1 Amp Miniature PCB Relay



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- Long Life
- Low Profile
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- More Than 70 Types Standard
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Features

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- Mounts On Printed Circuit Boards
- Sealed Enclosure
- Driven By Integrated Circuits
- Immune Against Soldering And Washing Process
- Same Height As TO-5

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Features

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- Bifurcated Contacts Available
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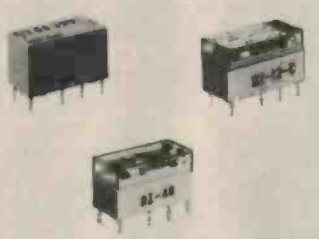

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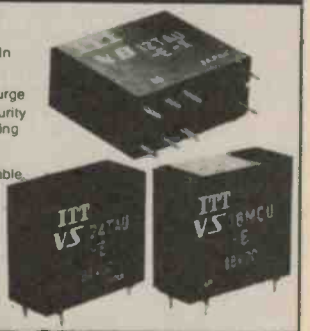
- CSA Approval LR 35577, LR 35579



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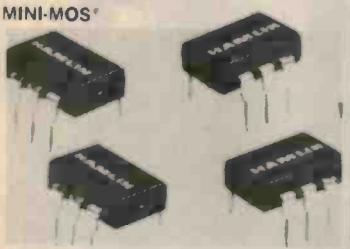

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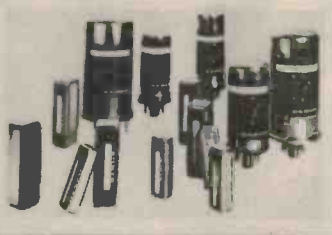

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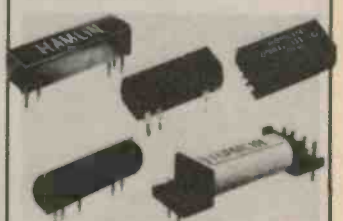

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RELAY TYPES

There are well over 100 different types of relay. Most are produced with a wide choice of actuating and switching levels, contact configurations, ac or dc operation, and commercial or military standards of construction.

Most of the material in this feature relating to coil windings and contact materials and characteristics applies to the relays described in this section — any anomalies should be obvious.

AC: ac-energised relays are similar in construction to dc relays. however as an alternating current, by definition, passes through a zero value each half-cycle, the magnetic field generated by an ac-energised winding will likewise have corresponding zero values each half cycle of applied alternating current.

It is necessary therefore to ensure that the relay armature remains closed as magnetism falls away during every half cycle of the energising input. This may be done crudely but quite effectively by making the armature so heavy that it is held in position by sheer inertia!

A second and somewhat more elegant way is to use two windings — each on a separate core — and each connected out of phase with the other.

A third method uses a heavy copper ring acting as a shorted turn. The energizing ac in the main coil winding induces a current in the copper ring. This current lags the main coil winding current and consequently passes through zero sometime later — thus there is always some magnetic pull available to hold the armature closed.

AC relays are generally used in non-critical applications. They are unsuitable for complex switching circuits, or for applications where timing is critical.

Balanced Armature: these relays have armatures which are pivoted at their centres of mass. they are in a state of equilibrium in respect to external static and dynamic forces and hence they are relatively immune to vibration and shock loadings.

Balanced armature relays are produced in a wide range of types and sizes.

Crossbar switching: these are multi-contact relays and switches used for making and breaking connections across a grid or matrix. They were/are primarily used in earlier telephone exchanges (Figure 10).

Current Sensing: nowadays generally replaced by solid-state triggering circuits, these relays operate reliably at pre-set current levels. A 'snap action' mechanism is generally included to prevent contact chattering or creeping. Thermal mechanisms are also used for sensing and switching current — these devices respond to the heating rather than the electromagnetic effect of the energising current.

Delay-slugged: opening and closing time is delayed by up to half a second by placing a large copper collar around the winding. This delays the build-up and collapse of operating magnetic flux.

The same effect is also achievable electrically by using a capacitor/resistor network with a conventional relay.

Differential: these have two or more windings which are most commonly employed in simple logic operations — AND, OR, etc. Diffential relays may also have a 'polarised' action. These will be arranged such that the direction of armature and contact movement depends upon the polarity of the coil voltage/s, either from a 'centre-off' or bistable positions.

The next two relays really do exist — to the surprise of your otherwise erudite editor! They also add a certain charm to the discipline.

Electrostatic: These are delightfully and totally basic — essentially a pair of moving capacitor plates (to which contacts are mechanically linked) and arranged so that charge forces move the plates together or apart.

Naturally, these relays only work at very high voltages, but they work equally well on ac or dc, responding to the rms value with ac. They have to be seen (preferably from a safe distance) to be totally believed.

Electrostrictive: perhaps not as rare as electrostatic devices but still not seen every second day. These utilise the movement generated across a piezo-electric crystal (or a ferro-electric material) when the material is subject to an electric field.

They have a number of unusual and endearing characteristics. Efficiency is one. Piezo-electric materials behave rather like capacitors (which in effect they are) so that energy requirements are limited to charging the devices. This may be done by one big pulse or a series of little ones. The relay then remains closed until the charge across the crystal leaks away internally (or via an external resistance). Operation is limited to dc.

High Speed: actuating speeds of less than a millisecond are obtainable primarily through the use of low mass, low moments of inertia, low eddy currents etc.

Within limits, relays may be sped up by driving the windings at their highest rated voltage or current. A very effective method, once used by the writer to speed up a 12 volt power relay, was to connect a 12 volt tungsten lamp in series with the winding, the whole then being run off 24 volts.

The lamp has very low resistance for the first 50-100 milliseconds (dropping about 1.5 volts across itself). Thus the relay is initially hit with close to 24 volts. The voltage then falls to the designed level as the globe reaches operating temperature.

Relays may also be sped up by driving the windings from a low-impedance source. Bear in mind though that excessive speed may result in equally excessive contact bounce.

Ac relays can be sped up in similar ways, but operating speed will generally have a random aspect as there is rarely any way of knowing at which point on the ac waveform the relay winding will start to become energised.

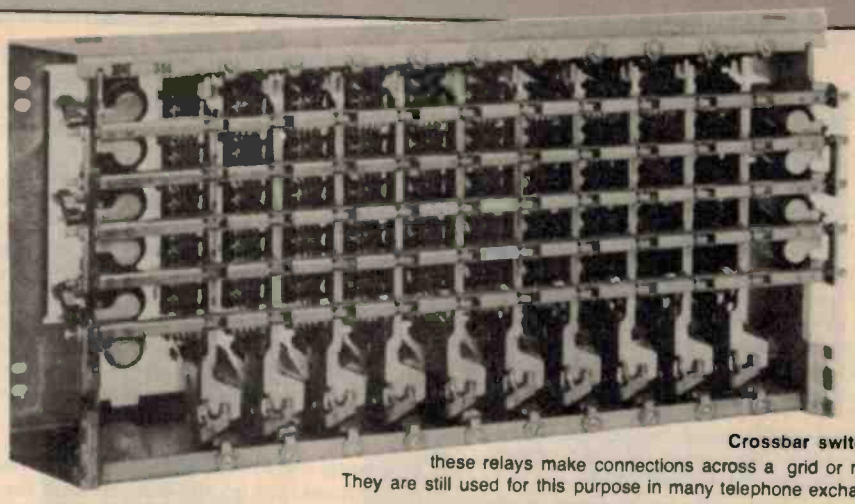
High voltage: these relays switch up to 10 000 volts at one amp or so alternating current, or about 0.2 amp dc. They may also be used to switch lower levels of voltage but in circuits working at very high voltages above earth.

Apart from the obvious requirements, such as high dielectric strength insulation, high voltage relays have large contact gaps plus rounded and polished conductors to reduce corona discharge.

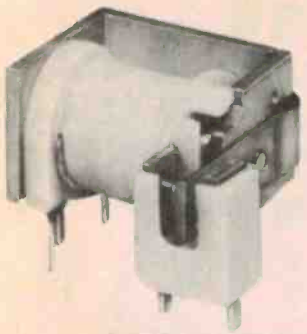
Power requirements are much higher than usual — 5 watts dc or 25 volt/amps ac being typical.

Hot wire: this type of relay uses the linear expansion of a length of wire, heated by the current passing through it, to open and close a set of contacts.

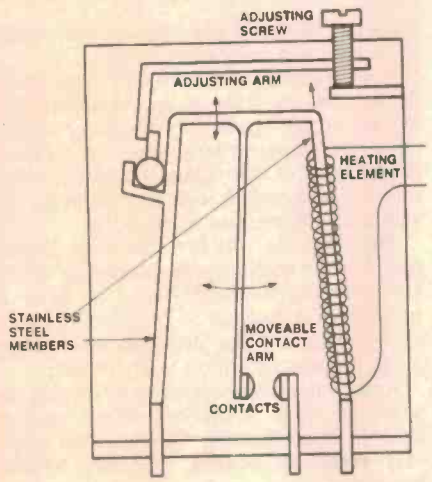
Impulse: electronic types will probably best visualise these as the mechanical equivalent of a bi-stable multivibrator! The armature and contact movement is such that they move sequentially from a first stable position to a second stable position each time the winding is energised.



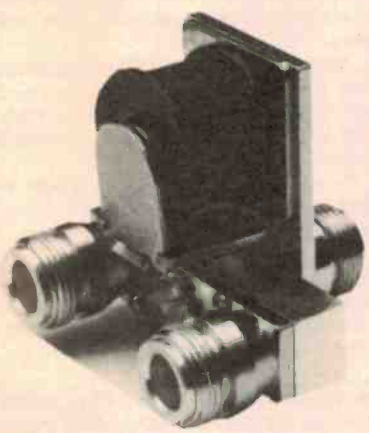
Crossbar switches: these relays make connections across a grid or matrix. They are still used for this purpose in many telephone exchanges.



High current, pc mount. This pc mount Potter & Brumfield relay (from Technico), shown about twice life size, will switch 30 A.



Linear expansion relay: current flowing through the heating element on the right hand member of the otherwise symmetrical metal yoke causes that member to expand differentially. The resultant movement is mechanically amplified causing the contact to open or close at preadjusted current levels. Changes in ambient temperature are automatically compensated for by the bi-symmetrical construction.



Coaxial relay. This RF switching relay is a coaxial changeover type that preserves the input/output impedance of 50 ohms by means of its special construction.

Linear expansion: as with the hot wire relays described above, the linear expansion relay relies upon the linear expansion of materials to provide a mechanical switching action.

A common type of linear expansion relay has two (mechanically identical) rigid metal arms around one of which is wound a heating element (Fig 11). The energizing current flows through this winding and thus heats up one of the two arms. The resultant expansion is multiplied by a simple but precise linkage and causes a set of contacts to open and close. Changes in ambient temperature affect both arms in a similar fashion — thus providing automatic compensation.

Low-level: used to switch 'dry circuits' (no power flows through the contacts until they are fully closed) or loads of less than 0.1 volt and/or less than a milliamp.

Contact surfaces are generally gold, a gold alloy, or platinum.

These relays go for ever (several billion operations is not atypical) as long as their voltage and current ratings are not exceeded.

Magnetic latching: self-latching is generally accomplished by using an additional pair of relay contacts to switch the relay directly across the power supply once the relay has been energised — even momentarily.

However, latching may also be performed magnetically — by having a permanent magnet as well as the usual soft-iron core. The (permanent) magnetic flux holds the relay in the operated state after the electromagnetic energy ceases.

The relay is reset by reversing the polarity of the electromagnetic flux, or by momentarily energising a reset coil winding, or via a mechanical mechanism.

Magnetically-latching relays are essentially bi-stable. They may be operated or reset by pulsed energy and once set will remain so securely and virtually indefinately and of course, once latched, no power is required to hold the relay in that position.

Magnetically-latching relays are highly resistant to vibration and shock loads. They are used extensively in aerospace applications.

Magnetostrictive: not often encountered — these utilise the dimensional change resulting when ferro-magnetic materials (usually nickel alloys) are subject to a magnetic field.

In one form, a coil is wound around a bundle of nickel-alloy rods. When the coil is energised, the rods become slightly longer. This movement is mechanically amplified by a lever arrangement and used to open or close a pair of the contacts.

Mechanically latching: as the name implies, these relays use a mechanical mechanism to latch them in the operated state once the electromagnetic energizing force has ceased. They are reset manually, or electrically via a separate coil and armature.

These relays are often used as machinery or circuit overload warning devices. When a load exceeds a pre-set level the relay is caused to operate and by so doing to draw human attention to the fact that some action is required.

Mercury Plunger: these are curious looking devices used to switch currents up to 100 amps. In the 'off' position a magnetic plunger floats on top of a pool of mercury. An electro-magnet, when energised, attracts the magnet down into the mercury, which being displaced, rises and bridges a pair of contacts.

A normally-closed version has the plunger held down by a spring. The electro-magnet, when energised, works in opposition to the spring force.

Another version allows the displaced mercury to empty slowly through an orifice into a chamber filled with inert gas. The gas is allowed to seep through a porous ceramic plug thus introducing a controlled time delay.

Mercury Wetted: see reed relay.

Meter relays: these were at one time used extensively to switch at precisely determined levels of voltage, current, power or whatever. They have largely been replaced by solid-state electronic circuits. They are essentially conventional electrical (D'Arsonval) meter movements in which a moving contact, replacing the pointer, touches a second adjustable stationary contact.

Like the Rolls-Royce, meter relays were/are largely a triumph of workmanship over design.

Phase Sequence: many electrically driven (three-phase) machines, particularly those used in the construction industry, are connected temporarily to various mains supplies, often by totally unskilled staff. In such applications there is a very real possibility of damage or accidents being caused by the motor rotating in an incorrect direction due to the phase sequence of the mains being incorrect.

Phase sequence relays check that the phase sequence is correct and either indicate aberrations — or corrects them automatically.

Polarised: many of the different types of relays described here may have one or more permanent magnets to provide a polarising magnetic flux which can normally flow in either one or the other of two symmetrical paths. The armature then moves in response to the nett force produced by the two flux paths.

The permanent magnet flux increases relay efficiency, sensitivity, and operating speed. It also improves resistance to vibration and shock.

Printed Circuit Board: these are high sensitivity relays designed to be energised by solid-state logic and other circuitry. These devices deserve to be covered separately — and consequently have been — elsewhere in this supplement.

Reed Relays: reed relays are a type of relay in which flat metal blades, often sealed within a glass tube, triple as armatures, springs, and conductors. Some even act as the contacts too (Figure 12).

Reed relays may be actuated by permanent magnets, or a magnetic field — in the latter case they are generally inserted within a solenoid.

The devices have innumerable applications. They are very fast, extremely reliable, and inexpensive.

There are innumerable variations including one in which the contacts are 'wetted' by mercury drawn up the reeds by capillary action.

Reed relays justify a feature on their own. The only one known was written by the present author in 1971. It has recently been reprinted in ETI's associated publication *Circuit Techniques Vol 4* (January 1984). The content is still applicable.

Resonant Reed: these have been largely replaced by solid-state devices. Their purpose is to make or break a circuit at specific (adjustable) mechanical or electrical frequencies.

In their electrical form they consist of a thin springy reed suspended above an electromagnet. When the winding is energised at a frequency corresponding to the reed's fundamental resonance the reed is excited into a major mode of vibration at the same frequency. The moving reed touches a second, fixed, contact once each cycle.

Rotary: used originally for military applications, these relays use armatures which rotate to close the gap between one or more pole faces. Their main characteristic is extreme resistance to shock and vibration.

Rotary relays are produced in a wide range of sizes and types — from miniature devices used in scientific instruments to massive devices which will withstand the shock of gunfire in tanks and naval vessels.

RF Switching: these are commonly used for switching antennas and associated equipment. They are designed for minimum loss at high frequencies, and often produced such that their switching components have a similar characteristic impedance to the coaxial cables connected to them.

Auxillary contacts are often included for switching coincident non-RF circuits.

Snap action: this implies a very rapid change from one stable state to a second stable state. It is usually achieved by using part of the relay actuating mechanism to store mechanical energy during initial movement and then releasing this energy to 'snap' the contacts open or closed during the final stages of movement.

The usual method is to use some form of 'over-centre' mechanism but the action may also be achieved electrically, for example discharging a capacitor through the coil winding. Magnetically polarised relays tend to have snap action characteristics.

Solenoid: solenoid actuation is commonly employed where the contacts must be moved over large distances or where high contact pressures are essential.

Seolenoid relays are generally limited to non-critical on/off applications.

Both ac and dc types are available. Both are characterised by very high in-rush currents for the first few microseconds. This is caused by the distributed capacitance within the winding. With ac solenoids the change in impedance as the armature moves through the solenoid will cause current surges.

It is generally essential to use some form of protection against the extremely high voltage transients which are generated when a solenoid relay is disconnected.

Users should note that solenoid relays are commonly position-sensitive — some even rely upon gravity to move the plunger!

Stepping switches: these cover a wide range of relay-like devices are are basically switches which operate sequentially when energised by a series of pulses. Figure 13 shows one typical form.

These relays/ switches were used by the million in telephone exchanges and switchboards worldwide. They are also still commonly used in vending and other machines.

Stepping switches generally employ some form of electromagnetic actuator which causes one or more contacts to move semi-circularly across further banks of contacts. In most applications the moving contact moves one step per energising pulse.

The devices commonly require 48 volts for energising, but stepping switches are also produced operating from 6 volts to 240 volts.

Telephones: typified by the ubiquitous Post Office type 3000, the term actually encompasses many different types and configurations of relays.

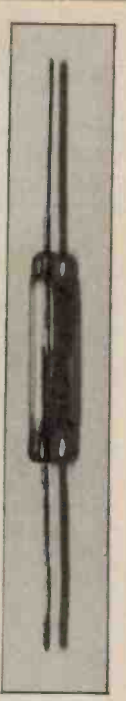
Most look something like Figure 14. They tend to have long, small diameter windings and provision for various combinations and numbers of contacts. They are difficult to assemble and adjust, but once set up they are extremely reliable.

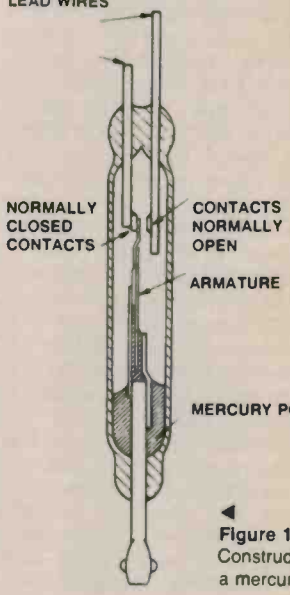
Vacuum relays: these relays have their contacts enclosed and sealed in a high vacuum. The coil winding is generally external and the contacts are actuated by magnetic transfer or mechanically via metal bellows forming part of the (generally) glass vacuum enclosure.

Vacuum sealed relays are costly but can switch very high voltages and currents for their physical size.

Voltage sensing: relatively similar to current sensing devices except that compensating networks are required to offset changes in ambient temperature. This is because a current sensing relay responds directly and only to the current flowing in the coil, and is this unaffected by ambient changes. A voltage sensing device however responds to the product of coil current and coil resistance and is thus directly affected by ambient change. ●

Reed relay. ▶
This tiny reed relay has a body just 16 mm long and about 3.5 mm diameter.





◀ **Figure 12.** Construction of a mercury-wetted relay.

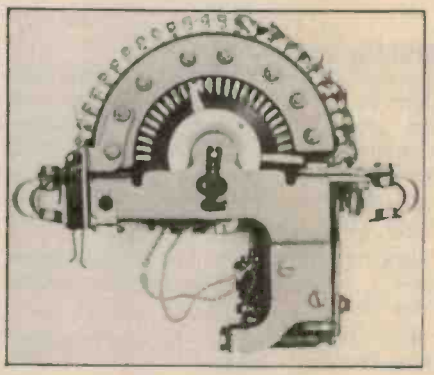
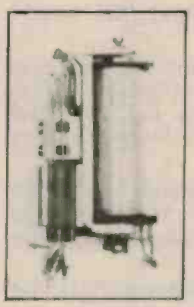
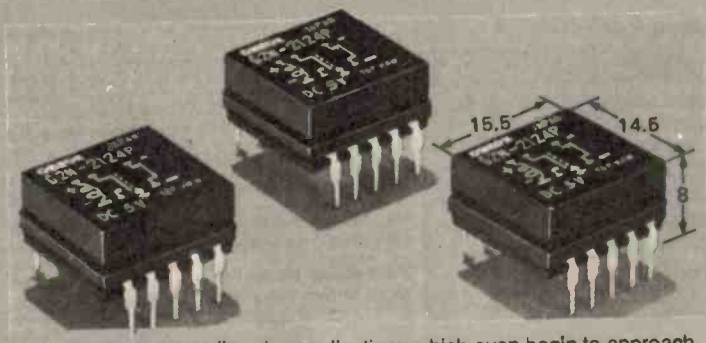


Figure 13. ▲ A stepping switch relay.



◀ **Figure 14.** Yes, it's a type 3000 relay!

DRIVING RELAYS FROM LOGIC CIRCUITS



Many designers specify unnecessarily complex and sometimes inherently unreliable solid-state componentry to interface their logic or other circuitry to drive medium to high current loads. Yet printed circuit board mounting relays may be driven directly from TTL and CMOS logic gates, or buffers or drivers. The necessary bits and pieces have been available for at least a decade!

There are a few drawbacks and very many advantages. First, the bad news.

Whilst being almost immune to false triggering from transients, static etc, electromechanical relays do themselves generate electrical noise and this may introduce unwanted problems in sensitive logic circuits. Shielded construction and arc suppression circuitry will usually provide a cure.

The second possible difficulty is that mechanical relays have a limited, (but predictable) life expectancy. However if the correct types are specified, possibly slightly derated, and given adequate contact protection, life expectancy may exceed 10^7 operations. There are few applications which even begin to approach that many cycles — in many applications the loads fail long before the relays.

On the plus side, electromechanical relays are virtually immune from false triggering — whether from load, power, static or other transients; nor do they required components to protect them against such evils.

Unlike solid-state relays, electromechanical devices need not be derated for any realistic operating temperature, nor do they require space consuming heatsinks.

There's no need for commutating dv/dt protection. Isolation between input and output is excellent — typically 100 megohms or more — with dielectric strength commonly exceeding 1000 volts at 50 Hz.

Where relays really score is in applications where the input must drive multiple outputs and especially so where the outputs are a combination of opening, closing or change-over circuits.

Here's how it's done.

TTL

Most commercially available pcb relays designed for use with TTL circuitry require energizing currents ranging from 4 mA to 25 mA (at 5 Vdc). A typical example is shown in Figure 1. Plenty of TTL ICs are more than capable of driving these relays. The 54/74 series of gates will readily handle 20 mA. The 7433 series quad switches sink 48 mA from each of the four outputs.

The 7400 series TTL buffers and drivers will readily drive most pc board relays directly — up to and including those having multiple contact 10 amp ratings. And if this is not enough there are any number of IC drivers with TTL or MOS inputs having high current output transistors fabricated into the same substrate as the logic gates. These devices will sink several hundred milliamps and can drive relays capable of switching 25 amps or more.

CMOS

The 4000 series logic gates operated at 12-15 volts will sink about 5 mA — this is sufficient to drive many sensitive pc board relays (Potter & Brumfield's Model LM for example requires 3 mA for its 5000 ohm coil and switches 1 A at 240 Vac).

As with TTL it's always possible to use a signal amplifying interface.

HYBRIDS

An increasing number of pc board mounting relays are now being produced with signal amplifiers built in. These mechanical solid-state hybrids generally use a bipolar transistor or Darlington amplifier.

A typical hybrid relay is rated at 10 amps 240 volts ac and requires less than one milliamp to drive it. ●

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PRICE HIKE FOR AUDIO TAPES?

CONCERN is mounting over an imminent Bill to go before Parliament shortly that would seek to impose a levy on the sale of blank audio tape.

The levy, as claimed by its proponents, would protect the copyrights of the giant record/entertainment companies against indiscriminate — and currently illegal — home taping of their material.

But a vast majority within the industry see the proposed levy as a draconian measure that would exact its greatest toll on the hapless consumer.

One of the Bill's most outspoken opponents is the Australian Audio and Video Tape Association, grouping the country's leading tape manufacturers.

AAVTA spokesman Peter Rose said: "The proposed levy would not only be a burden on consumers, many of whom do not even use their tapes to record copyright material; but it also has the runious potential of raising even more problems than it can solve."

Mr Rose pointed out that the only ones who stand to benefit from the measure are the multinational record companies, who are in fact already among the world's richest corporations.

The argument that audio tapes are being used to illegally record copyright material ignores the rights of consumers who use them for other legitimate purposes, such as in business or education, or to make use of technological developments like telephone answering machines or home computers, Mr Rose went on.

"And even in the case of the recording of copyright material, there is much evidence to suggest that the practice has in fact helped rather than hindered sales.

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

Attorney-General Senator Gareth Evans, who recently outlined the Labor Government's apparently favourable view on the proposed levy, indicated that the rate would be anywhere from two to 30 Australian cents per hour of tape.

"Added to the present 35% duty and 32½% sales tax — the latter only recently increased from 20% the levy is an onerous and totally unacceptable burden to lay on the consumer," said Mr Rose.

While the Attorney-General assures at this stage that a similar levy on video tape is "unlikely", AAVTA and other opponents of the bill fear that it is an all too likely probability if ever the current measure is passed into law.

"It is no secret that major film companies — many of them also among the world's richest — have been pressing for 'protection' of their copyrights," Mr Rose said.

"Yet industry research has shown that an overwhelming 90% of blank video tapes bought are used merely for the convenience of 'time-shift' — unattended recording for viewing at a more convenient time — a practice certainly not injurious in any way to copyright owners."

The passge of the proposed bill, AAVTA believes, could set a dangerous precedent that would embolden future proponents of a video tape levy.

"Despite all the research and studies by the world's major industry organisations, no foolproof formula has yet been found for exacting a levy only from those who use tapes to record copyright material. But the answer is certainly not to overlook this important distinction and ignore the legitimate right of the majority of consumers."

Further information, can be obtained from: **Mr Peter Rose, AAVTA spokesman, 3M Australia, 950 Pacific Highway, Pymble, NSW 2073. (02) 498-9351.**

VCR GUARANTEE

AWA-Thorn has announced that as from 5 December 1983, all recently released AWA and Thorn brand video cassette recorders will be covered by a new four year guarantee.

Under this guarantee AWA-Thorn will supply parts and repair labour, at no extra cost to the owner to rectify a product fault or failure (excluding video, audio or control heads) for a period of four years.

The recently released models to which this AWA-Thorn four year guarantee will apply are: AWA-AV-11, AV-21, AV-31; Thorn-TR101, TR-201.

Any of these models bought before December 5 1983 can also be covered by payment of $20 to AWA-Thorn.

For further information contact **AWA-Thorn Consumer Products Pty Ltd, PO Box 11, Rydalmere NSW 2116. (02) 638-9022.**

CANARE CABLE

Klarion announced that Canare cable and auxillary products are again available throughout Australia.

Canare manufactures bulk and pre-wired cables, junction boxes, pigtails, multipair cables, and multipin cable assemblies.

Canare's Starquad audio cable consists of two twisted pairs plus a high density braided shield. Because each 'conductor' in the balanced cable actually consists of a twisted pair, the included area between conductors is minimised, which maximises rejection of ac hum and all forms of electro-magnetically induced noise, claims the company.

Special types are offered to suit the specific technical interface requirements of mic and line level audio, video and musical instrument circuitry. Guitar cables are available in five colours and microphone cables in 10 colours.

Canare cable reels are available for single cables or large multipair cables, with or without connector panels. Several models come with three-position brakes that regulate tension or lock the reel completely. Most reels can be stacked and some models have roll around casters.

Canare also offers a variety of low crosstalk multipair cables for construction of custom 'snakes'. Factory wired 8-to-32 channel snakes are also available, with multipin connectors that mate either to junction boxes or XLR pigtails.

A catalogue that answers many technical questions and lists all of the electrical and physical parameters of each cable is also offered. Also listed are special cables for permanent installation in raceways and conduit, as well as instrumentation cable, speaker cable and heavy duty pre-wired guitar cable. Extensive diagrams and plain language discussions alert studio builder/designers, soundmen and engineers to the distinctions between the types.

For further information, contact **Klarion Enterprises Pty Ltd, PO Box 379, South Melbourne Vic 3205. (03) 61-3541.**

UNIQUE HEADSET

Sennheiser, has released a unique device for people who require occasional hearing amplification assistance.

The Conferette C2, released recently at the Hard of Hearing Congress in Germany, overcomes this problem. The device works in a similar manner to the occasional use of a pair of spectacles. The C2 folds away and is put in a little leather carrying pouch just like a spectacle carrying case.

The C2 incorporates two miniature microphones which are connected to twin amplifiers to give biphonic sound, maintaining the users' ability to perceive the direction of the sound source. Just like the home stereo, the amplifier balance may be adjusted as most people have a different hearing loss in each ear.

The C2 may also be used in conjunction with an infrared transmitter connected to a TV set giving wire-less/TV sound transmission. Since the microphones are also operating during the wire-less sound transmission, other people can still talk to the user at any time.

In order to prevent ambient noise from impairing the wireless sound transmission, the microphones only switch-on automatically in this mode when a defined sound level is reached, i.e.: when a person wearing the device is spoken to with normal speech volume from a distance of one metre.

The product will be available soon through hearing-aid specialists. It is imported by R. H. Cunningham Pty Ltd and distributed through **Shaw Sound, 160A New South Head Rd, Edgecliff, NSW 2027. (02)32-5222.**

COMPACT -DISC HEADPHONES

Sennheiser has released the Unipolar 2002 and HD230 headphones to complement the new wave of compact-disc players.

The Unipolar 2002, which has a frequency range of 16 Hz to 22,000 Hz, is based on an electrostatic two-way system without switching network. It has a control box to match the headphone to any stereo power amplifier, and features a visual over-modulation indicator. A second headphone may be connected.

The HD230, which offers a frequency response of 10 Hz to 30,000 Hz, is a two-way headphone without a frequency-dividing network. The impedance of 600 ohms permits easy connection to the compact-disc player.

Further information is available from **R.H. Cunningham, 146 Roden Street, West Melbourne Vic. 3003. (03) 329-9633.**

INTERFERENCE TO VCRs INVESTIGATED

Videocassette recorders (VCRs) used in households near radio transmitters could suffer from interference problems, claims a spokesman for the Department of Communications.

The spokesman said that, although not all VCRs were susceptible to the interference, the number of such complaints from residents throughout Australia had risen dramatically over the past year.

"The interference comes in the form of horizontal coloured bars across the screen when the viewer is watching a commercially pre-recorded tape.

"Unfortunately, the interference affects the 'playback' mode and therefore cannot be filtered out at the recording stage, and with many radio stations transmitting for 24 hours a day, the problem is a continuous one for viewers."

The spokesman said most radio transmitters were originally sited some distance from residential areas. With the growth of cities and towns, many householders were living in close proximity to radio transmitters and found their VCRs were susceptible to interference.

A number of complaints had recently been received from people living around the Brisbane transmitter of the ABC's Radio 4QR. The spokesman hoped other people in similar situations would now be aware of the problem and could safeguard themselves against unsuitable purchases.

BASF'S SUMMER SELLOUT

Leading audio and video tape manufacturer, BASF, was caught unawares by the runaway success of its Summer Sweepstakes promotion.

Continuing its bold strides towards market leadership, BASF found itself with no stock and still a month of the promotion to run. So, more than 30 tonnes of its entire range of audio and video cassettes had to be air-freighted from Germany to restock retailers around Australia.

BASF's manager, consumer products division, Horst Hanfeld, said the outstanding success of the Summer Sweepstakes had exceeded all expectations.

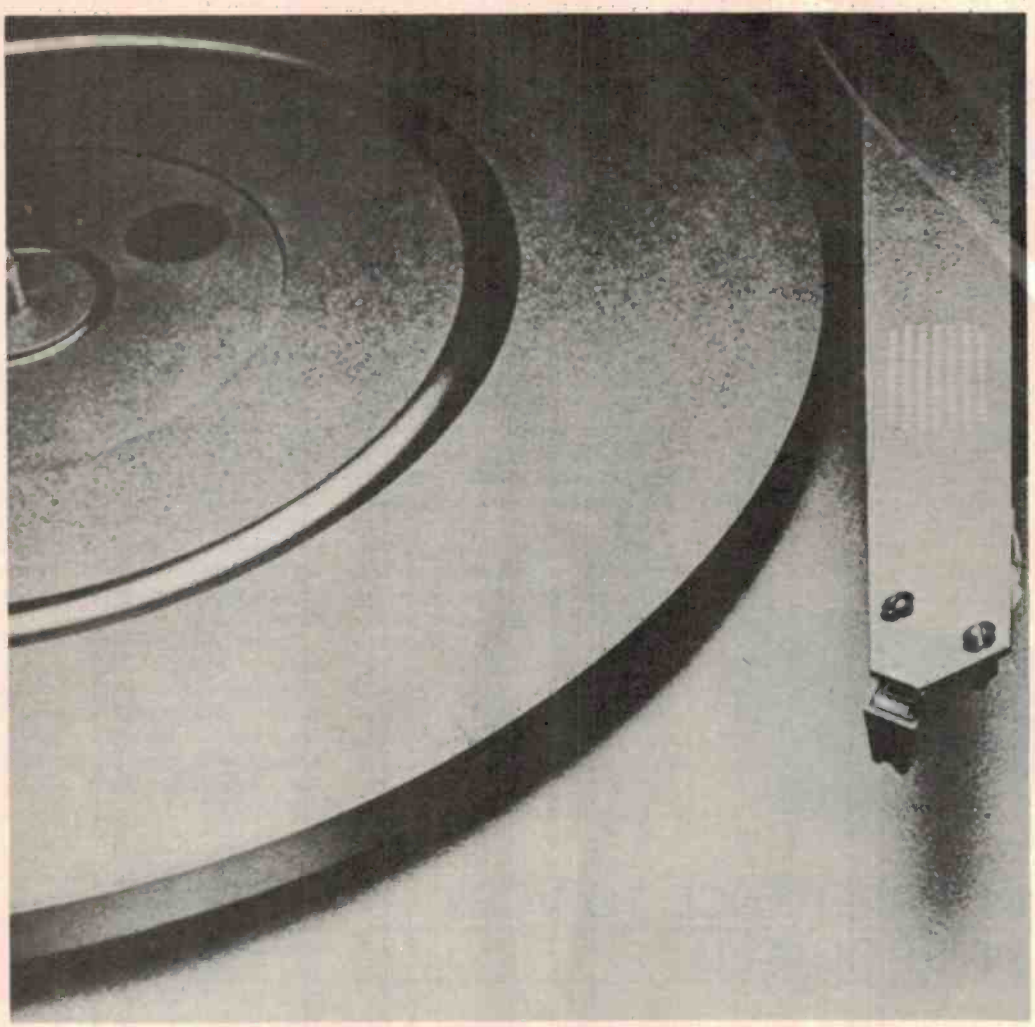
"Both audio and video sales are going like a rocket, and it is likely we will have to continue to air-freight product from Germany to keep up with demand through to the end of January," Hanfeld said.

BASF customers in all States are in the running to win an $8500 Suzuki Sierra four-wheel-drive vehicle or one of hundreds of other prizes in the Sweepstakes. He said entries were flooding into the competition.

Mr Hanfeld said the support of major radio stations around Australia had also contributed significantly to the success.

Mr Hanfeld said it appeared BASF would assume market leadership for both audio and video products early in 1984.

Things have sure "hotted up" in the tape market this summer.



PHILIPS TRENDSETS

Philips has consolidated its position as the world's leading manufacturer of colour TVs they claim by introducing the Trendset, featuring ultra-modern 'monitor-look' styling in a variety of housings including traditional silver-grey and vivid maroon.

The first Trendset on the market is the 34cm CTV CJ413 UHF/VHF portable. Weighing only 11.8 kg, the Trendset is truly portable, with built-in retractable aerial and foldaway carry handle. Volume, brightness, colour and contrast controls are front-mounted beneath the screen. Channel selection is by soft-touch, push-button controls at the top of the set.

"34cm screen size TVs represent some 40% of the Australian CTV market. Philips now has three different models in this size and is very well placed to cater for different consumer demands and lifestyles," said David Filsell, Philips Video Group product manager. The 34cm maroon Trendset is available nationally at about $499.

For further information, contact **Philips, 15 Blue Street, North Sydney NSW 2060. (02)925-3333.**

NEW NAD TURNTABLE FEATURES UNIQUE ARM

Falk Electrosound has announced the release of the new NAD 5120 turntable, featuring a unique flat, flexible, phenolic tonearm.

The development of the NAD 5120 turntable involved thorough attention to suppressing or eliminating many of the vibration-induced resonances that can mar sound reproduction in conventional turntables.

The belt-driven platter and the tonearm are mounted on a floating sub-chassis with an unusually low 4 Hz suspension frequency, providing much-needed isolation from external vibrations (such as acoustic feedback) that can colour the sound.

Unlike conventional turntables that achieve smooth rotation by depending on the inertia of a heavy and costly machined metal platter (whose bell-like resonances are then only partly tamed by a rubber platter mat), the NAD 5120 employs a simple, low-flutter belt drive.

Its unique platter is a thin aluminium disk, for stiffness, combined with a soft rubber mat that is 7 mm thick in the middle and 9 mm thick at the rim where it wraps around the edge of the aluminium disk.

This platter system is said to be incapable of resonant vibration, and the smooth upper surface of the rubber mat efficiently absorbs any extraneous vibration in the vinyl record itself.

The design of the NAD 5120's tonearm overcomes a resonance problem that is inherent in the shape of conventional tonearms: a long, slim tube, especially if it is thin-walled to minimize mass, has natural flexure modes that occur at midrange frequencies. These add subtle colorations and can affect stereo imaging.

The 25 mm width of the 5120's tonearm provides ideal lateral stiffness, so it is much less prone to midrange flexure than a thin tube; and since it is constructed of non-resonant phenolic, it cannot "ring" like metal NAD claim.

In the vertical direction, however, the flat tonearm has very little stiffness. It is so flexible that the vertical flexure mode has been moved completely out of the midrange, where the ear is sensitive to any coloration, and down to the low bass — below the lowest frequencies normally encountered in recordings.

Thus, tonearm flexure has been virtually eliminated as a source of sonic coloration.

The final element in the design of the tonearm is its counterweight, which is not mounted rigidly to the tonearm but rather is suspended on a spring with a viscous damper, forming a compliant assembly that resonates in sympathy with a flexure of the floppy tonearm.

This forms a dynamic vibration absorber, cancelling the large infrasonic resonance that is produced in all tonearms by the compliance of the stylus assembly interacting with the effective mass of the arm.

The Model 5120 turntable was developed for NAD by a team of audiophiles and engineers affiliated wqith the Tesla VUST Research Institute in Prague, Czechoslovakia.

For further information, contact **Falk Electrosound, 28 King Street, Rockdale NSW 2216. (02)597-1111.** ▶

Hear digital perfection.

Introducing the Sony Compact Disc Player.

When we used our long experience in digital technology to create the CDP-101 Compact Disc Player, we wanted to give you something more than the world's clearest sound.

WIRELESS REMOTE CONTROL Full-function remote control.

3-WAY MUSIC SEARCH ☐ Instant direct access to any selection with the 10-key pad on remote control unit. ☐ AMS (Automatic Music Sensor) allows access to the beginning of next or previous selection. ☐ 2-speed bi-directional search to find any desired music passage.

REPEAT FUNCTION Program to repeat the entire disc, one selection, or a specific portion of music.

3-FUNCTION DIGITAL READOUT DISPLAY ☐ Selection number. ☐ Time lapse of selection being displayed. ☐ Remaining time on the disc.

LINEAR SKATE DISC LOADING Just press the button, platter control and cueing are automatic.

Get even more perfect sound with the Sony Digital Audio Component System, "Precise Series".

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MCR RM4960L

"To accurately test our cartridges, we created the world's finest stereo headphones."

To test our cartridges for the improper tracing and signal-to-noise ratios that an ordinary speaker would not register, we needed highly sensitive stereo headphones.

To obtain the accuracy that our reputation demanded, we had to create our own.

The present ATH series is the second generation of Audio Technica headphones, subtly refined and further improved.

Lightweight, comfortable precision instruments, they reflect Audio Technica's unrivalled reputation for reliability and the intelligent application of advanced audio technology.

And now Australian hi-fi enthusiasts will discover Audio Technica stereo cartridges, stereo headphones, stylii, microphones, tone arms and other accessories more readily available through an expanded dealer network.

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MCR RM4960R

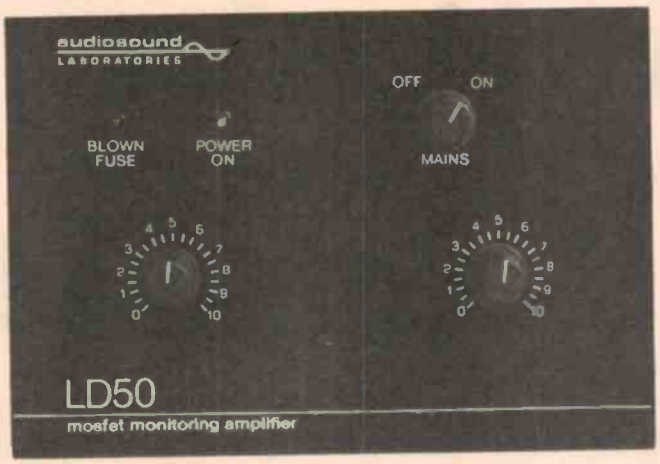
MOSFET MONITORING AMPLIFIER

This new 50 W per channel amplifier provides balanced line bridging inputs via Cannon sockets to two separate and identical channels for stereo or two channel monaural use.

Both channels can be bridge connected allowing 100 watt single channel use without any additional adaptors.

For domestic use there is the matching ASC-1 high performance control unit which provides a wide selection of inputs.

For further details contact **Audiosound Laboratories, 148 Pitt Rd, North Curl Curl NSW 2099. (02)938-2068.**



TIVOLI MOVE

When Tivoli Hi-Fi moved their premises they also decided to take a new direction and now specialise only in top end hi-fi equipment.

All portables, car and video equipment have been cleared out and replaced by a wide range of up-market hi-fi components. The company says that their technically informed consultants will be pleased to talk to you about improving, repairing or performance tuning your hi-fi system and after hours consultations are welcome by appointment.

Tivoli Hi-Fi can now be found at **155 Camberwell Rd, Hawthorn East, Vic. (03)813-3533.**

THE SUPER WALKMAN

In January last year, Sony released the Super Walkman built to the same dimensions as a standard audio cassette case. They claim that it's the worlds smallest stereo — just 109.5 mm long, 69.5 mm wide (81.3 mm with cassette inserted), 17.6 mm thick and weighing only 180 grams.

A single 1.5 V alkaline battery gives up to five hours operation. The super thin BSL motor is only 4.5 mm thick.

Dolby B noise reduction reduces tape hiss, and accidental turn-ons are eliminated by a built-in switch which prevents the unit being turned on until the headphone plug has been inserted. Either metal or CrO_2/ normal tapes can be used.

Available in red, blue or silver, the Super Walkman is marketed under the WM-20 model number, retailing around $179.

Filling out the Super Walkman line in 1984 will be the WM-F20 featuring a built-in fm tuner, and the SRS series speaker-amplifier units. Built to the same dimensions as the Super Walkman, the SRS-20 and the SRS-F20 (with am/fm tuner) unfold to let the listener share the sound.

Further information can be obtained from **Sony (Australia) Pty Ltd, 33-39 Talvera Rd, North Ryde NSW 2113. (02)887-6666.**

TWO NEW SANYO VCRs

Sanyo has released two new video cassette recorders. The VTC 6500 video cassette recorder comes complete with a 12-function infra-red remote control unit that provides quick, easy control of record, playback, stop, rewind, fast forward, pause/still picture, Betascan picture search, power on/off and channel up and down buttons for the easy changing of channels.

The '6500' also boasts a 14-day, 8-event programmable timer that offers a selection of recording time, length, and schedule repetition. The built-in timer can be set to record any time up to 14 days after it has been set.

An electronic switching system has been incorporated in the VTC 6500 together with soft-touch transport controls. This feature not only makes changing functions faster and more reliable, but also reduces wear on the switch mechanism.

The VTC 6500 utilises five multi-coloured LED indicators to show how much blank tape remains. The electronic tape counter is equipped with a 4-digit display and a switchable memory function that allows any sport on the tape to be marked for easier location for programmes. When the memory switch is on and the tape is being rewound, the unit will automatically stop at the point marked by '0000'. The unit retails for around $829.

The other new model, VTC 5005, is equipped with an eight-day programmable timer that can record a programme up to eight days in advance. With this feature, one can also record a programme at the same time every day over the eight-day period.

Other features of the VTC 5005 include a picture search function at seven times normal speed, plus a cord remote pause-control that allows the viewer to edit unwanted material from his armchair. The VTC 5005's digital timer also doubles as a 12-hour (am/pm) clock, generally regarded as more convenient than the 24-hour type.

This model sells for around $599.

Details from **Sanyo Australia Pty Ltd, 14 Mars Rd, Lane Cove NSW 2066. (02)428-5822.**

An update on the compact disc scene — three CD players reviewed

MARANTZ CD-73 • PHILIPS CD 303 • TECHNICS SL-P8

Unusual design philosophies characterise differences between these CD players and other units previously reviewed. Visual and technical differences, different demodulation processes and a different type of digital-to-analogue converter produce some interesting results.

Louis Challis

SINCE WE REVIEWED the Sony CDP-101 in ETI, February 1983, and saw our first Philips CD player, the market has responded enthusiastically to all the publicity. Most manufacturers are already selling their second series, and in some cases their third series, of CD players.

In a number of pre-release models that we have seen recently, the second or third series of CD players incorporate technical advances and improvements in manufacturing which reduce the costs and cause the first models to be superseded. The most notable of these is undoubtedly Pioneer's first excellent P-D1 model which was so expensively and well made that Pioneer was not able to sell them with a reasonable profit margin.

When we reviewed the first series of six CD players in ETI, September 1983, there were not many players in the shops and even less software. That situation has now changed; my local hi-fi retailer usually has a minimum of half a dozen machines to pick from and my local record shop generally has approximately 80 discs from which I can select. Both the players and the discs are constantly on the move.

You may have been interested in CD players and enthusiastic about the concept, however, it is only now possible to evaluate players in the shop or hear a representative selection of the discs. Some of the early discs released leave much to be desired.

MARANTZ CD-73
Manufacturer: *Marantz, initially in Belgium, now in Japan.*
Distributor: *Marantz (Aust) Pty Ltd, 19 Chard Rd, Brookvale NSW 2100. (02)939-1900.*

PHILIPS CD 303
Manufacturer: *Philips, Hasselt, Belgium.*
Distributor: *Philips Consumer Products, 1092 Centre Rd, Clayton Vic. 3168. (03)542-3333.*

TECHNICS SL-P8
Manufacturer: *Technics, Osaka, Japan.*
Distributor: *National Panasonic (Aust) Pty Ltd, 95 Epping Rd, Nth Ryde NSW 2113. (02)887-5333.*

Having purchased a dozen discs, I am now aware of how technically poor some of the original analogue recorded material sounds when used as a basis for producing a CD disc. I am not the only one with these views. Not only have some of my reviewer friends overseas been complaining but, more significantly, the key marketing personnel at such illustrious firms as Phonogram, Sony-CBS and EMI also share my concern.

But before I discourage you, let me assure you that this situation is rapidly changing and most of the new material being produced and released now is of a much higher calibre than some of those early releases that hit the market.

In order to critically assess the three newly released CD players in this review, I acquired some representative CD discs from Deutsche Gramophone, Polydor and Phonogram. These discs have convinced me that the CD medium is not only worth the time and trouble but is also worth the money.

The three CD players being reviewed are representative of the low to medium price range of machines being released in Europe, America and Japan. They are a Marantz CD-73, a low to middle price range machine from that company; a Philips CD 303, a low to middle price range machine from Philips; the Technics SL-P8 is the first machine to be released by that company but would be considered a middle price range machine. ▶

Make and Model	Recom. Retail Price	Dimensions W x H x D mm	Weight kg	Remote Control	Disc. Rotation	Dynamic Range with Emphasis	Distortion @ 1 kH3 re 0/VU	Distortion @ −60 dB re max recorded level
MARANTZ CD-73	$899	416 x 81 x 300	8	No	Horizontal	89 dB Lin 102 dB (A)	0.0019%	−29.1 dB
PHILIPS CD-303	$899	420 x 88 x 315	8.2	Yes	Horizontal	94 dB Lin 105 dB (A)	0.0018%	−28.9 dB
TECHNICS SL-P8	$1100	430 x 88 x 325	6.1	No	Horizontal	107 dB Lin 117 dB (A)	0.0018%	−44.3 dB

Marantz CD-73

The Marantz player is visually attractive featuring what I can only describe as the classical 'big and brassy' appearance that seems to be that company's design trademark. In keeping with the latest market demands, the unit features a front-loading disc system which is pushbutton operated and has a slide out drawer and hinge-up disc clamping cover.

The front of the machine is, in typical Marantz fashion, golden, satin brushed, aluminium with two large clear viewing windows on the right and left-hand sides of the front panel. On the extreme left-hand side is the reasonably small open/close button which is sensibly located at the top of the panel; below is the illuminated power on/off switch. To the right of these controls is a clear panel which has, at its base, four switches for 'reverse', 'fast-forward', 'next programme and play' and 'pause'.

Behind the clear panel are three light emitting diodes. A red LED is used to indicate that the laser is in operation, a green LED indicates the standby mode and a yellow LED indicates that the equipment is in the pause mode.

On the right-hand side of the panel is an elongated clear viewing window behind which are 15 numbered green lights to indicate the precise number of different tracks actually recorded on the disc. Immediately below these lights are 15 yellow LEDs which are individually illuminated during the programming sequence; the controls for these are positioned on the front panel immediately below.

Unlike some of the Japanese machines that we have recently reviewed and, more specifically, the Technics machine that I will describe below, this machine only provides a visual programming indication up to a maximum number of 15 sequences. If you happen to have a test disc with up to 42 tracks, as I do, you can have your work cut out in obtaining assistance from the machine to undertake an automated track selection.

The Marantz philosophy, which is undoubtedly true for most current commercial discs, is that there are unlikely to be more than 15 tracks on the disc; if there are the overflow light will operate and the player will proceed to play those tracks but will not provide user pre-selection for those tracks beyond number 15.

The controls associated with this section of the Marantz CD player are delightfully easy to use and during normal usage will be infrequently used, if ever. The latest research data from America and Japan indicates that most people using a CD player load a disc and play it from start to finish. Of course this situation may change but if you want to listen to music and not 'play with machines' all you really need are three controls; 'open/close', 'play' and occasionally 'stop'.

The 'stop/all cancel' control is self-explanatory; 'select' allows you to index the programme selection number independently of what is actually being played using the yellow LEDs in the large display above; when the 'preset button' is pressed for a given selection it memorises that track number; the 'repeat' button memorises the sequence just recorded and plays that sequence again, however, if no sequence has been recorded, the unit replays the whole of the disc; the 'cancel' button cancels the memorised track sequence information.

The top of the player features a clear acrylic window in the steel cover through which you can see if a disc is loaded. This

MEASURED PERFORMANCE OF MARANTZ CD-73 Serial No. 100386

FREQUENCY RESPONSE

FREQUENCY	OUTPUT LEVEL dB
1.0kHz	0.0
20Hz	-0.1
40Hz	-0.1
100Hz	+0.1
200Hz	+0.1
500Hz	+0.1
1.0kHz	0.0
5.0kHz	-0.2
10.0kHz	-0.8
16.0kHz	-1.0
20.0kHz	-1.3

LINEARITY

RECORDED LEVEL dB	OUTPUT LEVEL dB
0.0	0.0
-1.0	-1.0
-3.0	-3.0
-6.0	-6.0
-10.0	-9.9
-20.0	-20.0
-60.0	-60.0
-80.0	-77.7
-90.0	-85.3

EMPHASIS

Frequency	Recorded Level	Output Level (Left)		Output Level (Right)	
1kHz	-0.37dB	-0.3	dB	-0.3	dB
5kHz	-4.53dB	-4.9	dB	-5.0	dB
16kHz	-9.04dB	-10.2	dB	-10.2	dB

CHANNEL SEPARATION

FREQUENCY	RIGHT INTO LEFT dB	LEFT INTO RIGHT dB
100Hz	112.4	100.3
1kHz	103.3	98.0
10kHz	83.7	96.7
20kHz	78.9	-95.1

DISTORTION AT MAXIMUM OUTPUT LEVEL = 0dB

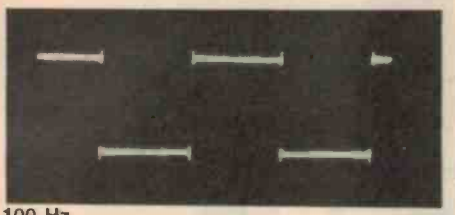
	100Hz	1kHz	10kHz	
2nd	-94.3	-95.7	-89.3	dB
3rd	-91.7	-104.6	out	dB
4th	-101.0	-102.1	of	dB
5th	-106.1	-110.8	Range	dB
T.H.D.	0.0034	0.0019	0.0034	%

AT INDICATED LEVELS FREQUENCY = 1kHz

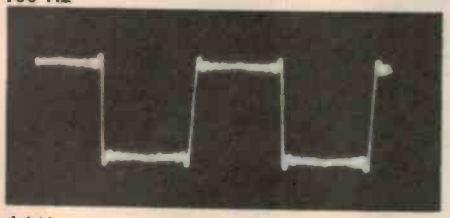
	Level = -10dB	Level = -20dB	Level = -60dB	Level = -80 dB	
2nd	-	-	-	-	dB
3rd	-86.3	-84.1	-33.2	-16.3	dB
4th	-	-75.9	-32.5	-20.1	dB
5th	-93.2	-81.9	-36.7	-27.5	dB
T.H.D.(%)	0.005	0.019	3.5	18.7	%
T.H.D.(dB)	-86.0	-74.4	-29.1	-14.6	dB

SIGNAL TO NOISE RATIO

Without Emphasis	88.0dB(Lin) 91.0dB(A)
With Emphasis	89dB(Lin) 102.0dB(A)



100 Hz



1 kHz

cover is finished in the now famous 'Marantz gold' and is well ventilated by means of a large area of perforated metal at its rear.

The rear panel of the unit incorporates two gold-plated coaxial signal sockets, two remote control sockets, a large heat sink, a fuse holder, voltage selector and a continental rather than an international mains power socket to accept a double insulated two-wire power lead.

The objective testing of this unit was performed using the Sony test disc YEDS 7 whose performance we have previously compared directly with the Philips test disc. (See ETI, September 1983). The measured frequency response of the Marantz CD player is essentially flat to 10 kHz, is only down by 1 dB at 16 kHz and by a miniscule 1.3 dB at 20 kHz.

The linearity proved to be perfect down to −60 dB, but over the range 60 dB to 90 dB exhibited the normal problems of slight imperfections in the digital-to-analogue conversion process. By way of example, at −80 dB the measured signal was 2.3 dB high while at −90 dB the signal was a quite perceptible 4.7 dB high.

The unweighted signal-to-noise ratio was 88 dB while the A weighted signal-to-noise ratio was 91 dB(A) without emphasis. With emphasis this figure improved to 102 db(A).

The channel separation was much better than the specification at all frequencies below 5 kHz in both channels and only exhibited slightly lower performance between 5 and 20 kHz for a signal separation from right to left channel.

The measured distortion at the maximum output level is substantially better than the manufacturer's claims at all frequencies. It only starts to become significant at −60 dB where it rises to 3.5% and at −80 dB where it rises to a very measurable, but generally inaudible, 18.7%. The measured emphasis characteristics are quite acceptable and well within specification.

The square wave response test displays an unusual ripple; this is a function of the type of demodulation filter that Marantz has chosen which they selected in conjunction with the Philips research laboratories. The characteristics of this filter are different from everybody elses and result in a different measurement and audible characteristic to the other units now available.

We tried to measure the wow and flutter with a new test disc we had acquired specifically for this purpose. This test disc has an offset centre hole and we found that we could not measure the wow and flutter; this machine would accept the disc and play it when the majority of other machines refused.

Taken overall, the Marantz CD-73 provides exemplary performance over most of the range. It only shows moderately high distortion characteristics at the very bottom end of its dynamic range.

Philips CD 303

The Philips CD 303 compact disc player is very different from the Philips CD players that I have been used to seeing at my local record shop. The record shop's player is a top-loading unit which I believe is currently the cheapest machine in the Philips' range and is probably the least expensive available in Australia at the moment.

The CD 303 has a number of significant similarities in both appearance and performance to the Marantz CD-73. The reasons for this are not hard to find as many of the technical components and design philosophies are common; I suspect the two machines may have even come out of the same factory in Belgium.

The CD 303 also features a disc 'open/close' and an illuminated 'power on/off' switch on the left-hand side of the brushed satin, aluminium front panel. Like the Marantz machine, the disc-loading tray slides out and the overlying clear cover lifts up to facilitate the loading of your disc.

The front of the disc compartment features a 15-segment display module indicating the number of tracks on the disc. Below this are the associated rectangular LEDs required for the automatic multi-mode programmable selection facility. These work in a very similar manner to those of the Marantz machine, although the machines have many other significant visual differences in both facilities and layout of the front panel controls.

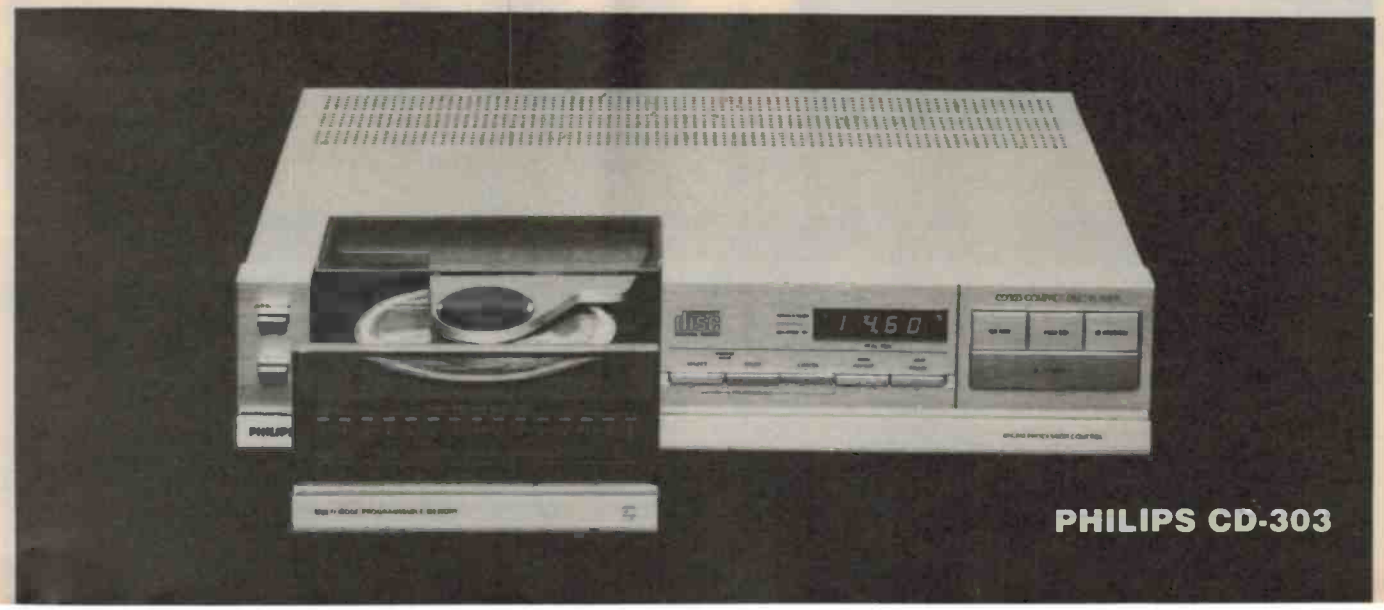
The four main controls on this machine are all grouped on the right-hand side of the panel; 'play/next' (track) is a triple width touch bar and above it are three smaller controls for 'reverse', 'fast-forward' and 'stop/clear memory'.

In the centre of the escutcheon are five controls for 'programme selection', 'storage' and 'cancelling', 'repeat' and 'pause' which are supplemented by LEDs.

Immediately above these controls is an illuminated display which provides data on both absolute (total) playing time and relative playing time (for that track) in minutes and seconds. This feature is controlled by a small switch on the side of the display which took me a while to find and was not described in the handbook.

The top of the cabinet features a strong, steel cover with a large, clear transparent area overlying the CD playing section. An area of perforated metal towards the back allows for ventilation.

The rear of the unit is even simpler than the Marantz machine featuring, much to my surprise, a permanently wired pair of signal ▶



MEASURED PERFORMANCE OF PHILIPS CD 303 Serial No. 000782

FREQUENCY RESPONSE

FREQUENCY	OUTPUT LEVEL dB
1.0kHz	0.0
20Hz	-0.2
40Hz	-0.2
100Hz	0.0
200Hz	0.0
500Hz	0.0
1.0kHz	0.0
5.0kHz	-0.3
10.0kHz	-0.8
16.0kHz	-1.1
20.0kHz	-1.2

LINEARITY

RECORDED LEVEL dB	OUTPUT LEVEL dB
0.0	0.0
-1.0	-1.0
-3.0	-3.0
-6.0	-6.0
-10.0	-10.0
-20.0	-20.0
-60.0	-59.9
-80.0	-78.2
-90.0	-86.0

EMPHASIS

Frequency	Recorded Level	Output Level (Left)		Output Level (Right)	
1kHz	-0.37dB	-0.3	dB	-0.3	dB
5kHz	-4.53dB	-5.0	dB	-4.9	dB
16kHz	-9.04dB	-10.2	dB	-10.2	dB

CHANNEL SEPARATION

FREQUENCY	RIGHT INTO LEFT dB	LEFT INTO RIGHT dB
100Hz	108.2	107.5
1kHz	102.6	98.7
10kHz	-83.0	-95.3
20kHz	-78.5	91.7

DISTORTION AT MAXIMUM OUTPUT LEVEL = 0dB

	100Hz	1kHz	10kHz	
2nd	-99.2	-96.2	-92.0	dB
3rd	-90.0	-104.3	out	dB
4th	-103.6	-108.9	of	dB
5th	-105.7	-105.7	Range	dB
T.H.D.	0.0034	0.0018	0.0025	%

AT INDICATED LEVELS FREQUENCY = 1kHz

	Level = - 10dB	Level = -20dB	Level = -60dB	Level = 180 dB	
2nd	-	-	-	-	dB
3rd	-101.1	-93.6	-33.4	-17.5	dB
4th	-105.0	-	-32.7	-20.7	dB
5th	-96.2	-97.2	-35.6	-29.3	dB
T.H.D.(%)	0.0019	0.0025	3.6	16.5	%
T.H.D.(dB)	-94.4	-92.0	-28.9	-15.7	dB

SIGNAL TO NOISE RATIO

Without Emphasis	93.0dB(Lin) 104.0dB(A)
With Emphasis	94.0dB(Lin) 105.0dB(A)

leads terminated in coaxial sockets (not gold plated) and a double insulated mains lead from the other side of the panel. The unit is wired for 240 volts with no fuse visible and no facilities for changing the voltage.

The objective testing of this unit was simple and straight forward. The fequency response was essentially flat to 10 kHz, 1.1 dB down at 16 kHz and only 1.2 dB down at 20 kHz. The linearity was essentially flat to −60 dB, only 1.8 dB high at −80 dB and 4 dB high at −90 dB.

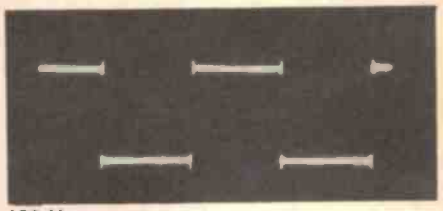
The unweighted signal-to-noise ratio is excellent; 93 dB and 104 dB(A) without emphasis and providing 1 dB better performance with emphasis. The channel separation is better than the specification at all frequencies, with the exception of the right to left channel between 5 kHz and 20 kHz where it measurably drops but is still completely adequate.

The distortion characteristics at maximum signal level are significantly better than the specification being only 0.0018% at 1 kHz and only 0.0034% at 100 kHz. These distortion figures remain essentially the same over the first 30 dB of the signal range, rising to 3.6% at −60 dB and 16.5% at −80 dB.

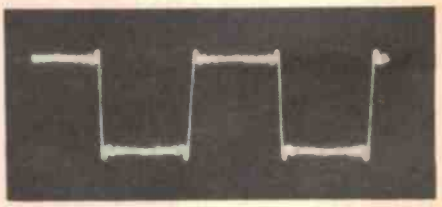
The low level distortion figures from the Marantz and Philips disc players, it should be noted, are amongst the best that we have seen and are a result of the type of digital-to-analogue converter which is associated with the particular design philsophy of these two units.

The measured emphasis characteristics are also well within the specification and the wow and flutter was just not measurable. The overall performance of the Philips CD 303 is remarkably similar to the Marantz CD-73 and I suspect that they may use similar circuitry and possibly a number of common components as well.

While the performance is excellent it is, however, not quite as esoteric as some of the other CD players that we have reviewed.



100 Hz



1 kHz

Technics SL-P8

The Technics SL-P8 compact disc player is the first, not the eighth, model released by Technics. The first thing I noticed about this particular player, when compared with the other two players, was how much lighter it is when it is picked up.

The differences do not end there, however, as this machine has many other visual and technical differences when compared with some of the other machines that I have previously reviewed.

The front of the SL-P8 has a somewhat 'busier' appearance than the other two players. The front panel is divided into four separate areas. At the extreme left-hand side is the 'power on/off' switch and below is a volume control for the tip-ring-sleeve socket provided for a pair of 8 ohm headphones.

Immediately to the right of this is the slide-out tray for loading the compact disc. This operates in a very similar manner to that of the Sony units but looks very different. The tray opens by pressing the 'open/close' switch but will also close by pressing the 'play' button.

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The lowest two controls are a foward and reverse "skip" button which allow you to move backwards and forwards by one complete track.

At the top centre of the panel is an illuminated, fluorescent display which provides a bar-graph type of indication as to how many tracks are on the disc up to a maximum of 20. This also provides an indication as to which track is selected or is playing (by means of a flashing bar), the track number and either the index time data relating to the track being played or the total playing time available or that has elapsed.

The secondary controls located below include the 'music scan' button which allows you to listen sequentially to the first 10 seconds of each track on the disc, and 10 numeral key buttons by which you can enter the track selection number up to 34 and the associated sequence in which you want those tracks.

Other controls include the 'memory' activate button, the 'index' button to select index data, the 'time' button that tells you the remaining time on the disc, the 'clear' button which clears the memory when you make a mistake and the 'repeat' button which allows you to repeat either a selected sequence or replay the whole disc.

Adjacent to the digital display is a sensor window which receives the infrared signal from a remote control unit which was not supplied with the unit we received. At the bottom left-hand corner of the control panel is a three-position switch for 'auto-pause' which causes the disc player to pause automatically at the commencement of each track, even when no pause is incorporated on the disc. One of the imported discs that we have has no pauses between tracks and consequently this facility now has more meaning.

An associated control setting includes 'time play' which allows the unit to be controlled by an external programmable timer. The most unusual control is the pitch control, a new feature that none of the previous reviewed CD players incorporated. This provides a +5.3% to −3.5% speed range adjustment, enabling you to set the speed of your music and also the pitch of that music.

The top of the cabinet, like those of the other two units, is strongly made of steel and also features a large area of perforated metal to assist ventilation at the rear. The rear panel provides a pair of coaxial sockets, a synchronising timing socket and an external equipment control socket so that the unit may be inter-connected with existing or future components in a music centre. The unit is double insulated and provides two switch-voltage setting positions.

The frequency response of this unit is very similar to the other two units, being almost flat to 5 kHz, dropping to 0.7 dB at 10 kHz and being only 1 dB down at 16 kHz and 20 kHz. The digital-to-analogue conversion linearity of this particular CD player is extremely good exhibiting an effectively flat linearity to −60 dB, only 0.2 dB low at −80 dB and 1.3 dB high at −90 dB. *These are the best linearity figures we have yet seen from any CD player.*

The signal-to-noise performance of this CD player is also really excellent with an unweighted signal-to-noise ratio of 107 dB and the A-weighted figure is 117 dB(A), both with and without emphasis.

The channel separation on both left and right channels is better than 90 dB for signals up to 1 kHz, but both channels exhibit substantially less separation for signals above 10 kHz. The 20 kHz separation for left channel into right channel is only 66.3 dB which is the lowest channel separation figure for any CD player that we have yet seen.

The measured distortion at 0 dB (maximum output level) is excellent and the high ▶

MEASURED PERFORMANCE OF TECHNICS SL-P8 Serial No. 390TL022

FREQUENCY RESPONSE

FREQUENCY	OUTPUT LEVEL dB
1.0kHz	0.0
20Hz	-0.2
40Hz	-0.3
100Hz	0.0
200Hz	0.0
500Hz	0.0
1.0kHz	0.0
5.0kHz	-0.2
10.0kHz	-0.7
16.0kHz	-1.0
20.0kHz	-1.0

LINEARITY

RECORDED LEVEL dB	OUTPUT LEVEL dB
0.0	0.0
-1.0	-1.0
-3.0	-3.0
-6.0	-6.0
-10.0	-10.0
-20.0	-20.0
-60.0	-60.0
-80.0	-79.8
-90.0	-91.3

EMPHASIS

Frequency	Recorded Level	Output Level (Left)		Output Level (Right)	
1kHz	-0.37dB	-0.2	dB	-0.2	dB
5kHz	-4.53dB	-4.6	dB	-4.5	dB
16kHz	-9.04dB	-10.0	dB	-9.7	dB

PITCH CONTROL -3.5% to + 5.3%

CHANNEL SEPARATION

FREQUENCY	RIGHT INTO LEFT dB	LEFT INTO RIGHT dB
100Hz	97.2	91.1
1kHz	96.5	92.4
10kHz	82.3	82.2
20kHz	77.9	66.3

DISTORTION AT MAXIMUM OUTPUT LEVEL = 0dB

	100Hz	1kHz	10kHz	
2nd	-98.2	-95.7	-91.5	dB
3rd	-89.3	-106.3	out	dB
4th	-101.4	-106.1	of	dB
5th	-109.1	-108.4	Range	dB
T.H.D.	0.0037	0.0018	0.0027	%

AT INDICATED LEVELS FREQUENCY = 1kHz

	Level = - 10dB	Level = -20dB	Level = -60dB	Level = -80 dB	
2nd	-	-	-	-	dB
3rd	-100.6	-92.3	-44.3	-32.5	dB
4th	-104.2	-	-	-	dB
5th	-97.1	-96.1	-	-26.2	dB
T.H.D.(%)	0.0019	0.0029	0.61	5.4	%
T.H.D.(dB)	-94.4	-90.8	-44.3	-25.4	dB

SIGNAL TO NOISE RATIO

Without Emphasis	107dB(Lin) 117dB(A)
With Emphasis	107dB(Lin) 117dB(A)

Technics SL-P8

The Technics SL-P8 compact disc player is the first, not the eighth, model released by Technics. The first thing I noticed about this particular player, when compared with the other two players, was how much lighter it is when it is picked up.

The differences do not end there, however, as this machine has many other visual and technical differences when compared with some of the other machines that I have previously reviewed.

The front of the SL-P8 has a somewhat 'busier' appearance than the other two players. The front panel is divided into four separate areas. At the extreme left-hand side is the 'power on/off' switch and below is a volume control for the tip-ring-sleeve socket provided for a pair of 8 ohm headphones.

Immediately to the right of this is the slide-out tray for loading the compact disc. This operates in a very similar manner to that of the Sony units but looks very different. The tray opens by pressing the 'open/close' switch but will also close by pressing the 'play' button.

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The frequency response of this unit is very similar to the other two units, being almost flat to 5 kHz, dropping to 0.7 dB at 10 kHz and being only 1 dB down at 16 kHz and 20 kHz. The digital-to-analogue conversion linearity of this particular CD player is extremely good exhibiting an effectively flat linearity to −60 dB, only 0.2 dB low at −80 dB and 1.3 dB high at −90 dB. *These are the best linearity figures we have yet seen from any CD player.*

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1.0kHz	0.0
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40Hz	-0.3
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1.0kHz	0.0
5.0kHz	-0.2
10.0kHz	-0.7
16.0kHz	-1.0
20.0kHz	-1.0

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-1.0	-1.0
-3.0	-3.0
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-10.0	-10.0
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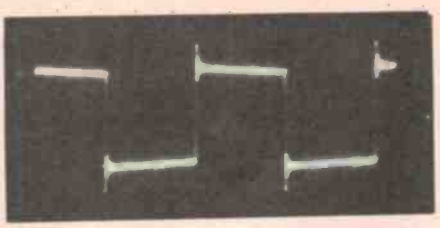
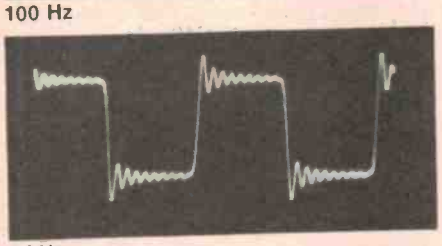


100 Hz



1 kHz

level figures are generally comparable with the other two machines. These figures do not significantly deteriorate till −60 dB where the distortion is still only 0.61%, while at −80 dB it is only 5.4%.

The measured emphasis characteristics are reasonably close to the theoretical performance. Taken overall, the objective performance of the SL-P8 CD player is excellent and it offers unusually good linearity and low distortion and an unusually wide dynamic range.

Subjectively

The subjective evaluation of these three machines was a real pleasure as I was provided with two copies of the same disc and, more importantly, the same music but from a different recording company. (By playing the two copies on two out of the three CD players in parallel I was able to listen to the differences between any two machines while the same program content was repeated sequentially on each of these machines.)

One of the two copies of Gustav Holst's 'The Planets' is conducted by Herbert von Karajan with the Berlin Philharmonic Orchestra (Deutsche Grammophon 400 028-2). By playing the same music with Lorin Maazel conducting the French National Orchestra (on Sony-CBS disc 38DC 12) I was able to compare the differences in orchestration, production and recording quality of two of the largest current recording companies (and most probably the largest future CD producers).

These records were supplemented by a series of equally superb classic and pop discs from other sources. These included Dvorjak's '9th Symphony' (The New World) with Lorin Maazel conducting the Vienna Philharmonic Orchestra (Deutsche Gramaphone 410 032-2), Elton John's 'Too Low For Zero' (Rocket 811 052-2) and 'Charlie' (Polydor 813662-2).

Unlike many of the other CD discs and conventional records that you may have heard, these discs were all digitally recorded to provide base material with dynamic ranges matching the capabilities of the medium. In particular, 'The Planets', Elton John and Dvorjak's 'The New World Symphony' would be regarded as 'AA' classification records for both content and recording quality, but they have been conventional microgroove discs. Even as CD discs they must rank amongst the better or best of those currently available, in terms of recording quality and their overall technical attributes.

Elton John's performance on 'Too Low for Zero' would be unquestionably one of the best renditions of his work that I, or any of my family, have yet heard. This disc provides superb material and another, by virtue of the quality of the voice material. 'Charlie' contains some of the newest and best synthesised music I have yet heard and provides electronic percussive material to 'tickle the fancy' of any digital-to-analogue convertor, quite apart from the filter networks that follow.

The listening task was pleasant although arduous. The assessment of the audible differences between the three machines was a different matter. The big question, of course, was what differences were there and were they audible? Having already written something on the subject myself and having read a great deal more by other reviewers, I experienced increasing trepidation as I proceeded with this difficult task.

The first and most significant different that I perceived was that at normal listening and recording levels (i.e: in the range 0 dB to −50 dB) I was unable to detect any substantial difference on either speech or normal high level classical music. At lower levels in the range of −50 dB to −80 dB, and particularly on transient material on the 'Charlie' disc, I was able to detect and even on occasions pinpoint audible differences between the machines.

A number of reviewers have presented statements on the superiority of the Philips CD disc player, stating strong preferences for this machine when compared to others that they have reviewed. I must acknowledge that I was able to detect, and on occasions readily hear, differences between the Technics machine and this machine which is a very similar unit to the Marantz player.

Unlike the English and one American reviewer (who were comparing a different Philips machine with a different comparison machine), I found that the Technics player had a slightly cleaner response. I believe that it had a slightly purer sound than that provided by the Philips and Marantz players at very low levels.

The only explanation that I can give for this relates to the replay linearity of the digital-to-analogue decoder in the Technics player; I suspect that this is coupled with the lower distortion that this unit exhibits. Taken overall, and on a far more objective level, the three machines produced superlative sound that I fear you would be hard pressed to fault even with an arduous A-B testing sequence of the type I used.

The only major difference between these machines relates to their individual functional and ergonomic controls, their supplementary controls (like the availability of an optional remote control which I would recommend) and their individual prices. It is still clear that in terms of value for money the lowest price players still have an edge over the highest price players in the cost-conscious market place.

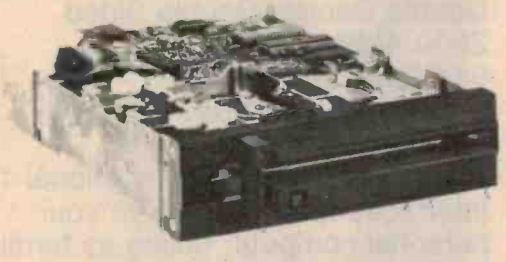
With a recommended retail price of only $899 the Marantz player has an awful lot going for it and undoubtedly offers the best value for money for an intending purchaser.

By contrast, with such unusual features as pitch control, full infrared remote control (presumed at extra cost), music scan and 34 sequence programmable sequence control, the Technics machine technically has a great deal going for it. The Philips CD 303 happens to have attributes lying in between these two options as it neither offers the option of being able to add the remote control to it, nor does it offer anything extra by way of smart appearance or cost advantage.

In the end, I doubt if you will buy a player on the basis of this review. However, if you do you are certain to get the best value for your money and if technical performance is the 'name of your game', then the best technical performance as well. ●

It has been claimed that compact discs are indestructible.
However, it has been proved that if they are mishandled, the sound quality will deteriorate.

TANDON DISK DRIVES



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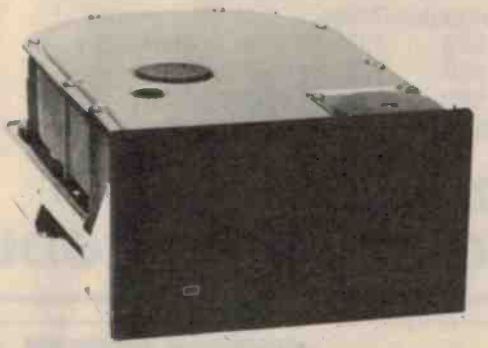
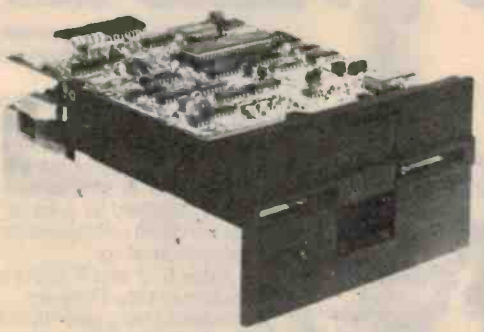
Tandon's low cost 5¼" rigid disk drive features an on-board microprocessor which calculates the optimum positioning algorithm, yielding an Average Access Time of 110 milliseconds. This product family includes 1, 2, and 3 platter models with unformatted capacities of 6.4, 12.8, and 19.1 megabytes, respectively.

Up to four Tandom TM500's can be daisy-chained on a single bus, which provides a capability of up to 76 megabytes of on-line storage (unformatted) in a single system.

These drives are compatable with controllers that use an industry standard interface (ST 506).





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Model TM-100
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Tandon's TM-100 family of mini-floppies offer the absolute highest storage capabilities of any 5¼" high-speed, random access disk drive available in two single head and two double head models, all double density.
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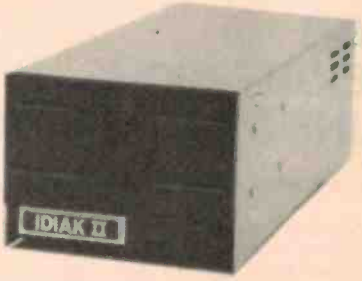

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COURT DECISION PROMPTS SOFTWARE LEGISLATION

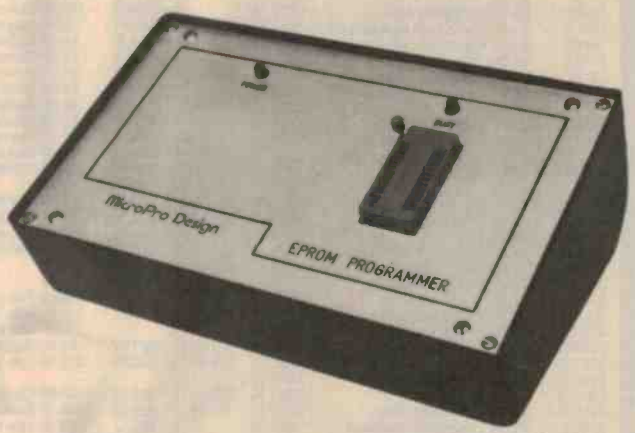
Following the shock decision by the Federal Court whereby Apple lost its software piracy case against Computer Edge, the Australian software industry will seek talks with the Attorney-General's Department as soon as possible.

The Australian Computer Society's software industry committee and the Australian Software Houses Association both welcomed the decision, believing it will clarify the situation.

The ACS-SIC national chairman, Karl Reed will ask the Attorney-General's Department to set up a working party of legal experts and industry representatives to study legal proposals for the drafting of software protection legislation, which the industry sees as an urgent requirement.

ASHA president, Ian Dennis accused the Attorney-General's Department of waiting for other countries to act first. Japan proposes to introduce legislation next year on software protection.

In Australia, legal protection of original material is covered by different Acts and administered by different government departments: the Copyright Act is administered by the Attorney-General's Department and patent trademark, and industrial design legislation is administered by the Department of Science and Technology. Neither the ACS or the ASHA want the Copyright Act as the only means of software protection.



EPROM PROGRAMMER

MicroPro Design has announced the availability of three new versions of their EPROM programmer which have been designed for use with the Osborne 1, Apple II and VIC-20 microcomputers.

These units retain all the features of the original design used with the Commodore CBM style computers, including the ability to read and program all currently available 24 pin EPROMs.

The EPROM programmers are simple yet versatile devices, operating under the control of a program executed in the host computer. Commands are entered in response to menus presented on the screen of the computer. The commands allow simple operations such as READ, PROGRAM, VERIFY or ERASE CHECKING to be performed easily.

The programmers are available through microcomputer retailers throughout Australia, or directly from MicroPro Design, **P.O. Box 153, North Sydney NSW 2060. (02)438-1055.**

DRUM PLOTTERS BOOM?

Anderson Digital Equipment (ADE) has announced the availability in Australia of two of the major Houston Instrument drum plotters, the CPS-19 and the recently-released DMP-40.

A single-pen drum plotter, the DMP-40 features pen speeds of up to 4.2 ips and a format size of up to 11" x 17" (279.4 mm x 431.8 mm) and is ideally suited to a laboratory environment.

The DMP-40 can automatically generate circles, arcs, ellipses and general curves on command. Five different character sets are resident in ROM, which may be presented normally, or as italics, and at 225 possible sizes and 360 different degrees of rotation.

For further information, contact **ADE, 14 Whiteside Road, Clayton Vic. 3168. (03)544-3444.**

DISK DRIVE

A disk drive system that will enable Apple II personal computers to run software programs based on the widely used MS-DOS operating system has been announced by Rana systems and Apple Computer.

The Rana 80862/2 is a plug-compatible co-processor and dual disk drive system for Apple II Computers. The product uses an 8086 microprocessor, with a double-sided drive providing 360K of storage per drive. The co-processor portion will provide 256K of main memory expandable to 512K.

For further information contact **Burson-Marstellar, 19th Floor, 1 York St, Sydney NSW. (02)241-3016.**

SOURCEWARE TO SOURCE IBM ADD-ONS

Sourceware has been appointed the Australian distributor for AST Research, one of the leading US suppliers of add-on products for the IBM Personal Computer.

AST Research produces more than 20 hardware and software accessories for the IBM PC in three categories — communication products, multifunction memory cards, and system enhancements.

AST products were voted first in two categories in a contest conducted by the US magazine PC World among its readers and reported in the September issue. The "Super Drive" was voted the most popular disk emulation program and "Combo Plus (256K)" the most popular combination memory board.

Based in Irvine, California, the company markets products worldwide through more than 700 distributors and dealers and has achieved sales of more than $2 million a month.

Sourceware's Managing Director Mr Doug Ruttan said AST had focussed its product line on the office and business automation usage of the PC with emphasis on mainframe communications and local area networking.

Several products have enabled many installations to communicate between mainframes and personal computers, and file serving, electronic mail and disk sharing was now possible with AST's networking.

For further information, contact **Sourceware, 4/73 Albert Avenue, Chatswood NSW 2067. (02)411-5711.**

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25 OR MORE KITS.

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Board No	PCB Price	Description		Kit price
EA6800	$15.50	6800 Micro computer		$119.00
EA6802	$15.50	6802 Micro computer		$119.00
		Power supply to suit		$35.00
		Hex keypad 19 keys		$39.50
75L11	$2.50			
78UP10	$9.50	2650 extra ram	OCT 78	
79FE11	$3.50	Photo flash exposure mtr.	NOV 79	$24.50
79PC9	$3.90	Pulse generator	SEP 79	
79SE3	$4.90	Train model sound	MAR 79	
79TI11	$3.90	Transistor assisted ign.	NOV 79	$34.50
79PS11	$2.90	Experimenters power sup.	NOV 79	
79PC12	$2.90	Fan speed control	DEC 79	
79SF10	$2.50	Photo slave flash	OCT 79	
79SF9	$2.90	Photo sound trigger	SEP 79	
79UPS6	$3.90	Universal power supply	JUN 79	$34.50
80ST10A	$3.90	Stylus timer	OCT 80	
80ST10B	$3.50		OCT 80	
80TC12	$3.90	Bipolar train controller	DEC 80	$34.50
80CM3A	$4.90	Digital capacitance mtr.	MAR 80	$49.50
80CM3B	$3.90		MAR 80	
80PG6	$7.90	TV pattern generator	JUN 80	$67.50
80TV8	$4.50	TV CRO adapter inc. p/pack	AUG 80	$39.90
80F3	$3.20	Audio prescaler	MAR 80	
80PP3	$2.50		MAR 80	
80LL7	$3.90	Leds & ladders	JUL 80	$19.50
80B7	$2.50	Beat frequency oscillator	JUL 80	
80BM10	$3.90	Car battery monitor	OCT 80	$11.50
80DC10	$6.50	Digital storage CRO ad.	NOV 80	$89.90
80HLA5	$2.90	Car headlight alarm	MAY 80	
80LS12	$3.50	Selectalott	DEC 80	$22.00
80LBR12	$2.90	Light beam relay	NOV 80	$13.00
80PC4	$2.90	Power heat controller	APR 80	
80PC7	$3.50	Power saver induc mtr	JUL 80	
80G6	$5.90	Musical tone gen.	JUN 80	
80GPS3	$2.90	Voltage regulator multi	MAR 80	
80AU3	$3.50	Hifi auto turn off	MAR 80	
80AW4	$4.50	Receiver all wave	APR 80	
80TM8A	$6.90	Digital engine analyser	AUG 80	$49.50
80TM8B	$2.90		AUG 80	
80PP7A	$8.50	Eprom programmer	JUL 80	$79.50
80PP7B	$3.90		JUL 80	
80RF5	$2.90	Rumble filter	MAY 80	
80SA3	$5.90	Playmaster stereo amp.	MAR 80	
80CH7	$8.50	240V ac light chaser	JUL 80	
80RAM12	$5.90	Ram expansion for dream	DEC 80	$39.00
80PA6	$7.50	Playmaster 300W amp module		$63.00
			JUN 80	
80CL4	$3.50	Timer controller	APR 80	
80TRS11	$2.90	TRS 80 printer serial in.	NOV 80	$17.50
80SA10	$9.90	Playmaster mosfet stereo amp.		
			JAN 81	
80AD12	$3.00	Autodim light dimmer	JAN 81	$32.00
80RM12	$3.90	Cylon voice simulator	JAN 81	$19.95
80FB12	$3.90	Guitar fuzz box	FEB 81	$19.90
81SW1	$3.90	Osc. switch dual trace	FEB 81	$60.00
81SP1	$2.90	TRS 80/SYS 80Serial interf.	FEB 81	
81GA3	$11.50	Color graphic analyser	MAR 81	$109.00
80GA12	$6.50	25W guitar amplifier	MAR 81	
81DC2	$3.50	Le Gong doorbell	MAR 81	$14.95
81DC3B	$8.50	Digital and	MAR 81	$189.00
81DC3A	$9.50	Analogue storage CRO	MAR 81	
81IR4	$4.50	Infra-red relay receiver	APR 81	$39.00
81RC4C	$2.90	Infra-red relay transmitter	APR 81	
81HB4A	$7.50	Heart rate monitor	APR 81	$82.00
81HB4B	$3.50		APR 81	
81MA4	$4.50	Touch sensitive alarm	APR 81	
81VM2	$2.90	High impedance DC voltmeter		
			APR 81	
81SI3	$7.90	TRS 80/SYS serial interf.	APR 81	
81RC4A	$4.90	2 channel (receiver)	MAY 81	$72.00
81RC4B	$2.50	Infra-red remote (preamp)	MAY 81	
81RC4C	$2.75	Control (transmitter)	MAY 81	
81SP5	$2.90	Sound pressure meter	MAY 81	$37.00
81CC5	$2.90	PC birdies	MAY 81	$14.50
81SS4	$4.90	Speed sentry	MAY 81	
81DT5	$3.00	Dream tape controller	MAY 81	
81MP6	$3.90	Microprocessor power supply		
			MAY 81	
81AO6	$4.90	Audio oscillator	JUN 81	$59.00

Board No	PCB Price	Description		Kit price
81UA6		Benchmate power supply	JUN 81	
81MC7	$2.90	Moving coil preamp	JUL 81	
81OR7	$9.50	Electrochume (electr. organ)	JUL 81	$59.00
81P6	$2.90	Pools/lotto selector	JUL 81	$22.50
81SW7	$4.90	Electronic steam whistle	JUL 81	$17.50
81MC8	$10.90	Musicolor IV	AUG 81	$84.00
81SM7	$3.90	Bagatelle	AUG 81	
81CL9	$4.00	Digital clock/thermometer	SEP 81	$80.00
81GA9	$4.90	Photon torpedo game	SEP 81	$24.50
81UC8	$4.50	Universal timer & stpwatch	SEP 81	
81WS10	$4.90	Wind universal indicator	OCT 81	$52.50
81AO10	$3.50	Audio test unit cass. deck	OCT 81	$47.50
81SS11	$8.90	Slide cross fader	NOV 81	$99.50
81SG9	$4.20	Led sandglass	NOV 81	$22.50
81AU11	$3.90	Audible turn indicator	NOV 81	
81FM10A	$5.90	500MHZ digital freq. mtr.	DEC 81	$135.00
81FM10B	$3.90		DEC 81	
81CH12	$3.50	Christmas decoration	DEC 81	
81LD12	$4.50	Led bar graph display	DEC 81	
81MI11	$3.90	Metronome (low current)	JAN 82	
81WD12A	$3.50	Wind direction indicator	JAN 82	$24.50
81WD12B	$3.50		JAN 82	
81P19	$6.90			
82EP1	$12.50	Free standing eprom prog with '24 pin' textool socket and AC plugpack	JAN 82	$45.00 $55.00 $69.50
82TH2	$3.90	Digital thermometer	FEB 82	$79.00
82CR1	$13.50	Lge. scrn. storage CRO Adapt	FEB 82	$119.00
82EG2	$3.90	Cudlip	FEB 82	$12.95
82PS2	$4.90	Dual tracking power supply	MAR 82	$87.50
82LF2	$3.90	Low fuel indicator	MAR 82	$16.50
82CM3	$3.90	LCD capacitance meter	MAR 82	$79.00
82AO3A	$7.90	Function generator	APR 82	$79.50
82AO3B	$3.90		APR 82	
82VC3	$3.50	Voice canceller	APR 82	$22.50
82VX4	$3.50	Vox	APR 82	$15.00
82VS10				
82PT4	$3.90	Photographic timer	APR 82	$48.00
82IV5	$5.40	12-240V inverter 40 watt	MAY 82	$49.50
82P5	$5.90	Universal preamp MM/MC	MAY 82	$35.00
82TO5	$3.90	Tacho/dwell meter	MAY 82	$72.50
82TS3	$3.90	Low cost touch switch	MAY 82	$12.00
82GA5	$9.90	Guitar booster	JUN 82	$17.50
82EM6A	$4.90	Theremin	JUN 82	$34.50
82EM6B	$3.90			
82IV6	$8.90	12-240V inverter 300 watt Power monitor	JUN 82 JUL 82	$195.00 $18.00
82HB6	$3.90	LDC heart rate monitor	JUL 82	$79.00
82CC7A	$15.50	Car computer	JUL 82	$109.00
82CC7B	$4.00	Car computer	to SEP 82	
82DP6	$4.90	Decimal point for D.G. meter	JUL 82	$70.00
82PA7	$9.50	Sub woofer amp	JUL 82	$85.00
82UR8	$4.90	Ultrasonic rule	AUG 82	$49.00
82MS8	$6.50	Stereo synthesizer	SEP 82	$55.00
82EF9	$4.90	Electric fence	SEP 82	$19.50
82PC8	$2.00	Fluorescent starter	OCT 82	$5.00
82FC8A	$6.50	Digital readout	OCT 82	$72.00
82FC8B	$3.90	For short wave	OCT 82	
82FC8C	$2.50	Receivers	OCT 82	
82TA10	$3.90	Freezer alarm	OCT 82	$21.00
82VS10	$7.90	Speech Synthesizer	OCT 82	
82PC10	$3.90	Power up	NOV 82	$36.00
82AL11	$3.90	Super siren	NOV 82	$23.50
82PC11	$3.90	Driveway sentry	DEC 82	$32.00
82QR12A	$9.95	Playmaster AM tuner	DEC 82	$239.00
82QR12B	$9.95		DEC 82	
82PH12	$4.90	Digital PH meter	DEC 82	$135.00
82EG12	$2.90	Boggle goggles (short form)	DEC 82	$9.60
82FD5	$4.90			
82DP6	$3.90			
83TV1A	$4.90	Remote infrared TV	JAN 83	$39.50
83TV1B	$2.90	Sound control	JAN 83	
83TV1C	$2.90		JAN 83	
83PS1	$3.90	Plugpack regulator with plugpack	JAN 83	$14.00 $29.50
83EG1	$3.50	Led head light chaser	JAN 83	$12.00
82WB1	$2.90	Wheatstone bridge	FEB 83	$45.00
82AO2	$2.90	AM tuner alignment kit Moisture alarm	FEB 83 FEB 83	$8.00

Board No	PCB Price	Description		Kit price
79TI11	$3.90	Trans.ass. ignition updated	FEB 83	$34.50
83FC2		Fuel consumption meter	MAR 83	$50.00
83BP3	$3.90	Brown out protector	MAR 83	$25.00
83MS4	$3.90	Stereo simulator PCB version	APR 83	$12.00
		Self contained unit	AUG 83	$20.00
83PC3A	$3.90	Touch lamp dimmer	APR 83	$20.00
83PC3B	$3.50	Touch lamp timer	AUG 83	$21.00
83PS5	$4.90			
83SC7	$3.90	LCD event counter	JUL 83	$32.00
83SC8	$3.50	2MHZ digital freq. meter	AUG 83	$60.00
83VA8	$5.90	Video amplifier	AUG 83	$15.00
83EG5	$4.90	Electronic roulette wheel Electronic breath tester	MAY 83 MAY 83	$24.00 $25.00
83PS5	$5.90	50V/5A power supply	JUNE 83	$140.00
83GA6	$7.90	Effects unit	JUNE 83	$75.00
83PP5	$5.90	Overload indicator	JUNE 83	$20.00
83PS7	$3.50	±12V for lab power supply	JULY 83	$13.00
83AL6	$2.90	Fridge door alarm	JULY 83	$9.00
83MS4	$3.90	Compumuse	AUG 83	$20.00
83WM8	$6.95	Electronic watt meter	SEPT 83	$65.00
83TT8	$3.95	Transistor tester	SEPT 83	$15.00
83MS8	$4.90	Soil heating unit	SEPT 83	$70.00
83VE10	$4.90	Video enhancer	OCT 83	$35.00
83MD9	$3.50	Nail finder	OCT 83	$10.00
83SS9	$3.90	Speed sentry	OCT 83	$11.00
ET014	$4.90	Dual voltage power supply	DEC 71	
ET043	$2.50	Heads or tails	OCT 76	$3.90
ET044	$2.50	Two tone doorbell	OCT 76	$4.90
ET047	$2.50	Morse practice set	DEC 76	$3.90
ET048	$2.50	Buzz boards	DEC 76	$4.50
ET061	$2.50	Simple audio amp	OCT 76	$5.90
ET062	$2.90	Simple AM tuner	MAR 77	$6.90
ET063	$2.90	Electronic bongos	NOV 79	$5.90
ET064	$2.50	Simple intercom	OCT 83	
ET065	$2.90	Electronic siren	DEC 79	$5.90
ET066	$2.50	Temp alarm	DEC 79	$5.50
ET067	$2.90	Singin moisture		$7.95
ET068	$2.90	Led dice	OCT 76	$6.90
ET071	$2.50	Tape noise limiter	JUN 79	
ET072	$2.50	Two octave organ	JUN 78	$9.50
ET081	$2.90	Tachometer	OCT 83	
ET083	$2.50	Train controller	DEC 79	
ET084	$2.90	Car alarm	JAN 77	$13.50
ET085	$2.50	Car over rev. alarm	OCT 79	
ET130	$2.50	Temp/volts converter	FEB 76	
ET132	$3.90	Experimenters power supply	FEB 77	
ET134	$2.90	R.M.S. voltmeter	AUG 77	
ET135	$3.50	Digital panel meter	OCT 77	
ET136	$2.90	Linear scale cap. meter	MAR 78	
ET137A	$4.90	Frequency meter LCD	MAY 78	
ET137B	$3.90	Audio oscillator	MAY 78	
ET139	$2.50	Power meter	MAY 78	
ET147	$4.90	Electronic dummy load	OCT 80	$99.00
ET149	$3.50	Two tone generator	JUL 80	$34.90
ET152	$2.90	Capacitance meter	FEB 80	
ET153	$3.50	Temperature adaptor	MAY 83	$19.95
ET157	$4.90	Crystal marker	OCT 81	$37.50
ET158	$3.50	Low Ohms meter	NOV 81	$36.50
ET159	$2.90	10-15V exp. scale voltmeter 13.8V 10 amp power supply	DEC 81 JUL 82	$26.50
ET160	$4.90	Evaluation meter		
ET161	$4.50	0-30V var. power supply	DEC 82	$47.50
ET162	$6.50	0-40V/5A alb power supply	MAY 83	$169.00
ET163	$8.00	Zener diode tester	MAY 83	$9.00
ET164		Frequency counter	AUG 83	$16.00
ET166	$4.90			
ET166B	$4.90			
ET166C	$4.90			
ET166D	$4.90	Power supply	AUG 83	$24.00
ET165	$7.50	Tacho calibrator	NOV 82	$39.50
ET245	$2.90	White line follower	NOV 77	
ET255	$2.90	Thermometer	NOV 80	
ET256	$3.50	Humidity meter Humidity sensor	OCT 83 OCT 83	$29.50 $19.95
ET257	$2.90	Universal relay board	MAY 81	$13.50
ET258	$2.50	Mini drill speed controller	JUL 81	$9.50
ET259A	$3.90	Versatile 'incremental' timer	JAN 82	$39.00
ET259B	$3.90			
ET260	$2.60	Photo lamp flasher	DEC 79	

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it is fun to get one going

REMEMBER BY DIRECTLY IMPORTING OUR OWN COMPONENTS OUR KITS ARE CHEAPER AND BETTER. ROD IRVING.

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Board No	PCB Price	Description		Kit price
ET261	$2.90	Fog horn	DEC 79	
ET263	$2.90	Simple egg timer	DEC 79	
ET264	$2.90	Simple siren	MAR 80	
ET265	$3.90	Power down	JUL 83	$37.00
ET268	$2.50	Nicad float charger	MAR 83	$9.50
ET316	$3.50	Transistor assisted ignition	MAY 77	$34.00
ET317	$3.90	Car rev monitor	JUL 77	
ET324	$4.90	Led tacho	AUG 80	$34.00
ET323	$3.90	Headlight delay	MAY 83	$17.50
ET325	$2.50	Car auto electric probe		
ET326	$2.50	Exp. scale led voltmeter	SEP 80	$12.50
ET327	$3.50	Turn/Hazard indicator	OCT 80	$22.00
ET328	$2.90	Led oil temp meter	JAN 81	$19.00
ET329	$2.50	Exp. scale vehicle ammeter	FEB 81	$19.00
ET330	$3.90	Car alarm	JUL 81	$29.00
ET332	$3.90	Electronic stethoscope	AUG 81	$34.00
ET333	$3.90	Reversing alarm	JAN 82	$10.00
ET334	$3.90	Auto tester	JAN 83	
ET335	$4.50	Windscreen wiper controller	MAR 83	
ET336	$3.90	Low cost tacho dwell	AUG 83	$24.00
ET363	$3.50			
ET417	$2.90	Overload indicator	AUG 73	
ET421		Three way (Dick Smith)	SEPT 83	
ET438	$3.90	Led level meter		$12.95
ET440	$8.50	25 Watt stereo amp	MAR 75	
ET445	$2.90	General purpose preamp	JUL 76	$8.25
ET446	$3.90	Stereo limiter	JUL 76	
ET449	$3.90	Mike preamp	MAY 77	
ET450A	$4.90	Bucket brigade	DEC 77	
ET450B	$4.90			
ET452		Guitar practice amplifier	JAN 80	
ET453	$2.90	Amp class B gen purpose	APR 80	
ET454	$3.90	Fuzz box	APR 80	
ET455	$4.50	Loud speaker protector	MAR 80	$32.50
ET457	$3.90	Scratch & rumble filter	SEP 80	$49.50
ET458	$4.90	Led level meter	JUN 81	$27.00
ET459A	$16.50	Series 5000 1/3 oct graph equ	NOV 82	$199.00
ET459B	$16.50	Graphic equ. front panel Graphic equ. metal work		
ET461	$3.90	Balanced input preamp	DEC 82	$20.00
ET464	$2.90	IC audio amplifier	JUL 83	$8.00
ET465	$4.50	Loud Hailer	JUL 83	$50.00
ET466	$8.50	300W amp module	FEB 80	$67.50
ET467	$6.90	4 input mike preamp	JUL 80	$29.50
ET470	$4.50	60 watt amp module series 4000	TPV 6	$26.00
ET471	$9.90	Audio preamp series 4000 Series 4000 front panel Series 4000 metal work	TPV 6	$49.50 $14.90
ET472	$4.50	Power supply for series 4000	TPV 6	$24.00
ET473	$5.90	Moving coil preamp series 4000	TPV 6	$54.00
ET474	$2.90	Interface 60W amp	JAN 80	
ET475	$6.90	AM tuner Set of three pot cores	SEP 80	$99.00 $29.50
ET476	$7.90	Series 3000 amp 25W stereo	NOV 80	$84.00
ET477	$7.90	Series 5000 pwr. amp mod 150W Series 5000 power amp complete kit Series 5000 pwr amp front panel Series 5000 pwr amp metal work	JAN 81	$63.50 $319.00
ET478MB	$13.90	Series 5000 preamp main brd OCT 81		
ET478MC	$4.90	Moving coil preamp (5000)	SEP 81	$24.50
ET478MM	$4.90	Moving magnet preamp (5000)	SEP 81	$18.50
ET478SA	$2.90	Series 5000 preamp switch brd	OCT 81	
ET478SB	$1.90	Series 5000 preamp switch brd	OCT 81	
ET478SC	$1.90	Series 5000 preamp switch brd	OCT 81	
ET478SD	$1.90	Series 5000 preamp switch brd.	OCT 81	
ET479	$3.50	Series 5000 bridging adaptor	MAR 82	$12.90
		Series 5000 preamp complete kit		$259.00
		Series 5000 preamp front panel		
		Series 5000 preamp metal work		
ET480	$4.50	100 watt amp module	30 AP	$25.50
ET480PS	$4.50	50-100W amp module pwr supply	30 AP	$22.50
ET481M	$3.95	Hi-power p.a./guitar amp mod.	30 AP	
ET481PS	$4.90	12V/100 p.a. inverter	30 AP	
ET483	$4.50	Sound level meter	FEB 78	
ET484	$5.90	Expander compressor 30 AP	JUL 77	
ET485	$5.25	Graphic equaliser	JUN 77	
ET486	$4.90	Howl round stabilizer	NOV 77	$59.00
ET488	$7.90	60W amp module	JAN 83	
ET489A	$3.50	Audio spectrum analyser no2	APR 78	
ET489B	$3.50			
ET492	$3.90	Sound bender	FEB 82	$29.00
ET494	$3.90	Loud speaker protector	OCT 82	$24.50
ET496	$8.90	Series 4000-1 speaker kit Speakers & crossovers Crossover kits Speaker boxes (prices per pair)	FEB 80	$779.00 $499.00 $199.00 $299.00
ET499	$4.95	50W mosfet amp 75-85 Transformer Anodised heatsink	MAR 82	$79.00 $43.50 $42.50
ET525	$4.90			
ET527	$5.90			
ET528	$2.90	Intruder alarm	JAN 75	
ET539	$3.90	Touch switch	MAR 76	
ET541	$3.90	Train controller	MAY 76	
ET547	$3.50	Telephone bell extension	JUN 77	
ET549A	$3.90	Metal detector	MAY 77	
ET560	$2.50	240V mains locator	MAY 80	
ET561	$3.90	Metal Detector	MAR 80	$34.00
ET562	$3.90	Geiger counter	APR 80	
ET563	$4.50	Nicad fast charger	JUL 80	$59.95
ET566A	$2.90	Pipe & cable locator	APR 80	
ET566B	$4.90			
ET567	$4.50	Core balance relay	APR 81	$44.50
ET568	$2.90	Photo flash trigger	OCT 80	$26.50
ET570A	$2.90	Infrared 'trip' relay TX	JAN 82	$24.50
ET570B	$3.20	Infrared 'trip' relay RX	JAN 82	
ET572	$4.90	Digital pH meter with probe	DEC 80	$109.00
ET573	$4.50	Universal timer	OCT 79	
ET575	$2.90			
ET576	$8.90	Electromygram	TPV 6	$95.00
ET577	$3.50	General purpose power supply	TPV 6	$39.50
ET578	$3.90	Simple nicad charger	JUN 80	
ET581	$3.25	15V dual power supply	JUN 76	$17.50
ET583	$2.90	Marine gas alarm	AUG 77	
ET585R	$2.90	Ultrasonic receiver	TPV 6	$17.95
ET585T	$2.90	Ultrasonic transmitter	TPV 6	$10.95
ET586				
ET596	$2.90	White noise generator	NOV 81	$8.00
ET598A	$3.90	Touch switch	FEB 81	$10.00
ET598B	$3.50			
ET599A	$3.50	Infra red remote control	MAY 80	$76.00
ET599B	$3.50			
ET599C	$4.90			
ET599D	$3.20	I.R. remote cntrl power supply	MAY 80	
ET603	$4.90	Music synthesizer sequencer	AUG 77	
ET604	$4.50	Metronome	SEP 77	
ET606	$3.90	Electronic tuning fork	NOV 79	
ET607A	$2.90	Sound Effects generator	AUG 81	$12.50
ET607nf	$2.90		AUG 81	
ET631-2	$7.50	Keyboard encoder	APR 77	
ET635	$4.90	Computer power supply	APR 81	
ET636	$19.90	7 slott s100 mother board	MAY 80	$89.50
ET638A	$5.90	Eprom programmer	JUL 78	
ET640	$69.00	Memory mapped VDU		$129.00
ET644	$69.00	Direct connect modem	OCT 82	$169.00
ET646A	$3.75			
ET646B	$3.75			
ET647		Speech synthesizer	OCT 82	
ET649		Microbee light pen	AUG 83	$19.95
ET650A	$4.90	Stac timer	NOV 78	
ET650B	$4.50			
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ET660	$19.00	Learners microcomputer Key set (18) to suit ET660 Colour option kit to suit 660	OCT 81	$99.00 $30.00 $16.50
ET668	$5.90	Microbee eprom programmer With textool socket	FEB 83	$38.00 $47.50
ET670	$11.00	Low cost micro keyboard	MAY 82	
ET682	$79.00	Versatile eprom card	MAY 81	$115.00
ET686	$9.50	ppi-based eprom programmer	OCT 82	$48.00
ET688A	$3.50	Bipolar prom programmer	JUL 83	$48.50
ET688B	$3.50			
ET708	$2.90	Aerial amp	MAR 76	
ET713	$4.90	FM tuner add on	SEP 77	
ET717	$4.90	Crosshatch generator	MAY 78	
ET724	$3.90	Microwave leak detector		$16.50
ET726	$3.50	R.F. amp 70W 6/10 meter	FEB 80	
ET729	$3.90	UHF TV masthead amp	APR 81	$36.00
ET730		UHF TV converter	MAY 81	$37.50
ET731	$4.50	Teletype modulator	OCT 79	
ET733	$4.90	RTTY computer decoder	APR 83	$20.00
ET734	$7.90	Phoney patch	MAY 83	$65.00
ET735	$4.90	UHF to VHF convertor	MAY 81	
ET736	$3.90	Radio facs pict-comp decoder	SEPT 83	$25.00
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ET918	$3.90			
ET1501A	$2.90	Negative Ion generator	APR 81	$39.00
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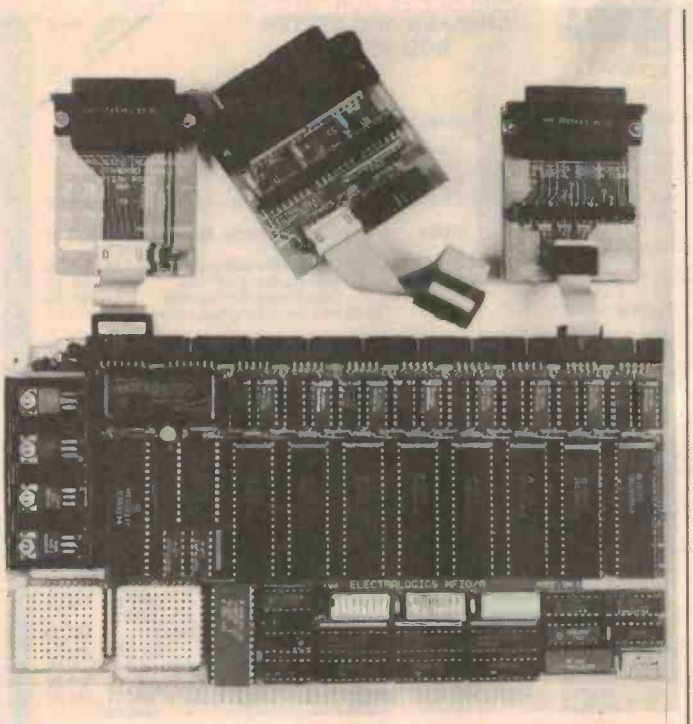

S100 I/O BOARD

The MF10 I/O Board is now available through Lamron, who claim that this is the most powerful S-100 single I/O board on the market.

The MF10 conforms to IEEE S100-696 standards and has such features as eight asynchronous serial ports, two eight-bit bi-directional parallel ports, internal baud rate generators, data rates to 57.6 Kbaud and programmable wait states for fast systems.

An eight-level programmable interrupt controller, together with a battery backed-up real time clock, provide features which traditionally require three or more boards.

The MF10 allows direct connection to modems, printers, terminals and other parallel or serial devices and special option boards which eliminate the need for custom cables and wiring are available.

The MF10 is only available assembled and tested, and is supplied complete with an extensive 240-page manual, source listings for a standard C/PM BIOS, interrupt driven BIOS, clock routines and initialization routines.

For further information, contact **Lamron Pty Ltd, PO Box 438, Ryde NSW 2112. (02)85-6228.**

INTEL TO DEVELOP UNIX SYSTEM V FOR 286

Intel Corporation and Western Electric are to jointly develop a part of the UNIX System V operating system for the Intel iAPX 286 microprocessor.

Western Electric has announced similar UNIX system development arrangements with Motorola and National Semiconductor.

"Standardisation is the key to delivering the full potential of microprocessor technology," said David L. House, general manager of Intel's Microcomputer Group.

"We believe UNIX System V will also evolve as one of the standards for microprocessor-based systems, and putting UNIX System V on our iAPX 286 processor will meet the needs of this emerging marketplace."

XENIX FOR IBM CS 9000

Microsoft has announced that IBM Instruments intends to provide the Xenix operating system for their CS 9000 microcomputer.

Xenix is Microsoft's licensed version of AT & T's Unix operating system. It is designed to provide multi-user, multi-tasking capability for high performance microcomputers.

Other manufacturers who have announced support for Xenix include Apple, for the Lisa, and Radio Shack, for their Model 16.

IBM Instruments CS 9000 is based on the 68000 microprocessor from Motorola and is targeted at the engineering/scientific community.

The CS 9000 is a modular computer system that permits the user to tailor it to a specific scientific analysis, instrument control, or automated, integrated laboratory application.

"With the announcement of Xenix support for this product, IBM has demonstrated the broad acceptance of the Xenix operating system in the engineering and scientific environment as well as the business environment," said Steve Ballmer, Vice President of marketing at Microsoft, USA.

According to documents released by IBM, Xenix provides as standard features development tools such as "C" compiler, a sophisticated text processing system, multi-user support with storage protection, and programs to compare, sort, merge, scan and translate files.

For further information, contact **Microsoft, P.O. Box 98, Terrey Hills NSW 2064. (02)450-2522.**

NEW THERMAL PRINTER

A new thermal, 40-column computer printer capable of graphics has been released in Australia by Oscwell International.

An ideal WP drafting printer, the Pony thermal printer is available with RS232 and Centronics interfaces, as well as specialist Atari and Commodore interfaces.

The print control electronics are contained in the printer housing, and all interface control and character generation is contained within the plug-in interface module.

It operates at a speed of two lines per second, with 40 characters per line and it can produce good quality 320 x n dot graphics that are ideal for boardroom presentations or classroom visuals. The character matrix and specific character sets are determined by the plug-in interface module.

The Pony printer sells for $166 (sales tax included). Prices range between $20 and $40 for the interfaces.

Further information can be obtained from **Oscwell International Australia Pty Ltd, 271 Blackburn Rd, Mt Waverley Vic 3149 (03)233-3716.**

AUSTRALIAN SOFTWARE GOES TO US

An Australian-developed communications interface card, which enables the Apple Computer user to communicate with virtually any IBM mainframe, was launched in the USA at the Comdex exhibition in Las Vegas, in November '83.

Local microcomputer researcher, NetComm, developed the interface card and announced in May 1983 that it had signed an agreement with Apple Computer, giving Apple worldwide marketing and distribution rights for the card.

NetComm currently has two designs available for both the Apple NC20 and Apple NC22 computers. They communicate with IBM mainframes in 2780-3780 file to file transfer mode or 3270 on line VDU emulation. The 2780 facility also permits the transfer of files of information between other remote or local Apple computers, and any other mainframe that supports 2780-3780.

In conjunction with another local research unit, Datasat, NetComm has developed a new synchronous or asynchronous modem card for the Apple NC20 and NC22. This card will be mounted internally in the Apple's expansion slot and offers 300, 1200 and 1200/75 baud complying with Australian, UK and Europe and US standards.

This modem has auto dial, auto answer and auto disconnect features and is speed and mode selectable. Thus one internal modem will connect to asynchronous computers (DEC, Prime, Wang and database services such as CSA, GEIS, Source, MIDAS etc.), synchronous computers (IBM, ICL, Burroughs) and the recently announced Prestel service (Telecom, Cybertel, Viewdata etc).

NetComm's communications card range has been supplemented with NC23, a card designed for SNA/SDLC with a faster on-board processor (Z8) plus bigger RAM (24K) and a lower IC count.

Thus NetComm now have available the hardware cards, the telephone interfaces and the software emulations for connection to asynchronous, bisynchronous, SDLC and Prestel networks.

Further details on NetComm products are available from **Chris Howells, NetComm, Suite 8, 33 Ryde Road, Pymble NSW 2073. (02)498-5577.**

LOCALLY DESIGNED VIDEO TERMINAL

Appropriately named 'The Squatter', this locally designed video terminal with powerful emulation facilities is designed to replace overpriced and poorly supported imported terminals.

The terminal is designed and manufactured by CK Systeme and costs under $2000 in one-off quantities.

Emulations currently available on 'The Squatter' include Hazeltine Esprit II, ADM 3A and Regent 25, although a wide range of emulations (including IBM) are available on OEM quantity request.

Three screen formats are available. Baud rates from 50 to 38,400 are user selectable. The terminal has a screen based, user modifiable translation table of the control codes, enabling quick and easy modification for a given installation or replacement by another terminal.

Further facilities include: hard copy output via a Centronic type port; edit mode; full and half duplex; selective scroll and delete function; alpha graphics with vector drawing; RS232C; RS422A and RS423A outputs; and 4K of user ROM.

For further details contact **J.C. & J.P. Cens Pty Ltd, P.O. Box 122, St. Peters NSW. (02)517-1275.**

COMPUTER INFORMATION/ MESSAGE CENTRE

Paris Radio Electronics has introduced a remote computer information and message service.

This service will allow any computer user who has access to a computer with a terminal/ communications program, acoustic coupler and a telephone, to access information related to the TRS-80 Color Computer range of products. This information includes descriptions of current and soon to be released software and hardware.

Users may also send messages via the system to Tandy Computer with questions or information they may have.

For further information contact **Jacky Cockinos, Paris Radio Eléctronics, 165 Bunnerong Rd, Kingsford NSW. (02)344-9111.**

THE RAD FAMILY EXPANDS

Distributed by Datacraft and similar in size to a standard D type, 25 pin connector, these ultra miniature short haul modems are a full duplex, four wire data set.

There are now three members in the RAD-6 family: SRM-6D Async 0-19.2 kbps up to 35 km, SRM-6A Async 0-19.2 Kbps up to 20 km transformer isolated and SRM-6S Sync 1200-9600 Kbps up to 33 km transformer isolated.

Requiring no external power, these low cost modems plug directly into the interface socket and are powered from the transmit data lead — even if the terminal is dumb (no RTS and no DTR). They will generate both positive and negative signals in accordance with RS232 (V.24) standard, even when Transmit Data is constantly Mark or constantly Space. High common mode rejection ratio is provided by transmitting balanced voltages and receiving through balanced impedances.

Cost of the units is approximately $150 for the SRM-6D up to $350 for the SRM-6S.

For further information, contact **Adrian Wescott, Datacraft (Aust.) Pty Ltd, P.O. Box 353, Croydon Vic 3136. (03)726-9911.**

THE SECOND PERSONAL COMPUTER SHOW

The Second Australian Personal Computer Show is a complete sell-out, with exhibitors confirming space months prior to its opening in March 1984 at Sydney's Centrepoint, according to its organisers, Australian Exhibition Services.

The main feature of the show will be the staging of four spectacular audio-visual presentations every hour during the four days of the exhibition.

Each has been designed to provide visitors with information on how to use the show constructively and will provide a practical understanding of the commercial benefits that can be derived from the new microcomputer technology.

There will be four separate topics covered, during each showing: 'How to use the Exhibition'; 'Hard Decision' — decisions to consider when choosing hardware; 'Soft Options' — outlining the various options for software; 'Education' — aimed at the use of microcomputers in education. The presentations will be directed toward businessmen, serious personal computer users and educationalists.

Following each session, there will be time for practical demonstrations, using a wide selection of hardware and software. Coopers & Lybrand, who will be producing the audio-visuals, will have their own company microcomputer specialists on hand to answer business questions.

Due to the overwhelming demand this year, the show has been extended to four days. It will take place in the exhibition area of Centrepoint in Sydney from March 14-17 1984. However, the first day is a 'business-only' day.

VIDEO GAME CONTROLLERS

Discwasher has released several new video game control adaptors that the American company claims will sharpen the scoring skills of many players.

The new adaptors, the Pointmaster Quik-Stik I and Quik-Stik II, are compatible with Intellivision I and II respectively. Both have durable control sticks with extended handles that snap on and off the standard Intellivision controller easily to give the player better control.

For further information, contact **Arena Distributors, 642 Albany Hwy, Victoria Park WA 6100. (09)361-5422.**

68000 COMPUTER RUNS CP/M 68K

Software Australia is offering what is believed to be the first 68000 processor-computer in Australia running CP/M 68K.

The company's Manager, Dr Michael O'Shea, said that development of the 68K systems began about 18 months ago and has been under constant testing and modification up to the release date.

Dr O'Shea said the advantages of the system include; extremely high speed, massive memory capabilities, directly addressing 16 megabytes of main memory, up to 9 megabytes of memory disk available, up to 300 megabytes of fixed and/or removable hard disk storage and availability in the S-100 industry standard (IEEE-696).

The new computer will be one of the fastest micros available. It utilises a Motorola 68000 CPU running to eight or 10 MHz.

The system will be supplied standard with; 256K of memory expandable to 16 megabytes, four RS232 serial ports adjustable from 110 to 19 200 baud, or one RS232 serial and one Centronics parallel port, 24-bit address DMA floppy-disk controller, two double-sided, double-density 200 mm (8") floppy disk drives giving a total of 2.7 megabytes of formatted storage. Software for the 68K processor is relatively scarce. However, the machine can be supplied with an 8088 and an 8085 CPU or an 8086 CPU alternate processor running CP/M 80, CP/M 86 and MP/M 86 enabling a complete coverage of all programs written for CP/M or MP/M.

For further information, contact **Software Australia, (07)349-2269 or (07)349-9122.**

DISSAPPLER

In response to demand by Australian computer enthusiasts, a local computer consultancy, Latco, has developed a software package which enables the user to dissassemble (and thereby translate) 6502 object code (machine code) into source code.

Working with the DOS toolkit 6502 editor/assembler for the Apple II, Disappler enables the user to reassemble, edit or customise machine code programs.

Murray Baker, managing director of Latco, believes that the average Apple II enthusiast is at present trapped into a limited world of BASIC programming and mind destroying game software.

"The average enthusiast quickly runs out of enthusiasm when his inquisitive drive is limited in this way. Disappler will allow enthusiasts to examine operating systems, device drivers, software languages and even game software," he said.

All enquiries about Disappler should be directed to **Murray Baker, Latco Pty Ltd, PO Box 267, Cremorne Junction Sydney NSW 2090. (02)90-5462.**

GRAPHICS SOFTWARE CATALOGUE

Ramtek, one of the world leaders in colour computer graphics hardware, has produced their 'Software Affiliation Catalogue'. The catalogue lists third party software packages that are compatible with the Ramtek series of computer graphic terminals and controllers.

Intelligent Systems Research (ISR), a Melbourne based firm specialising in Ramtek and the Unix operating system software, has a limited number of these catalogues available for interested parties.

The catalogue includes alphabetically listed software, software listed by major application, software indexed by host computer and software indexed by Ramtek model number.

Applications include: business/statistical, CAE/CAD/CAM, cartography/demography, FEM, general purpose, geophysics and energy related, image processing, process monitoring and control. For further information, contact **ISR, 2/969 Burke Road, Camberwell Vic. 3124. (03)82-8287.**

APPLE SUPPORTS DEVELOPERS

A series of technical products designed to help developers create applications for Apple Computers has been announced by Apple Computer.

Called *Apple Workbench*, the product line includes development tools and technical information for hardware and software developers in the United States, but substantial flow-on is expected in light of a recent announcement by Apple Computer Australia that a local developer support programme is to be stepped up.

"Apple has always encouraged third parties to develop applications for its computer," said David Strong, Managing Director of Apple Computer Australia.

"Now, through the Workbench product line, we will be opening up our systems to developers even more to make hardware and software development for Apple Computers as easy and productive as possible."

The first group of Workbench products consists of six software packages for the Apple II and Apple III product lines:

The *DOS programmer's tool kits* provides the tools needed to program an Apple II computer in both assembly and Applesoft BASIC under DOS 3.3. Software utilities are included for developing and using special text animation character sets, as well as Boston Window, a full-screen editor.

The *ProDOS Technical Reference Manual* explains how to develop applications using the advanced features of ProDOS, Apple's new operating system for the Apple II family.

The *ProDOS Assembler Tools Package* contains the software utilities needed to program an Apple II computer in assembly language under ProDOS. The ProDOS Technical Reference Manual is recommended for use with this package.

Apple Pascal Numerics provides units that allow programmers to use single, double and extended-precision real and integer numbers in Apple Pascal for the Apple II and the Apple III.

The *Apple III Pascal tool Kit* helps programmers develop Pascal programs on an Apple III computer. It includes utilities for performing programming functions such as compiling Pascal code, comparing data text files, designing a good user interface to the program, and sorting SOS and ProDOS directories.

Pronto: The Apple III Pascal Debugger enables developers to control the execution of Apple III Pascal programs. Users can debug while executing programs at full speed, and no recompilation is necessary.

The Workbench products are for technically-skilled developers who require little or no tutorial information. Technical reference materials provided with each Workbench product are in a loose-leaf format, with separate binders available so developers can organize the reference materials to fit their individual needs. The loose-leaf format was selected to facilitate updates.

Each product is purchased separately and includes documentation. More products are scheduled to be added to the Apple Workbench series.

ROLAND MOVES INTO PERIPHERALS

The Roland Corporation is making a major move into the computer peripherals market. The company, which already holds 70 per cent of the Australian music synthesiser market, has now set up a computer division with its main arm in Melbourne.

The managing director of Roland Corporation Australia, Mr John Egan, said "Micro-processor technology plays a large part in all modern electronic musical equipment. The personal computer is about to play a large part in the area of creative music.

"It is not surprising therefore, that Roland should look to develop a presence in computers, specifically in the peripherals area.

"In the past seven years we have built up a very strong market in the musical instruments and professional equipment field. We intend to do the same with our digital products."

Roland's first product in the peripherals market was the Amdek monochrome monitor, a unit recognised as one of the top-selling monitors in the US.

Roland's new computer peripherals products, now being released, are the Roland A/D/A converter, the Roland 14" colour monitors and the Roland eight-pen and one-pen plotter range.

"Our emphasis is on quality, not volume," Mr Egan said. "We aim to supply the best value for quality products in each price bracket and to build a long-term relationship with our dealers."

Roland Corporation Australia is a local joint venture with the Roland Corporation, Japan. There are also joint venture companies in the US, Canada, UK, Scandinavia, West Germany, Benalux and Switzerland.

Roland Corporation Australia Pty Ltd is at 39 Victoria Street, Fitzroy Vic 3065. (03) 417-1800; and at 23 Cross Street, Brookvale, NSW 2100. (02) 938-3911.

CP/M PLUS, XENIX FOR TRS-80 MODEL 16

The Xenix multi-user operating system, developed by the MicroSoft Corporation, is to be the standard operating system on the Tandy TRS-80 Model 16 microcomputer.

A Model 16 equipped with Xenix can be expanded by the addition of up to two terminals to let three users operate programs simultaneously.

Tandy Electronics will release several multi-user applications software packages for Xenix-equipped Model 16s, including a full complement of interactive Australian modified accounting packages and a high-capacity inventory control system. Tandy will also offer MicroSoft's Multiplan package in a specially developed version that supports multi-user operation.

Xenix will operate on any Model 16 equipped with 256K of memory and a hard disk and on similarly equipped Model II or Model 12 microcomputers that have had a Model 16 upgrade kit installed.

Meanwhile, Tandy has signed an agreement with Digital Research to market and distribute the new CP/M Plus version 3.0 advanced operating system, which is compatible with the Tandy TRS-80 Model 12, Model II and Model 16 (when operating in the Z-80A mode).

CP/M Plus is a high-performance, single-user, single-task system developed for business and commercial applications, and will support about 3000 existing CP/M application programs without modification, including word-processing and financial business applications.

For further details, contact **Tandy Electronics, 91 Kurrajong Avenue, Mount Druitt NSW 2770. (02)675-1222.**

MICROPRO

MicroPro Design announces the availability of a printer exerciser which has been designed to aid retailers and distributors of RS232 or Centronics compatible printers, terminals and plotters.

Designed specifically to allow sales personnel to efficiently demonstrate the features and performance of an attached printer, it is also economical enough to find applications in the maintenance and testing of these devices as well.

The unit allows an attached printer to be driven with a standard ASCII character set or put through its paces with a custom message in EPROM. This EPROM could contain sequences to show all the features of the printer and the internal storage can give up to four typical pages of text.

The Printer Exerciser is easily set up and any configuration chosen unambiguous — a boon when setting up a printer prior to connecting it to a customer's computer.

Further details are available from **MicroPro Design Pty Ltd, PO Box 153, North Sydney, NSW 2060. (02) 438-1055.**

$180 000 GRANT FOR SOFTWARE DEVELOPMENT

The Australian Industrial Research and Development Incentives Board (AIRDIB) has approved an application for a project grant submitted by Kingdom Pty Ltd for financial assistance to research and develop a computer software process called Orion.

The grant application included a proposal for further research on this revolutionary new way of using a computer, the end result of which will be the ability to solve a wide range of numerical and logical problems without writing computer programs and to open up areas which conventional programming will never reach.

The Managing Director of Kingdom, Mr Richard Lovegrove, said that AIRDIB approved the granting of an amount representing about 50% of the project cost to Kingdom who will spend a similar amount on the research and development of the Orion system.

The potential of the system is so great that Kingdom is interested in finding a joint venture partner, perhaps with expertise in particular areas of software marketing.

Unlike programs such as 4GLs and other program generating languages, Orion does not produce a mass of third generation language code to solve a problem or develop an application.

Orion uses an altogether different organisation in the memory of the computer, and organisation tha has more similarity to a mental network than a conventional program.

The base program is written in a normal, transportable computer language and this relatively small program repeatedly operates to build up the solution from a description of the problem.

The software allows the building of models by the independent statement of known facts. The computer determines the links and relationships and, if the model is complete, produces the numeric solution.

If the model is incomplete the deficiencies are indicated. "What if" questions can then be applied at any point in the model to determine the effect on other parts of the model. Individual models can be assembled or disassembled to build larger or smaller models.

Up to now it has been necessary to write programs to enable a computer to solve problems and it was necessary for the programmer to think out the strict sequence that had to be used by the computer to achieve the solution.

In the future, using Orion, Kingdom claims a problem will be able to be described in a piecemeal fashion. The operator will only need to know a relationship between any two variables and indicate the relationship to the computer, continuing to add additional relationships as they are identified. The computer will build a model from the relationships as described. The operator will be advised when insufficient variables or relationships have been identified. By adding additional information or formulae the computer will work towards completing the construction of the model.

Kingdom is a specialised software house with concentrates on the research and development of computer programs for applied science especially engineering, architecture, surveying and information management and modelling. Kingdom computer software suites are in use in local and state government and consulting private practice in Australia, New Zealand and Singapore.

Orion is seen as a program which will have wider application than Kingdom usual computer suites and certainly represents a very significant world product.

Kingdom, P.O. Box 338, Ryde NSW 2112. (02)807-4822.

AT & T TO UPSTAGE IBM?

American Telephone & Telegraph is planning to introduce a microcomputer system within the next six months, according to a new research report from International Resource Development, a US market research firm.

The report predicts that the microcomputer will use 32-bit architecture based on Western Electric's Bellmac microprocessor, and that the software will be based upon Bell Laboratories' Unix operating system. The combination of the longer word length (32 bits, as compared with 16 bits on the IBM Personal Computer) and the powerful Unix-based software, will enable the new AT & T microcomputer to 'upstage' the IBM PC, according to the report.

In order to successfully enter the microcomputer market at this relatively late stage, AT & T will have to offer its microcomputer users the option of running software developed for the IBM Personal computer. The report predicts that the AT & T micro will be able to run an 'MSDOS lookalike' program which is apparently being secretely developed by Microsoft.

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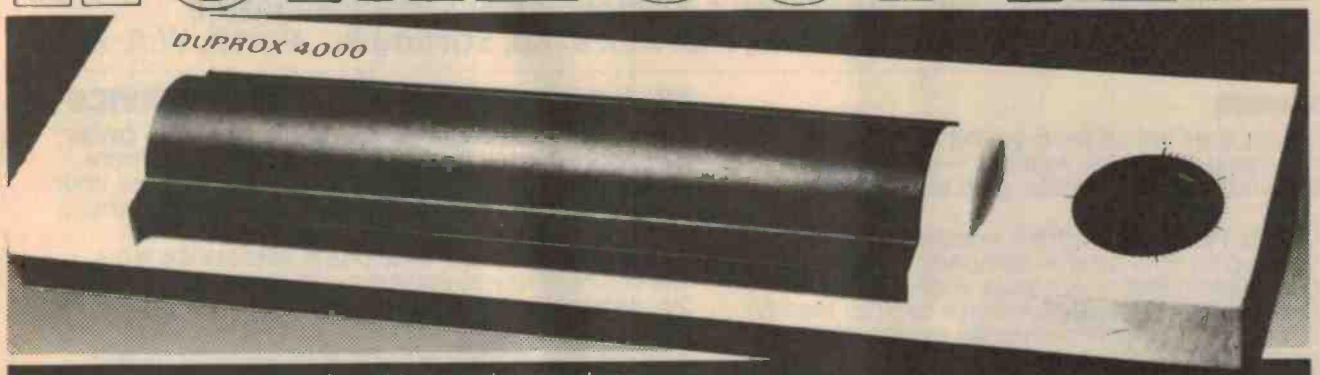

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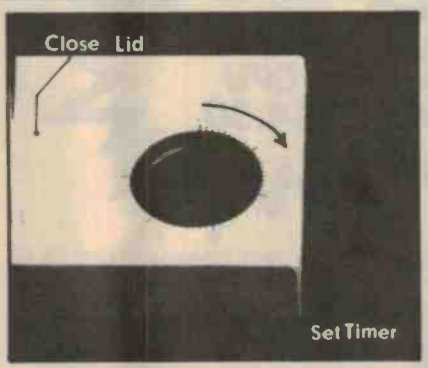
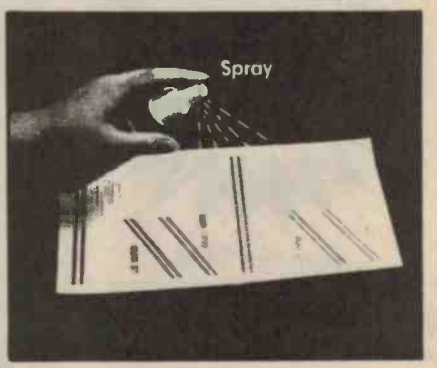


(2) Push through until sheets appear in front of cylinder and close lid of machine. SET TIMER DIAL. Light shines through original copy (for regular paper, set about two and a half mins or a bit more, and the thicker the paper, the higher the timer number).



(3) After timer shuts off, open lid, remove paper gently from machine, spray with image set developer back and forth horizontally, lightly covering entire page. A perfect copy appears in about 20 seconds. Wipe spray nozzle after application.

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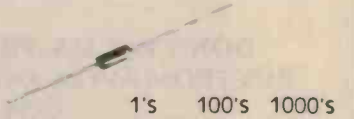

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The Sphere MkII computer reviewed

This computer is designed for the small expanding business rather than the home computer market. This article looks critically at its hardware and software.

Jonathan Scott

THE SPHERE MkII computer is a small business machine, not a home computer or a recreational piece of electronics. It is encased in heavy duty aluminium and sports two slimline 5¼" double density single-sided floppy disk drives.

A pair of momentary switches for hard reset and abort are on the front panel; the hard reset switch is particularly annoying because the red LED identifying it flashes continuously.

When reset, control is returned to the monitor, which initialises itself. This will be discussed shortly. The abort function returns control to the monitor, but outputs the current processor registers. It then returns to the control entry level of the monitor without severe interference to the RAM.

There is also a set of LEDs indicating I/O activity. The rear panel contains the power switch, a cooling fan and a number of plates designed to allow the installation of boards with connectors for interface cables.

The unit supplied to us for review had the processor board, a 6809 system with monitor, and 56K of RAM with interfacing for the terminal supplied. This, with the two drives internal to the system, is the recommended minimum system. Expansion of memory is possible, as is the connection of serial and parallel ports, disk controllers, etc.

The terminal which we received, a CCT-100, is a separate component to the computer. It is a substantially unintelligent unit, all processing power being vested in the main control box's 6809.

The CCT-100 consists of a neat enclosure, barely larger than the tube it contained, and a separate keyboard connected by a coiled cable. The protocol setting switches are accessible from the rear, below the rounded protrusion enveloping the CRT.

The whole package is very trim, and the keyboard is low and fairly ergonomically laid out. The screen is a green raster type with pleasant characters. The only possible complaint might be the strong background illumination which did not vary with the character brightness control. This does not, however, impair operation or cause any significant strain on the operator that we could perceive.

In line with the large scale type of machines used in business applications, the only firmware (software permanently stored in ROM) is a monitor. If you have seen the original 6800 microprocessor monitors, you have effectively seen the one supplied in this system. It has the usual crude memory examination and modification functions, but to the pure business user who is not developing any low level software for himself, these functions are of no concern.

Booting the DOS

We were surprised that this old sort of monitor was supplied because a command is required to cause the booting of the disk operating system (DOS). 'Booting' is a term used to describe the starting of a disk-based operating system. Although the hardware manual indicated that automatic booting was possible, no amount of coaxing would produce this on our unit.

Typing a 'u' causes booting for internal minifloppies, while more recent computer designs automatically search out all mass storage units (disk drives etc.), and load the DOS from wherever it is first located.

This is the first hint of the Sphere's major failure — it is rather old fashioned in its architecture, in that it does not follow modern trends to make computers more 'friendly' by minimising keystrokes and reducing the amount of effort required from the user. Since there is a method of entering the monitor already incorporated in the DOS, the original boot command is only a nuisance.

The operating system is called Flex. It is a standard 6809 system, related to OS9. Flex strongly resembles the kind of operating system (OS) found on large mainframe computers. It has a powerful set of commands with which one could have little complaint on grounds of technical inadequacy. However, the user should expect to take some time to become familiar with them because of their complexity. ▶

Vesting all processing powers in a single station, which communicates only via unintelligent terminals, is another shortcoming in the design. In more recent business systems, the OS either presents menus for command selection, or offers a 'help' facility of some kind on at least some of the commands.

In addition the commands, though powerful, assume a certain knowledge of the system and a basic familiarity with computer nomenclature. This frequently occurs in designs where unintelligent terminals share resources.

Flex is, not surprisingly, very flexible. It has a distinct leaning toward, and provision for, the user who will develop his own software.

It is also very well documented, with a degree of care and detail not found in the down-market domestic computers. The documentation has been progressively refined with each version of the OS. We were supplied with two manuals for the Flex, and documentation was right up to scratch on the additional features incorporated in one of them.

It was a seemingly bad decision to arrange the computer as a discrete CPU box with a standard unintelligent terminal. This prevents the incorporation of special function keys with screen labels, and all those ergonomic facilities such as partitioned screen lines and separate screen areas for separate task levels.

It has the dubious advantage of freeing the manufacturer from the need to build a CRT and keyboard, but this would seem to be a small gain for a large loss. Because a large computer is expected to communicate with large numbers of users at once this structure can be justified, since each user only needs a standard terminal interface. However, the Sphere isn't really up to multi-user operation.

Although it is being sold as 'an 8-bit machine offering the processing power of 16-bits at an 8-bit price', a single-user 16-bit computer is no news these days, and the latest machines offer 16/32 or full 32-bit power, dedicated to one user. Such products are equipped with a very friendly OS indeed, facilitated to a large degree by the permanent mating of the output device with the keyboard and CPU, and the use of a customised OS, rather than a standard OS such as Flex.

Expansion

On the hardware side, the Sphere is quite robustly constructed. Its case is heavy duty anodised aluminium. There is plenty of room for expansion, both on the motherboard's main buss and on the I/O 'slots' behind the rear plate.

We were a little disappointed to see that the connections to the motherboard were the cheaper pin-and-socket arrangement, rather than gold-plated edge connectors which are standard in a lot of up-market machines and some domestic machines. This connection scheme was popular a few years ago, which reinforced our opinion that the machine is very much based on traditional lines.

All memory and VLSI chips were mounted in sockets. The pc boards are not cramped and this no doubt enhances reliability. The hardware documentation is excellent. A bound manual is supplied which contains the circuits and layouts, as well as descriptions of the relevant concerns such as environments, etc.

The Sphere is targeted at the small expanding business that cannot justify the purchase of a large system, but which needs to be able to expand beyond the initial configuration, and have access to a lot of software. A 'home' type computer is inadequate in many respects for such an application.

Software

A considerable range of software is available for the Sphere because it is a standard configuration of a 6809, which is source-code compatible with the original 6800, the first microprocessor ever built. We were supplied with a sample of the programs. We will discuss the Extended BASIC and the editor in a moment.

Other software available includes PASCAL and C compilers, Forth, assemblers, cross assemblers for most 8-bit micros and for the 68000, as well as the usual word processors, spreadsheet programs spelling aids and COBOL compilers.

I can't comment on the quality of the software offered by the local agents as I haven't seen any of these operating. These high level programs will probably be of a quality similar to the OS and the two programs mentioned below. The C compiler was described as being a fast 6809 specific program, so it will be more recent and hopefully more efficient.

The extended BASIC is very much in the same vein as the rest of the system, ie: it is fairly complete, but has none of the more clever commands and facilities which have appeared recently. Unusual extensions of BASIC have made it into a much more powerful language than was originally intended. This version has the capability to crudely overlay program sections, trap errors, and has such commands as a 'print using' and a 'pass to DOS (+)' function. It can also partially compile sections of BASIC code.

The editor

The editor is also a very old fashioned arrangement and is, as such, fairly unfriendly. Amongst the software offered is what is termed a 'full screen editor', but it is not explained whether it is an on-screen editor in the usual interactive sense.

If you were doing a lot of development rather than some occasional updating, the editor would become a little tiresome. Nevertheless it seems to offer all the necessary facilities for getting the job done. I received no manual for this utility but a familiarity with editors in general allowed me to sort out its method of interfacing — an advantage of having a very conventional program.

Well now, let us get down to prices. The terminal sells for $799 and the Sphere CPU box for $3500, which presumably includes only the DOS. An idea of software prices can be gained from a few examples: the extended BASIC is $110, Flex is $175, an editor/assembler is $110, XForth is $175, a word processor is typically $350, and a spreadsheet program is typically $465. A parallel interface is $135 (suitable for driving a printer), while a modem interface is $180 including the software to run it.

A separate enclosure with two eight inch floppies and a controller, which will be able to handle a Winchester disk and a streaming tape drive (when available) sells for $3500. (Prices are without sales tax where applicable.) There is also a software update facility offered for those interested, at a nominal cost of $25 per year.

At these prices, a buyer would have to put a lot of value on having a system with extensive software backup to justify the expense. Similar terminals to the one we had can be purchased for less than $799 in several places. There are plenty of manufacturers of machines with similar software followings which are more recent in design style. In short, unless you have a need to maintain 6800 source-code up compatibility, I cannot recommend the Sphere MkII as good value or solid technical sense at its price. ●

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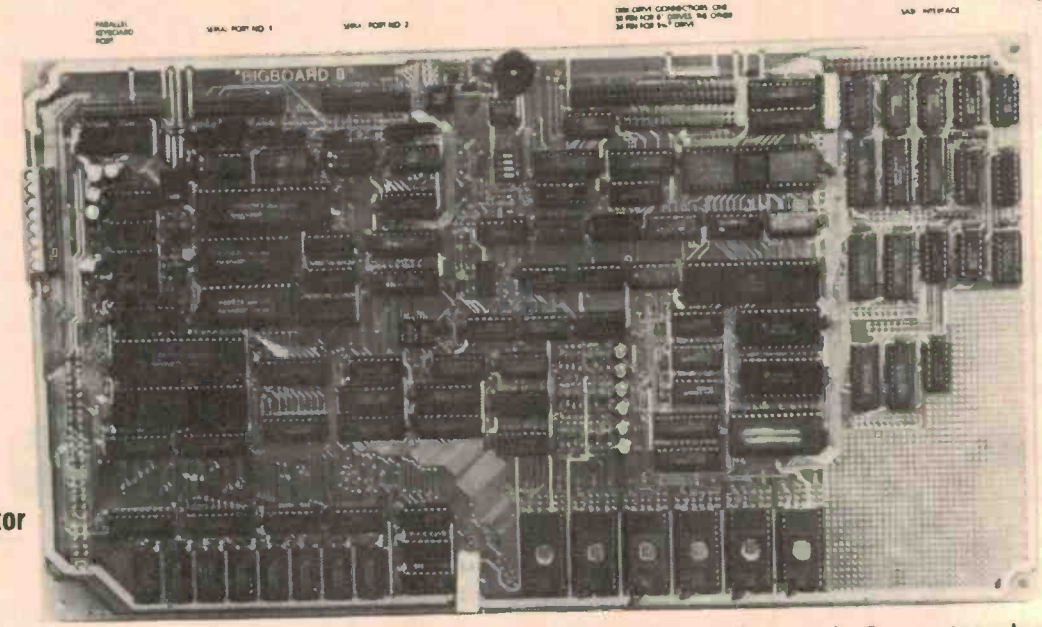

STD Bus Connector

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 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 450nS2732 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:

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In single quantities, full kits cost $695 plus 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 II "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 $395 + tax

Errors and omissions excepted

Understanding the microprocessor —

If you have a basic knowledge of electronics you can study this course at home and learn how a microprocessor actually works. How it functions, how it is programmed and how it may be used in a variety of applications will all be revealed.

Jennie Whyte

'LEARN HOW MICROPROCESSORS really work — the practical way' said the brochure from the Australian School of Electronics. It sounded interesting so I thought I'd do this correspondence course, not realising that I was committing myself to several months of study which had to be done mainly on the weekends.

However, I did find that the time spent on this course was worthwhile; it was interesting, I learnt how a microprocessor functions and I learnt how to program in machine code.

This 'Master the Microprocessor' course is organised by the Australian School of Electronics in Melbourne. The course was written by the British National Radio & Electronics School, Department of Computer Technology, England, and developed around the MPF-1B Microprofessor.

It was designed to "provide the necessary basic information to enable a student to really understand the functioning of microprocessors and their supporting circuitry. This is backed up by showing how to program a microcomputer in machine code as well as showing how Assembler and higher level languages relate to this".

The Australian School of Electronics staff say that the course is a useful introduction for people with an electronics background who want to install and service microprocessors, design systems or just want to understand microprocessor control functions and their applications.

What you get

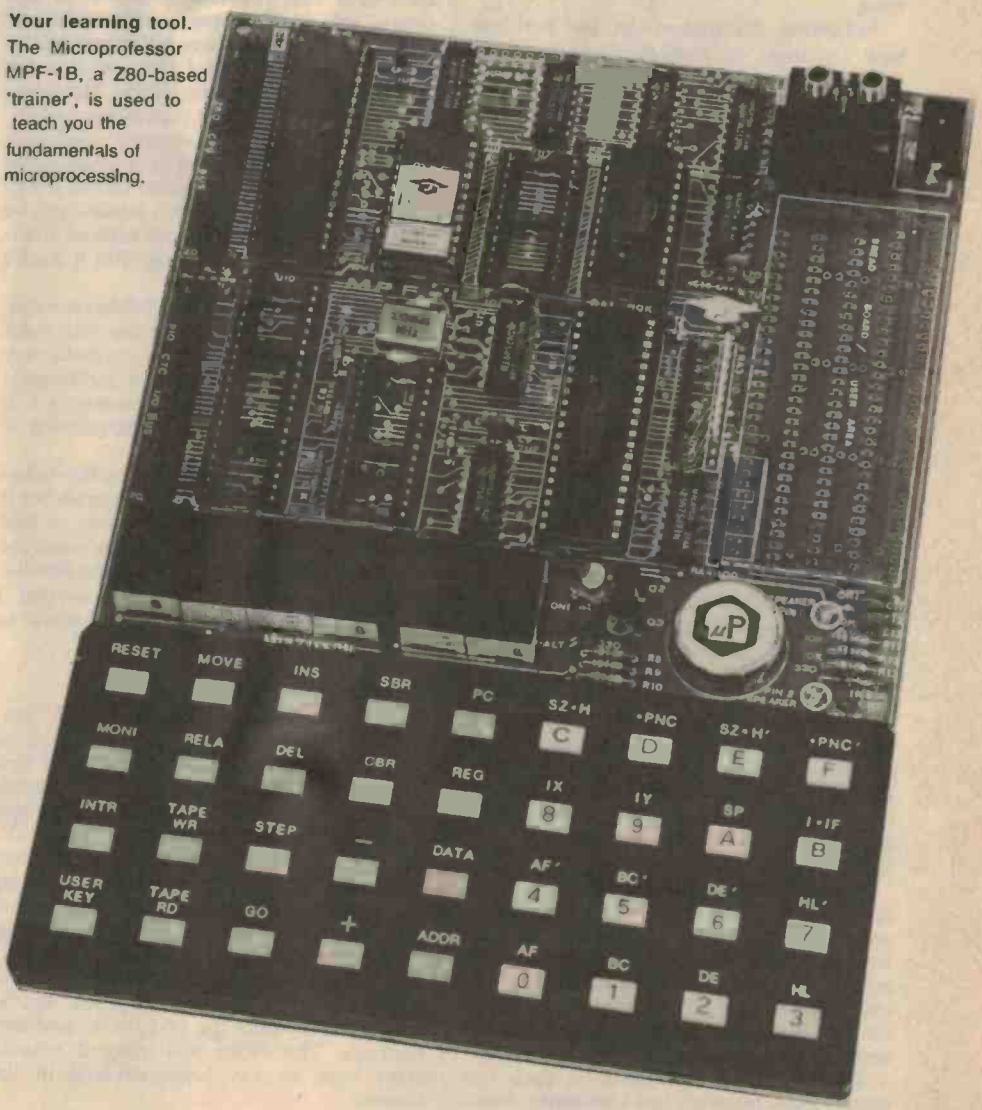
The cost of this course is $490; this includes the MPF-1B Microprofessor which comes completely assembled and ready to use, eight text books and eight test papers. Each student is assigned a tutor who marks each test paper and returns it to the student with comments. The tutor is also available to answer any written queries the student may have.

The MPF-1B, manufactured by Multitech Industrial Corporation, is a Z80-based microcomputer system which is described as a learning tool for hobbyists, students and microprocessor enthusiasts. It has 2K of RAM, a 6-digit, 7-segment LED display and a keyboard of 36 keys for hexadecimal data entry. (See ETI October 1982 for a review of the MPF-1 Microprofessor.)

Although this course is based on the Z80 microprocessor it emphasises the common features which exist between processors from different manufacturers i.e: the Intel 8080 and 8085.

It is claimed that no previous knowledge of computers is necessary. However, a basic knowledge of electronics plus digital and logic circuits is essential. It is assumed that the student has a knowledge of electronics up to a minimum level of transistor theory and circuits.

A short introductory course covering digital/logic theory is available, at no extra ▶



Your learning tool. The Microprofessor MPF-1B, a Z80-based 'trainer', is used to teach you the fundamentals of microprocessing.

COURSE CONTENTS

Lesson 1. Logic levels, flip-flops, input/output, binary/decimal conversions, hexadecimal notation, RAM, ROM, CPU registers and timing, ports latches, buss systems.
Lesson 2. Monitor program, keyboard: reset, register, address, increment/decrement, data, program counter, step and go; flowcharts are explained, a short program is given as an example with an explanation as to how to enter it and check the operations, stack pointer, subroutines.
Lesson 3. Interrupt systems, interrupt masks, Z80 interrupt modes, demonstration programs, stack 'push' and 'pop' instructions, object and source code, data transfer instructions.
Lesson 4. Addressing modes, flags, demonstration program with execution instructions to illustrate use of zero flag and register indirect addressing, breakpoint, demonstration of use of carry flag and some data transfer instructions — students are asked to write their own program first and then compare it with program in the text, jump instructions.

Lesson 5. Binary arithmetic, hexadecimal arithmetic, tens and twos complements, signed and unsigned numbers, program demonstrating addition and subtraction instructions, demonstration of add with carry and subtract with borrow, program for division.
Lesson 6. Binary coded decimal, decimal adjust instruction with demonstration program, instructions providing AND, OR and exclusive OR functions, demonstration program of Boolean logic instructions, shift and rotate instructions with demonstration program, demonstration of use of logic and arithmetic instructions in multiplication algorithms — programs are given for the multiplication of two 4-bit and two 8-bit binary numbers, program for the additional of multi-byte numbers.

Lesson 7. Now that a range of instructions has been demonstrated, this lesson moves onto discussing memory and input/output interface circuitry which may be used to provide a range of different facilities; RAM, ROM, PROM, EPROM, EPROM programmer, serial and parallel access, address decoding and chip selection, complete with partial decoding, 8255 PPI, mode definition control word, driving the display, reading the keyboard, programs to demonstrate use of output and input ports.

Lesson 8. Interface providing parallel data transfer between instruments, serial communications interface, direct memory access controller, CRT controller, counter/timer circuits, buffers, analogue to digital converters, duplex and half duplex operation, serial baud rate, synchronous and asynchronous modes, serial communications interface package, character codes, CRT interface, memory mapped I/O, practical demonstration of use of I/O port to provide an event counter, high level languages introduction, servicing microprocessor-based equipment.

cost, when requested by the student. However, it doesn't cover basic electronics. Without this basic knowledge the student would not be able to cope with this course.

The text of the course is arranged in a logical order. A description of the hardware is accompanied by instructions in programming.

Following descriptions in the text on new functions or techniques, a practical demonstration is given using the microcomputer. The notes give a flow chart accompanied by an explanation and the program is written out in full with the address, object code, source code and comments explaining the meaning of the source code. Later in the course the student is asked to write the program first before checking it with the given program.

Step-by-step instructions are given on how to enter the program into the computer and also on how to verify the contents of the accumulator and registers. This demonstrates very clearly how the system operates.

After each lesson book has been studied and all the questions have been answered on the corresponding test paper, the completed test paper has to be sent to the tutor assigned to the student. The tutor marks the paper and returns it with comments on the wrong answers.

I usually found that the comments were helpful, giving the correct answer with an explanation. However, on a couple of occasions I was told to read the text again and resubmit my answer. I didn't find that very constructive, especially as I'd already spent more time than should have been necessary studying the relevant text. I assumed that the information must have been somewhere in the notes, but finding it was a problem; the notes were sometimes not clear and the facts were scattered.

It seemed to me, after several frustrated attempts to find specific information to answer questions, that the course had been written by someone who is so familiar with microcomputers that many essential basic explanations had been overlooked. This is not an uncommon practice, unfortunately, and is often the case with technical manuals.

There are 6-10 questions on each test paper. Each question has a multiple choice answer and the instructions are to tick the box you believe corresponds to the correct answer.

However, it wasn't explained that only one of the possibilities could be correct. I once ticked three out of the four statements as they all seemed to be correct. But I was later told that the test questions in this course only allow for one correct statement.

I must admit that I was lulled into a false sense of security when I first saw that the answers were all multiple choice. However, it doesn't make the test papers any easier.

I treated this course seriously; read each text book carefully, did all the examples and worked through the programs on the MPF-1B. At first I thought that I would then be able to answer the test paper without referring back to the lesson book. But it wasn't that easy.

I think that there was a deliberate conspiracy to make me study the text book again. A good plan, I suppose, to make sure that the text has been read thoroughly. However, as I have already mentioned, it wasn't easy to find specific information to answer a question.

Sometimes I eventually found this information in the MPF-1B User Manuals but it was a frustrating experience trying to find anything in them. As there was no index for these manuals I wasted a lot of time familiarising myself with the contents so that I would know what was in them and where to find it.

Course revisions

The 'Master the Microprocessor' correspondence course was only started in Australia in August 1983. As I was the first student it was not surprising that I came across some areas that could be improved. Since completing the course I have discussed it with the staff of the Australian School of Electronics and they are making some alterations to the course structure. The main revisions are in the following areas.

1. Index. An overall index is being compiled which, for practical purposes, will be kept separate from the text books and user manuals. This index will make it easy to refer back to any topic covered in the course.

2. Lesson books. The British National Radio & Electronics School, which designed this course, has told the Australian School of Electronics that it is currently assessing the text and, where necessary, rewriting it. But who knows when we will see that in Australia. So the Australians are also going through the course and inserting extra information.

3. User Manuals. The British School is also assessing the User Manuals. However, the Australian School is ahead of them; wherever reference is made in the text to the User Manuals (for programming instructions, tables, etc) they are actually inserting that information into the lesson book. Hopefully, this will eliminate having to consult several books when answering the questions.

4. Study guide notes. These notes will be incorporated at the beginning of each lesson book. They will prepare the student for that particular lesson, emphasising certain sections where new concepts are discussed.

5. Test guide notes. These will be attached to each test paper, giving useful clues, hints, etc, especially on the more 'tricky' questions. The intention of these notes is not to make the tests any easier but to eliminate ambiguous questions which could be misinterpreted.

6. Discussion notes on tests. These will be sent to students with their corrected test papers and will contain any extra information which may be useful. These notes will concentrate on the questions which appear to cause the most difficulty.

7. Model answers. Model answers with explanations will be given for each question. They will be sent to the student with the corrected test paper.

Conclusions

I found the course very useful and definitely worth the effort. Now that the course has been assessed and improved with the additional notes it will certainly be worthwhile, if you want to learn about microprocessors in your own time at home.

If you would like to enrol in any of the courses run by the Australian School of Electronics contact **Bert Horszowski, School Director, P.O. Box 108, Glen Iris Vic. 3146. (03)523-5622.** ●

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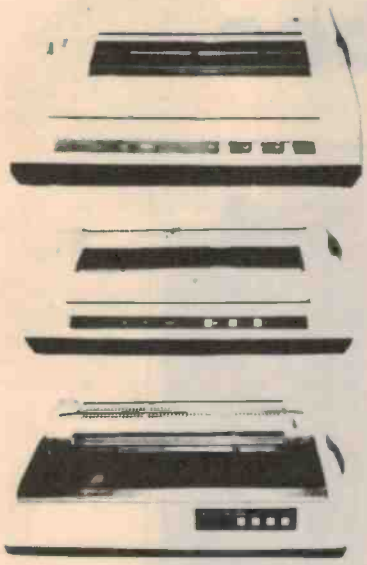

Pro/Writer Printer 8510

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

Model 1550

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

F-10 Printmaster Daisy Wheel Printer

Print Speed: 40 CPS. **Print Method:** Static Print Impact. **Number of Printable Columns:** 136, 163. **Variable Character Spacing:** 1/120 Inch (minimum). **Line Spacing:** 1/48. **Return Time:** 900 msec. **Line Feed Time** 40 msec. **Paper Width:** 406 mm (maximum). **Print Characters:** 96. **Printwheel:** Industry Standard 96 Character Wheel. **Interface:** Industry Standard 8-bit Parallel, RS232-C Compatible, X-ON, X-OFF, 12-bit Qume and Diablo Compatible. **Dimensions:** 574 mm W x 405 mm d x 153.5 mm H (22.5" W x 15.9" D x 6" H). **Weight:** 14 kg (30.8 lbs.) with cover and power supply. **Noise:** Less than 65 Db (1M from Platen, A Scale).

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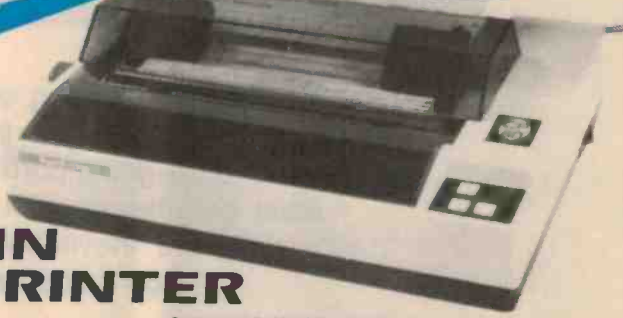

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CP-80/I, 80-COLUMN IMPACT PRINTER

SPECIFICATIONS

Functional Specifications
Printing method — Serial impact dot matrix.
Printing format — Alpha-numeric — 7 x 8 in 8 x 9 dot matrix field. Semi-graphic (character graphic) — 7 x 8 dot matrix. Bit image graphic — Vertical 8 dots parallel horizontal, 640 dots serial/line.
Character size — 2.1 mm (0.083")-W x 2.4 mm (0.09")-H 7 x 8 dot matrix.
Character set — 228 ASCII characters. Normal and italic alpha-numeric fonts, symbols and semi-graphics.
Printing speed — 80 CPS 640 dots/line per second.
Line feed time — Approximately 200 msec at 4.23 mm (1/6") line feed.
Printing direction — Normal — Bidirectional logic seeking. Superscript and bit image graphics — Unidirectional left to right.
Dot graphics intensity — Normal — 640 dots 190.5 mm (7.5") line horizontal. Compressed characters — 1,280 dots/190.5 mm (7.5") line horizontal.
Line spacing — Normal — 4.23 mm (1/6").
Programmable in increments of 0.35 mm (1/72") and 0.118 mm (1/216").
Columns/line — Normal size — 80 columns. Double width — 40 columns. Compressed print — 142 columns. Compressed double width — 71 columns. The above can be mixed in a line.
Paper feed — Adjustable sprocket feed and friction feed.
Paper type — Fanfold Single sheet. Thickness — 0.05 mm (0.002") to 0.25 mm (0.01"). Paper width — 101.6 mm (4") to 254 mm (10").
Number of copies — Original plus 3 copies by normal thickness paper.
Mechanical Specifications
Ribbon — Cartridge ribbon (exclusive use), black.
MTBF — 5 million lines (excluding pring head life).
Print head life — Approximately 30 million characters (replaceable).
Dimensions — 377 mm (14.8") -W x 295 mm (11.6") -D 125 mm (4.9") -H incl. sprocket cover.

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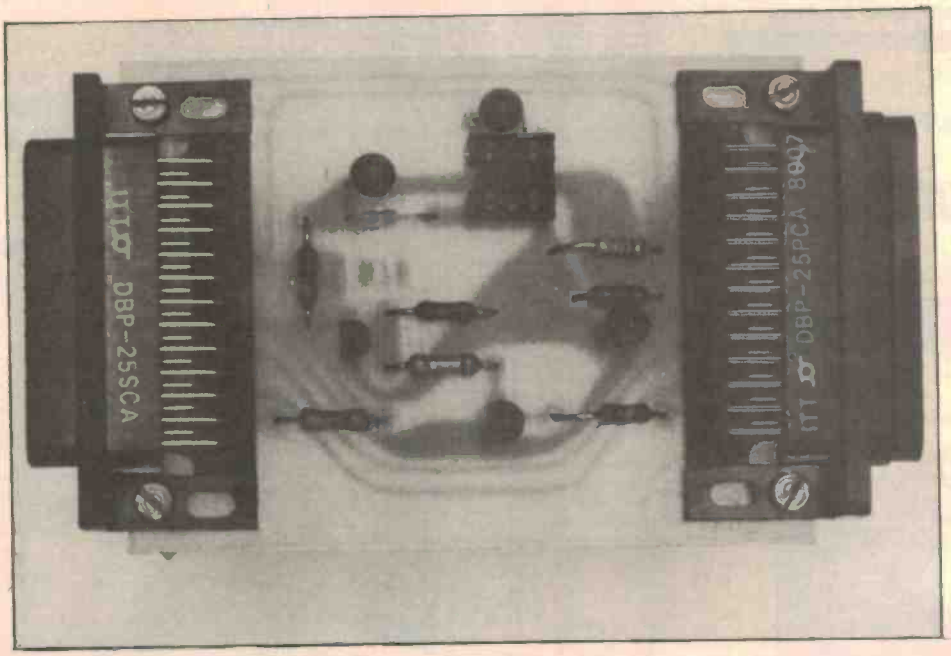
A 'fair dinkum RS232er' for the Microbee



The Microbee, among other home computers, has a 'sort of' RS232 port in that it doesn't implement the negative-going portion of its output signal (TxD). Most peripherals with an RS232 input can cope with that, but inevitably, there are those that can't — as Bob found out. This project fixes that.

Bob Martindale VK3BMA

HAVING HAD my Microbee for over 12 months, and after playing the usual games, etc, it came time for some 'serious' work for the machine. At about this time, I gained access to a high quality daisy-wheel type printer — a Diablo 1650 word processor terminal (*very* smart!) — which, fortuitously, is provided with a 1200 baud RS232 interface socket. Bewdy! I thought, and proceded to make arrangements to obtain super quality listings of my programs. After checking port pinouts, a patch cable was assembled and the system fired-up. It didn't work!

Application of an oscilloscope indicated that the Microbee's TxD output signal was switching between 0 V and about +10 V. Reference to the 'Bee's circuit diagram revealed a transistor switching stage powered from the +12 V (nominal) supply rail. A quick check of Graham Wideman's article *Beating the RS232 Blues* in ETI for August 1982 indicated there should also be a negative signal excursion of between 3 V and 12 V amplitude if, in fact, the Microbee's output was to be 'true' RS323. Hmmm ... could that be the culprit?

I quickly assembled a switching adaptor (two transistors) powered from positive and negative supply rails on solderless breadboard and tried the system again. It worked first up, and voila! — super quality printouts.

I then reassembled the circuit on a small piece of Veroboard, adding a negative supply rail inverter (Intersil ICL7660) to make the unit self-contained and capable of being powered from the Microbee's supply rail (available on pin 9 of the RS232 port). I managed to make it small enough to mount, out of sight, inside the backshell of a DB25 plug. However, ETI has made a pc board version that simply 'inserts' between the 'Bee's RS232 port and the peripheral's RS232 plug.

Construction

Assembly diagrams are given for both the Veroboard and pc board versions. A track-cutting diagram is given for the Veroboard. This should be done first if

PARTS LIST — ETI-676

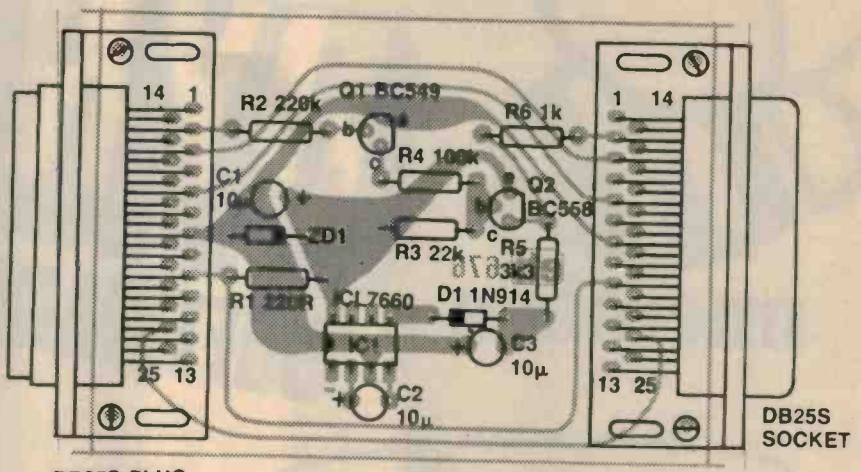
Resistors .....all ¼W, 5%
- R1 .....220R
- R2 .....220k
- R3 .....22k
- R4 .....100k
- R5 .....3k3
- R6 .....1k

Capacitors
- C1, 2, 3 .....10µ/10 V tant.

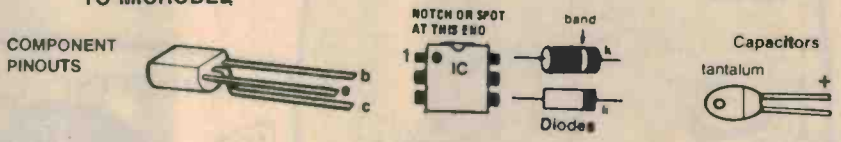
Semiconductors
- D1 .....1N914, 1N4002, etc
- IC2 .....ICL7660
- Q1 .....BC549
- Q2 .....BC558
- ZD1 .....6V8 zener

Miscellaneous
ETI-676 pc board; DB25P right-angle pc mount plug; DB25S right-angle pc mount socket; 4 x 4BA bolts, nuts and washers.

Price estimate $32-35



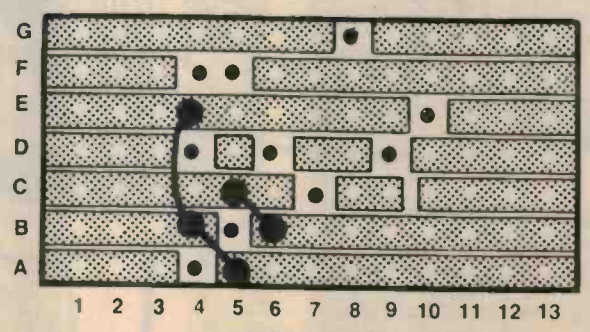
DB25S PLUG
TO MICROBEE

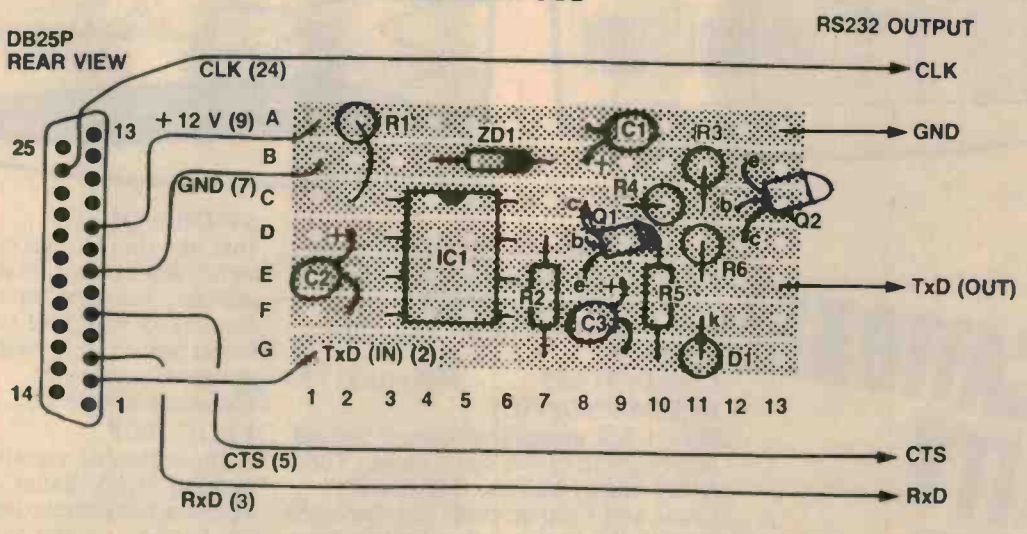


you're assembling the project this way. Note that two links are required, but these should be soldered in later. An IC socket may be used for IC1 but note that pins 1, 6 and 7 *do not* make connection to the copper strips of the Veroboard. If you're using a socket, snip off or remove pins 1, 6 and 7, otherwise cut off the pins from the IC.

The components can be assembled in any order, but, as usual, watch orientation of the semiconductors and tantalum capacitors. Note that some components are stood on end. Seat the components right down on the board and you'll fit the project in a DB25 backshell without too much difficulty. Wire the assembly to the DB25 plug with short lengths of hookup wire and wire the cable to TxD and GND. Note that RxD, CTS and CLK should be wired straight through to the DB25 plug.

The pc board version is also simple to assemble. Just follow the overlay. Carefully check the pc board before assembly. ▶





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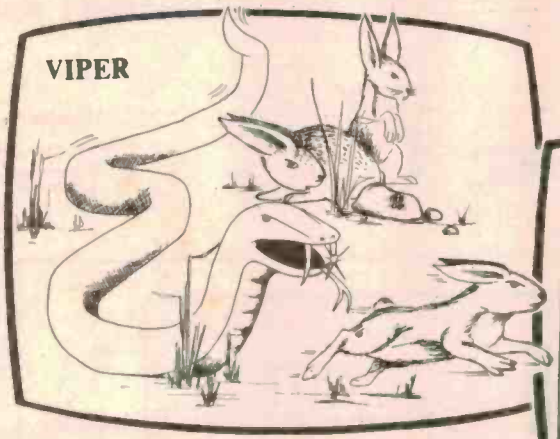

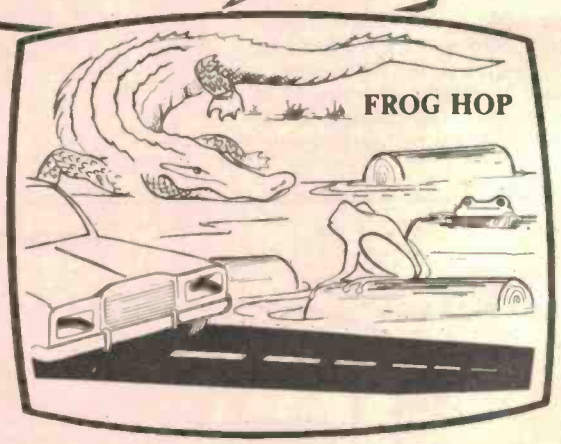

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TUTORIAL: Touch Typing Tutor and Basic Tricks. The microbee is an ideal educational computer recommended by educational authorities across Australia. This package enables you to learn to touch type using the Pitman touch typing method. For those who want to master Microworld Basic there is a series of hints and suggested subroutines arranged in a most effective menu driven style.
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RING OF DOOM
Your quest is to search for the Dark Lord of Saurean's Ring of Power. This action adventure game will operate in a 16k microbee.
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CHESS/CHESS TUTOR
For those who enjoy a serious graphics game it is hard to beat Chess. If your game needs improving try the tutorial first. You can select from 6 levels of play and these can be altered during the game. This program features very good graphics and, particularly at the higher play levels, becomes a most worthy opponent. (32k microbee recommended).
Cassette $14.95 ..... Diskette $19.95

TARGET/TREK
These are two of the 'classics' of computer games and will still impress with the use of characters to emulate graphics (remember they only had teletypes on the 'old' days around 1976). The challenge of Trek will attract even the most ardent 'anti games freaks'.
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By popular request, the low cost microbee Series 2 Experimenter has been designed for those who are starting out in the fascinating world of computers or those who want to share the fascination of exploring the exciting developments in the fast moving MICRO WORLD.
Demand for projects using the microbee is so great that 'Electronics Today' are now planning to run a microbee project every month during 1984. So far ETI has described the light pen, EPROM programmer, a radio TTY printer, the world's first home facsimile receiver and ROM expander board for the microbee. Virtually every local computer magazine has run reviews and/or columns devoted entirely to the microbee. If you want to be part of the MICROCOMPUTER GENERATION in 1984 then microbee Series 2 Experimenter is the ideal starting point. Of course you can expand your microbee Series 2 Experimenter as your need grows.

$399

Cat. XE-4000

Note: the software that is supplied with each machine – at no extra charge!!

microbee Series 2 EDUCATOR

The microbee Series 2 was specifically designed to serve the needs of the EDUCATION MARKET. Let's face it, the primary non-business use for most personal microcomputers is to increase our learning capabilities either about computers (computer awareness) or about life itself. microbee Series 2 has now been officially approved by Education Departments in NSW, WA and Queensland and is being carefully considered in virtually all other states and by the National Schools Commission at the time this ad was going to press.
The microbee Educator uses BATTERY BACKED NON-VOLATILE CMOS RAM so your programs are saved in the microbee Series 2 after the power is switched off. Students can bring the microbee Series 2 Educator home from school to complete assignments ready for class the next day. With the optional BEEMODEM you can use your microbee Series 2 Educator to talk to other computers or information networks.

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The microbee Series 2 APC uses the popular Z80 microprocessor and runs standard CP/M so that users have access to the vast library of CP/M software available world wide. MICROSOFT BASIC is now supplied on disk. WORDSTAR, according to independent surveys now accounts for 50% of ALL word processing software now in use so the designers of the Series 2 APC decided to purchase the OEM rights for your benefit. MULTIPLAN is considered by many to be one of the most powerful spreadsheets yet produced for the microcomputer.

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A fast action packed game which must rate as one of Mytek's best. You have full control of a helicopter and you must fly over enemy lines to rescue your allies. Fast realistic graphics and excellent sound.
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A program to help you design your own P.C.G. characters. Simple commands allow easy drawing of circles, polygons and boxes etc. These then can be dumped to tape to be used in a future program. Comes complete with manual.
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PRINTERS MATE
This program is two screen dump programs to suit CP80, MX80, DT80, 80DP and FAX80 printers. One program is a screen dump utility while the other prints out memory contents in both hexidecimal and ASCII characters. A must for use with printers.
Cat. XE-7051 $17.50

DUO – ONE
Another two programs for the price of one from Dreamcards. One side has poker, and the other is Casino which is a three reel poker machine. Both use hires graphics. Excellent value
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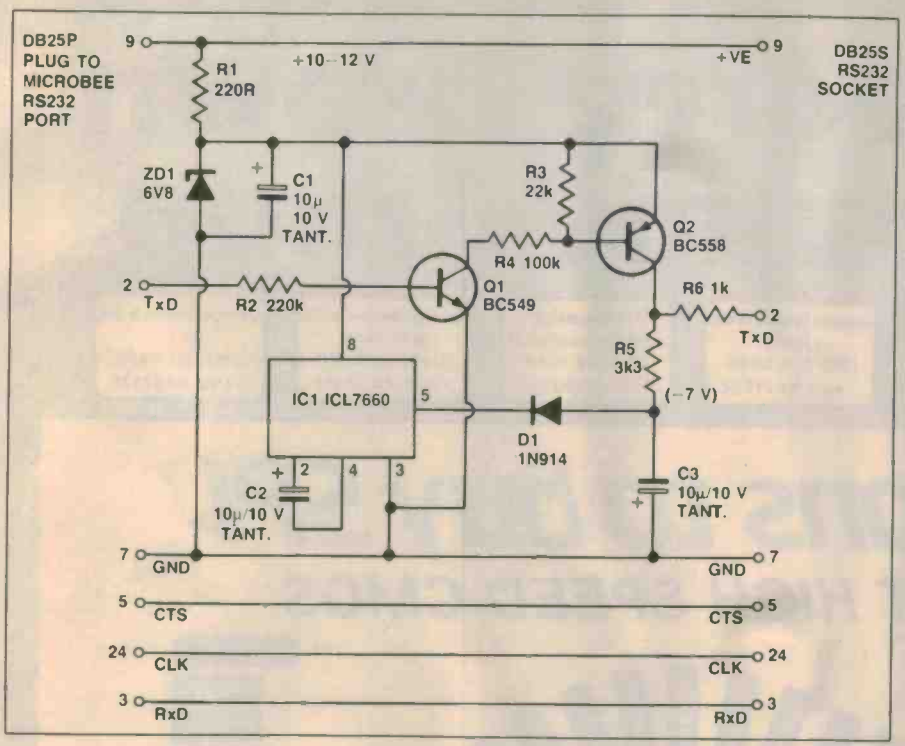
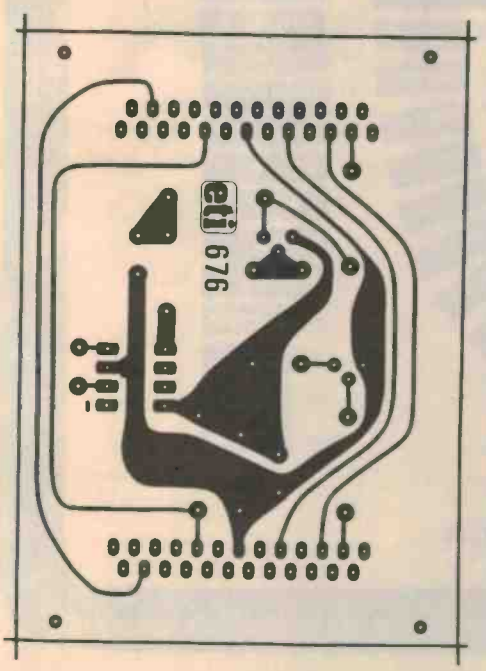


Mount the resistors, capacitors and semiconductors first, taking care to correctly orientate the semiconductors and tantalum capacitors. Mount the DB25 plug and socket last — making sure you get each at the correct end of the board. The plug goes at the Microbee end, the socket at the output end. When mounting these, bolt them to the board before soldering the pins so that no stress is placed on the soldered joints.

After a careful check, you're ready to go.



LLIST solver

So, if you are having trouble driving that fancy high quality printer with your 'Bee then check the actual line input printers available that are quite happy to work with only positive-going signals, but occasionally there will be a finicky one that insists on true RS232 levels — in that case, bring out your "Fair Dinkum RS232er".

HOW IT WORKS — ETI 676

The recipe is simple: take one positive supply rail (from Microbee), regulate it then invert it to provide a negative rail, too. Take common-or-garden NPN/PNP transistor pair and switch TxD signal between positive and negative rails without inversion, Voila — true RS232!

A regulated positive supply rail is supplied by zener ZD1 from the Microbee's internal supply rail (which is around 10 V with a bit of ripple onit). Capacitor C1 provides bypassing.

The negative supply rail is developed by ICl, an Intersil ICL7660 CMOS switching inverter which transfers charge from the positive rail to C2 then in opposite polarity to C3 via D1. The diode is included on the manufacturer's advice to prevent possible destructive latchup of ICl.

The incoming TxD signal from the Microbee is first inverted by Qi, the collector current of which drives the base of Q2 via R4. The emitter of Q2 goes to the unit's positive supply rail, while its collector load (R5) goes to the unit's negative supply rail and thus the TxD signal at the collector of Q2 swings both positive and negative. Resistor R5 provides a measure of protection to the circuit should the output he inadvertently short-circuited.

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73. 74HC257
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80. 74HC367
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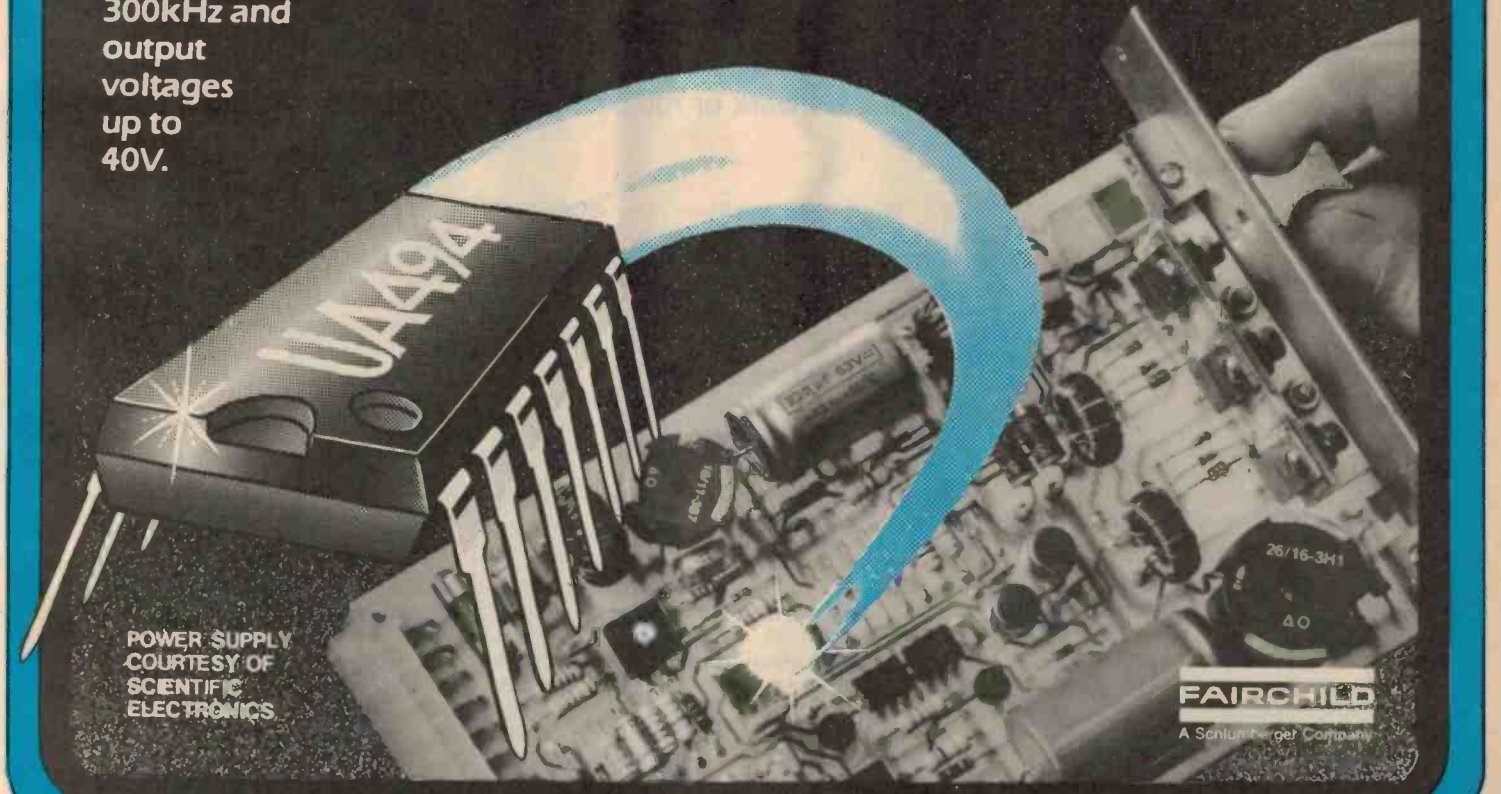
REGULATORS

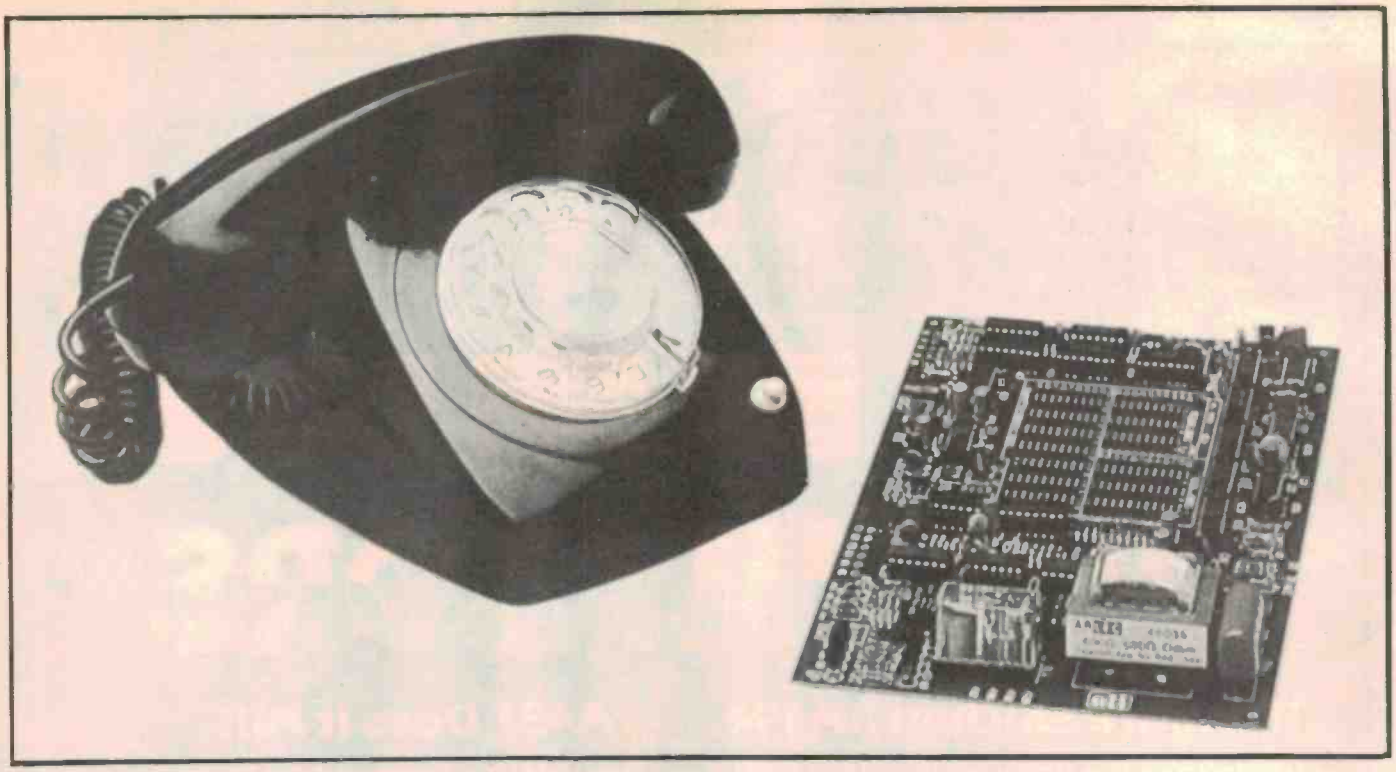
The more efficient μA494.

The μA494 is a monolithic integrated circuit which includes all the necessary building blocks for the design of pulse width modulated switching power supplies, including push-pull, bridge and series configurations. The device can operate at switching frequencies between 1.0kHz and 300kHz and output voltages up to 40V.

μA431 Does it All!

The μA431 is a 3-terminal Adjustable Shunt Regulator with guaranteed temperature stability over the entire temperature range of operation. The output voltage may be set at any level greater than 2.5V up to 36V merely by selecting two external resistors that act as a voltage divided network. Due to the sharp turn-on characteristics this device is an excellent replacement for many zener diode applications.





Direct-connect computer modem revision

The ETI-644A pc board is a revised version of the original computer modem which allows communications between computers over cables, the telephone network or radio links.

Geoff Nicholls

THE DIRECT-CONNECT MODEM project, ETI-644 (shown above), was designed by Trevor Marshall and the description and construction techniques were published in ETI, October 1982.

It was a very popular project but, as the many people who tried to build it found out, there were a few problems. So we published an errata for the modem in ETI, April 1983. And that's not all. A follow-up article appeared in ETI, November 1983, with lots of advice from the designer and a successful constructor.

However, we realised that it was not an ideal situation for constructors to have to make changes to the pc board and we have been planning to issue a revised pc board incorporating all the previous modifications. So, here it is.

The ETI-644A (hopefully) does not have the errors that were on the first version and it includes some other changes so that it conforms more closely to the Telecom requirements. This new board also allows a choice of isolation transformers.

If you are modifying the original pc board, or working on the revised version, you will need to refer back to the follow-up articles and, of course, the first article detailing the design and construction.

Modifications

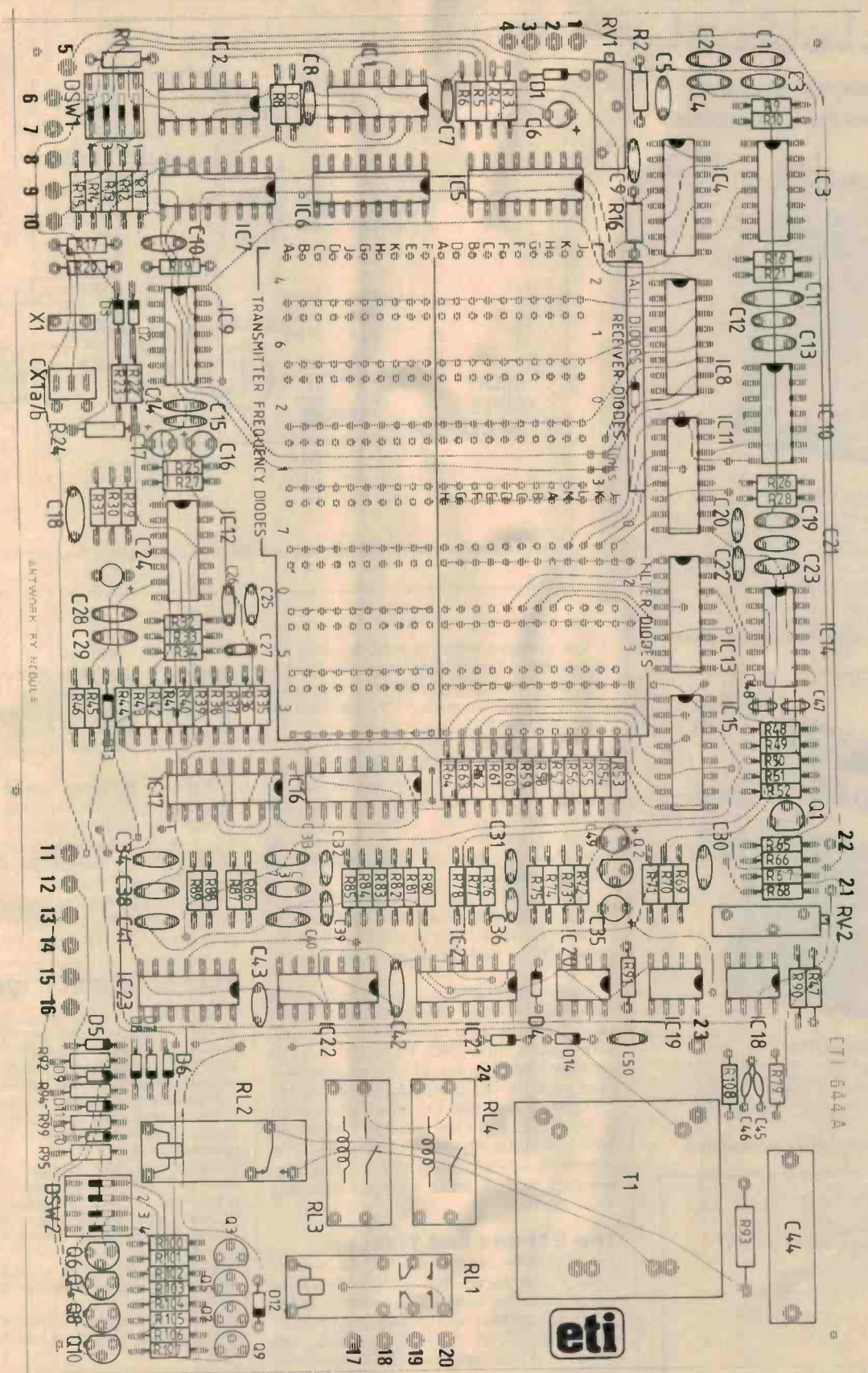
The errors corrected on the original version involve three areas of the circuit:

1. Rerouting the track to C31 to conform to the circuit.
2. Changing the tracks around IC12a to conform to the circuit.
3. Running R48 to 0 V, not −6 V.

The first and third changes were published in the errata in ETI, April 1983, and the modem follow-up article in ETI, November 1983. The second change has never been clearly explained before, due to a communication problem (the designer lives in California). If you have one of the original pc boards these modifications should be made by cutting tracks and running links.

- C44 has been moved.
- R93 has been moved.
- The isolation transformer pads have been extended to allow a choice between the Arlec 45035 transformer, as in the original modem, or the new Ferguson MT627 which we believe is less expensive. The position of the transformer has not been changed.
- RL1 has been moved towards the board edge.
- RL2 has changed to FBR611D012.
- RL3 and RL4 have been moved upwards.
- D12 has been moved.
- R96, R97 and R98 have been deleted, therefore 12 V relay coils must be used for RL1,2,3,4.

Some resistors and transistors associated with RL3 and RL4 have been interchanged so that the DIL switches and the relay drive input pads will be the same as the earlier board. These labels have been transposed: R95↔R99, D10↔D11, Q6↔Q4. ▶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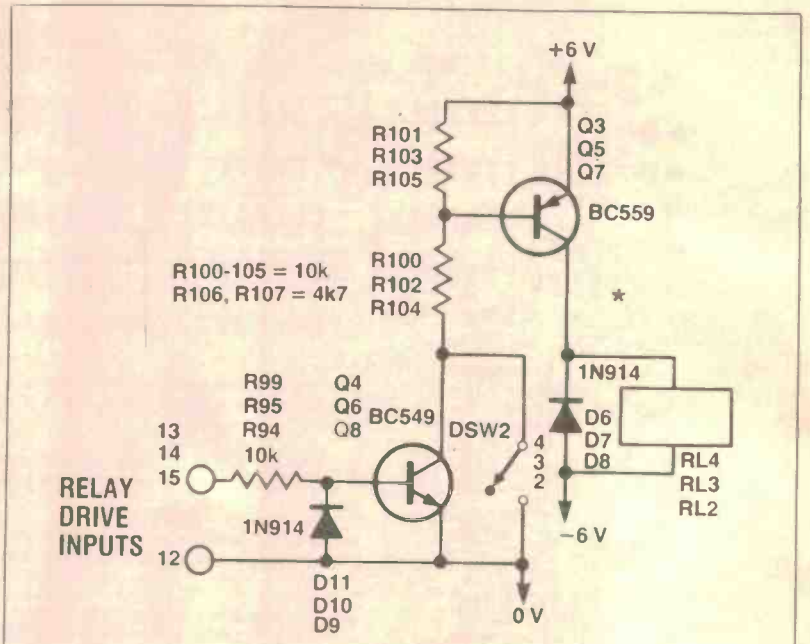


Line interface relay drivers. *Note that R96, R97 and R98 have been removed.

The changes made around the line wiring increase the spacing between the line side and user side tracks to 5 mm minimum, in accordance with Specification 1302, Section 15.7.

This section also calls for a minimum of 15 mm between wiring components and their pigtails on either side of the line interface. This requirement is not completely met, however, it may be possible to satisfy the inspectors by encapsulating the offending terminals with a suitable insulating compound.

The only *essential* construction changes are that insulated pc mounts must be used — either nylon bolts and nuts or plastic stand-offs — and all relays must have 12 V coils.

The usual practise is to provide a pair of back-to-back zener diodes across the user side of the isolation transformer to comply with Specification 1302. However, it is our opinion that the use of a type-approved plug pack for the power supply (as in the ETI-644) means that the entire user circuit is at a safe extra-low voltage and so no further limiting devices are necessary. This argument has *not* been put to Telecom, however, and we make no claim regarding its acceptance.

The ETI-644 and Telecom

The Telecom regulations, as we understand them, mean that any 'kit' modem will have to be individually submitted for approval and that no type-approval is possible. This is, of course, a sensible approach by Telecom since the standard of workmanship by individual constructors is unknown.

However, there may be a way for a kit supplier to get type-approval, providing that the line interface and power supply components can be pre-assembled in a way that satisfies Telecom, leaving only the user side for the constructor to assemble.

Another approach would be to use a type-approved line isolation unit between the modem and the Telecom line. I don't know of any suppliers of such units, but it is a way to get authorisation without having to submit a modem.

You should refer to the legislation concerning modems which was summarised on page 26 of ETI, October 1982. ●

TELECOM SPECIFICATIONS

To the best of our knowledge, no-one has gone through the approval process neccessary to gain authorisation from the Regulatory Branch of Telecom. This is not surprising, considering the amount of paperwork (and legwork) required.

The relevant documents that Telecom issue are:

1. Specification 1240 Issue 2 *Attachment of Privately Owned Data Modems to the Telecommunications Network.*
2. Specification 1302 *Electrical Safety Requirements for Permitted Attachments.*
3. Specification 1364 *Line Isolation Units.*
4. Specification 1050 *Attachment of Private Equipment to the Telecommunications Network, General Conditions.*
5. Specification 1053 *Attachment of Private Equipment to the Switched Telephone Network, Technical Conditions.*
6. Specification 1054 *Attachment of Private Equipment to Private Telephone Lines, Technical Conditions.*
7. Specification 1222 *Use of Type 604/611 Plug and Socket.*

Component NEWS

SOANAR NOW MARKETING NEC SEMICONDUCTORS

Soanar Electronics has been appointed as the distributor for the Semiconductor Division of NEC Australia Ltd.

NEC Electron Devices, the Semiconductor Division of the giant NEC Corporation of Japan offers a very competitive source for INTEL integrated circuits.

Backed by the resources of NEC, Soanar will now be stocking the following range at all Soanar Branches throughout Australia: RAMs, EPROMs, single chip 8-bit microcomputers, microprocessors and peripheral ICs.

In addition, Soanar will handle the NEC range of CMOS 4-bit microprocessors which they claim are ideally suited to the Australian market.

A new 1984 microcomputer catalogue is currently being printed and is due for release shortly. For further information contact **Soanar Electronics Pty Ltd, P.O. Box 170, Box Hill Vic. (03)890-0661.**

HCMOS DATA BOOK

Motorola's reference book on the MC54/74HC high-speed CMOS logic family is now available.

The book offers a complete function selector guide, a military/hi-rel selector guide, a design considerations chapter and data sheets. A total of 147 devices are detailed, with 71 circuit descriptions including ac/dc parametrics and 76 parts with pinout and functional descriptions only.

In the extensive function selector guide, the devices are grouped into 15 categories of logic functions. To assist users in choosing a device, the features are described in a vertical column and the devices are listed horizontally. The guide also includes block diagrams for all 147 devices.

The design considerations chapter provides information on power supply considerations and handling precautions.

The ac and dc parametrics are specified for a range of two to six volts and temperatures up to 125°C. The chapter on reliability includes major test descriptions and tabulations of results.

Copies of the High Speed Data Book can be obtained from **Motorola Semiconductor Products, 250 Pacific Hwy, Crows Nest NSW 2065. (02)438-1955.**

SURGE PROTECTION AND TESTING BOOKLET

A 20-page, fully illustrated booklet published by Key-Tek Instrument Corp is an introductory guide to surge protection and testing of systems, circuits and protective devices. The material is keyed to both technical and non-technical personnel.

A question-and-answer format covers the causes of transient spike voltage and current surges, and the problems they create in today's computers and other microelectronic systems.

The booklet outlines circuit design and test techniques for surge protection, and discusses the new IEEE Standard 587 for ac power-line spike surges.

Copies are free of charge to electronics engineers engaged in equipment design or testing, and can be obtained from **The Dindima Group Pty Ltd, PO Box 106, Vermont Vic. 3133.**

MOTOROLA'S MOS MODEMS

Motorola has announced a set of MOS ICs for 300 and 1200 baud modem applications to suit Bell 103/113 (300) and Bell 202 as well as CCITT V.21 (300) and CCITT V.23 (1200) communications standards

The MC145445 comes in a 22-pin package and is TTL compatible. When paired with the MC145440 filter, it makes up a 300 baud Bell 103 modem or, when paired with the MC145441 filter it provides a CCITT V.21 modem.

These devices, using differential delay demodulation, provide high performance, low cost modems with the lowest bit error rate of 300 baud IC modem solutions, Motorola claim.

The MC145445 features eight selectable RTS/CTS delay options, answer-back tone generator and a carrier detect input.

The MC145450 is a 1200 baud modem intended for use in Bell 202 and CCITT V.23 standard applications.

It is TTL compatible and can be pin-programmed for either Bell or CCITT operation. The 22-pin DIL package derives internal timing from a standard 3.6864 MHz crystal.

For CCITT V.23 applications, the chip is Mode 2 compatible with a baud rate of up to 1200 bits/sec on the main channel and up to 75 bits/sec on the backward channel.

A logic-controlled mode input selects the frequency pair used for modulation and demodulation, as well as the transmit and receive baud rates. The CTS signal can be delayed in eight steps over a 0-426.6 ms range under logic control. Additional functions include logic-controlled self-test, transmit test, answer-back and soft turn-off.

We have no information of delivery schedules or prices as yet. Motorola distributors in Australia are VSI and Soanar.

PC MOUNT RELAY SWITCHES 30 AMPS

Inexpensive printed circuit board mount relays for ac or dc loads up to 30 amps are now avaialble from Potter & Brumfield, through their Australian Distributor, Tecnico Electronics.

T90 series relays are designed for use in appliances and heating, ventilating and air-conditioning equipment. Additional applications are anticipated in load management, automotive and other markets where logic systems need to be interfaced with high current loads.

Measuring only about 24 x 30 x 17 mm high, open-style T90 series relays feature printed circuit terminals arranged on a 0.05" x 0.1" (1.3 x 2.5 mm) grid. Snap-on plastic dust covers are available as an option.

Silver or silver-cadmium oxide contacts are offered in 1 form A (SPST-N/O), 1 form B (SPST-N/C) and 1 form C (SPST) arrangements. Maximum contact rating is 30 amps, inductive or resistive, at 240 volts ac. T90 relays will also switch loads as low as 0.5 amps at 5 volts dc or

12 volts ac.

T90 series relays are available with dc coils for 5, 6, 9, 12, 18 or 24 volts. Coil resistance ranges from 18 Ohms for 5 volt models to 456 Ohms for 24 volt models. Nominal coil power is 1.25 watts. Class B (130°C) insulation is standard.

Initial breakdown voltage exceeds 1500 volts rms from contact to contact and from contact to coil. T90 relays are designed to operate in ambient temperatures from −55°C to +85°C.

For additional information, contact, **Tecnico Electronics, 67 Mars Road, Lane Cove, NSW 2066. (02)427-3444.**

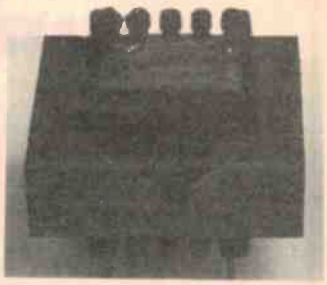
FIVE-LEGGED DRIVERS

Two new universal, high current drivers are now available from RIFA. They are intended for resistive loads, solenoids, relays and low-power lamps.

The PBD3544 and PBD3545 are complementary drivers (source/sink versions). They have a continuous output capability of 2 A at 45 V. Both feature an error detection function which is claimed to enhance serviceability by allowing their incorporation into diagnostic circuitry in the host product.

The PBD 3544/45s contain extensive protection circuitry which renders them virtually indestructible when driving a wide variety of loads. Important operational characteristics include short-circuit protection, thermal overload protection, internal protection diodes, open circuit detection. The inputs are LS-TTL and CMOS compatible. Encapsulation is a 5-pin TO-220.

Details from **RIFA Pty Ltd, PO Box 95, Preston Vic 3072. (03) 480-1211.**



NEW ISOLATION TRANSFORMERS FOR MODEMS

The ever increasing use of microcomputers has created a demand for modem interfacing to link computers via telephone or radio.

To meet this need, Ferguson Transformers has added two new Telecom-approved line isolation transformers to their range. Both are intended for printed circiut board mounting and are capable of handling most data transmission requirements.

Designated MT-620 and MT-627, both have a matching impedence of 600 Ohms. The MT-620 provides a flat response between 300 Hz and 2200 Hz with rapid attenuation to 20 kHz. As a result, crosstalk and noise outside the required bandwidth are greatly reduced.

Where a flat response is required across the whole bandwidth, the MT-627 covers the entire range from 300 Hz to 20 kHz.

Other applications include radio to telephone patching and centralised word processing.

The two new transformers join a range of printed circuit board mounted power transformers of similar design with secondary ratings from 9 to 30 V and 2.5 to 12 VA.

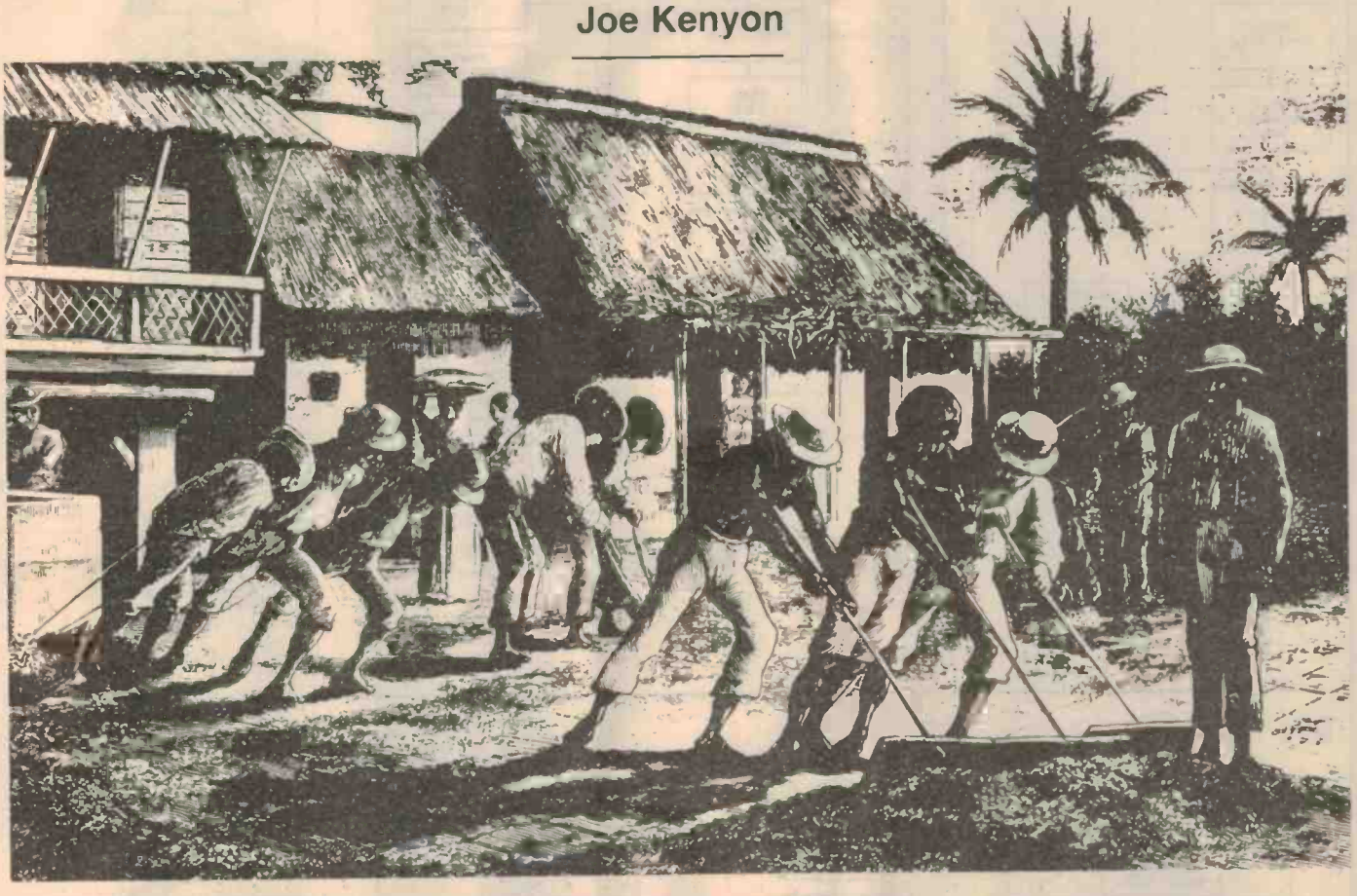
The MT-620 and MT-627 are wholly designed and manufactured in Australia to suit Australian conditions and are available from stock. Further information is available from **Ferguson Transformers Pty Ltd, 331 High Street, Chatswood 2067 NSW. (02)407-0261.**

You rotting swine!

— a compost calculator

If you're into gardening, or someone around your house is, and you own a computer — here's how to combine two disparate activities and maybe win friends and influence plants at the same time.

Joe Kenyon



HERE IS a down to earth 'basic' program anyone can use to quickly make sweet smelling, nutritious (for the garden) compost, completely rotted in three weeks, and help beat the high price of vegetables. But why bother? Well, doom and gloom seem to have gone out of fashion lately, but the simple fact is that we have to conserve our resources to survive. On our dry continent, water and soil are major resources. Composting otherwise wasted materials will help conserve both water and soil by reducing evaporation and erosion.

Every year we burn or dump thousands of tonnes of organic material which could be economically returned to the soil. In New Zealand these materials are composted by councils and the compost sold back to growers and householders. There are similar community composting facilities in America. (See April 1983 *National Geographic* magazine.)

We can do our part by composting (not burning or dumping) leaves, grass clippings, paper, and a large variety of other garden and farm products.

Compost is especially useful in home gardens in times of drought due to it's moisture conserving properties, and the fact that it can now be made quickly, just when it is needed. Placed around the trees and vegetables, it will keep the soil cool, even on very hot days, thereby cutting evaporation. Earthworms will come up and mix the compost into the surrounding soil thus raising the level of humus and nutrients and reducing nitrogen loss.

Compost can be:

(a) Quickly made.

(b) Sweet smelling.

(c) Made in the open air without bins or fancy containers.

(d) Made so that all weed seeds, plant pathogens, and even maggots are killed.

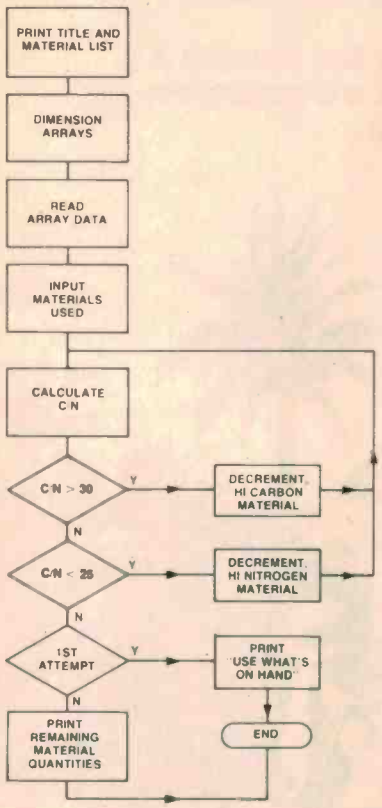
Just what is a compost heap?

It is simply a method of speeding up the natural process of rotting organic materials, in order to return nutrients and humus to the soil. However, a compost heap is also a very complex chemical factory. Till about the fourteenth day after making the heap there are changes continuously occurring in the temperature, pH level, chemical composition and microbiological population. See *Reference 1* if you are interested in a more detailed description of these changes.

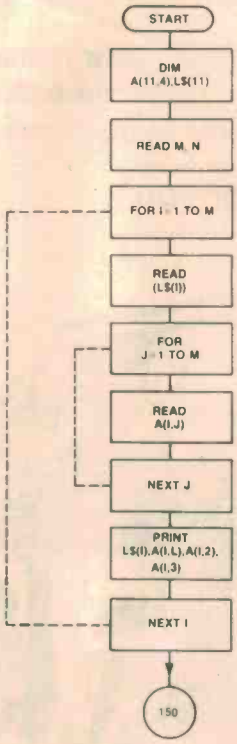
The method described here is called the Berkeley Method and was developed at the University of California, Berkeley. It is the best method of making compost without exception.

The essential elements for this type of compost heap are: ▶

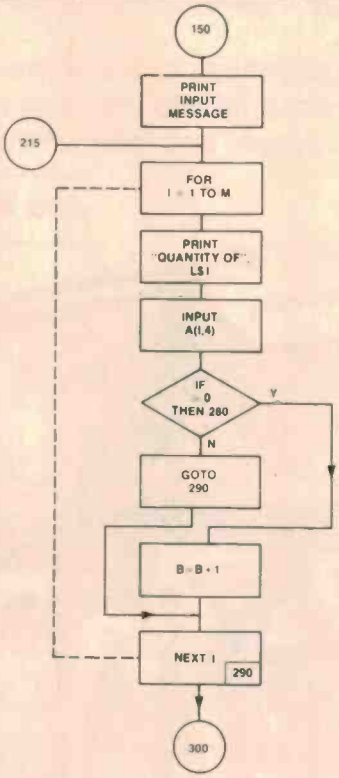
FLOWCHART PRECIS



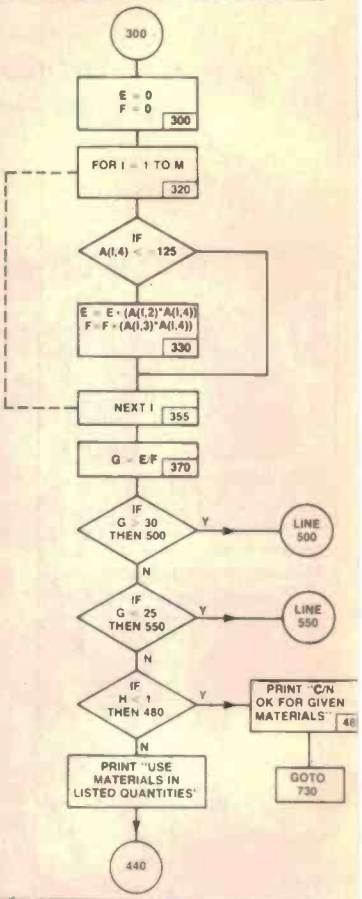
FLOWCHART COMPOST



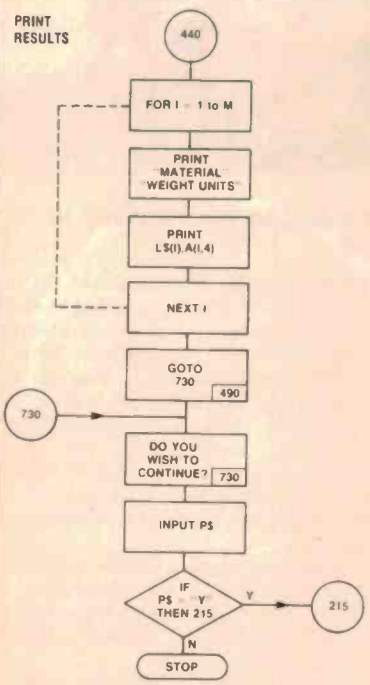
INPUT MATERIALS AND QUANTITIES



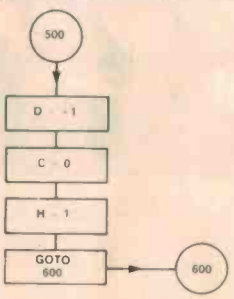
SEARCH ARRAY AND CALCULATE C/N RATIO



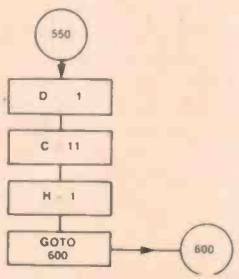
PRINT RESULTS



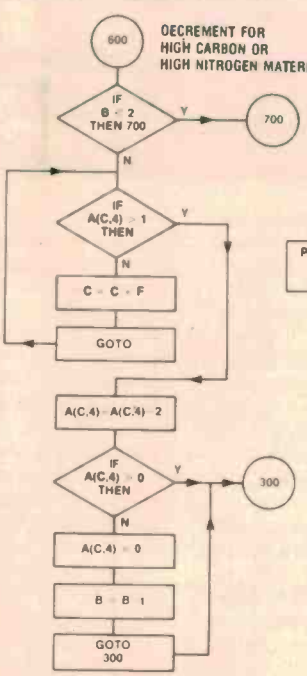
FOR > 30 PROGRAM

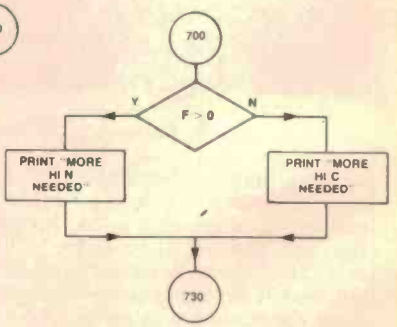


FOR < 25 PROGRAM



DECREMENT FOR HIGH CARBON OR HIGH NITROGEN MATERIAL





VARIABLES:

M, N	= ROWS AND COLUMNS OF ARRAY
A(M,N)	= DATA ARRAY
B	= NUMBER OF MATERIALS COUNTER
C	= ROW POINTER
D	= 1 OR −1, INCREMENT OR DECREMENT ROW POINTER
E	= CARBON QUANTITY
F	= NITROGEN QUANTITY
G	= CARBON/NITROGEN
P$	= YES OR NO

compost calculator

PROGRAM

```
00100 PRINT "COMPOST CALCULATOR - 11 TYPES OF MATERIAL USED"
00110 PRINT "UNITS OF WEIGHT MUST BE CONSISTENT"
00120 READ M
00130 DIM A0(M,4) ,L0(M)
00140 REM....print table of materials & composition.
00150 REM....L0$(x) contains material names
00160 REM....A0(x,1) holds C/N ratios
00170 REM....A0(x,2) holds %C
00180 REM....A0(x,3) holds %N
00190 UNDERLINE
00200 PRINT "MATERIAL"TAB(18)"C/N RATIO"TAB(29)"%CARBON";
00210 PRINT TAB(38)"%NITROGEN"
00220 NORMAL
00230 FOR I=1 TO M
00240 READ L0$(I)
00250 FOR J=1 TO 3
00260 READ A0(I,J)
00270 NEXT J
00280 PRINT L0$(I)TAB(20)A0(I,1)TAB(30)A0(I,2)TAB(40)A0(I,3)
00290 NEXT I
00300 REM....input material amounts into A0(x,4)
00310 REM....B is number of materials used
00320 PRINT "PLEASE ENTER MATERIALS IN WEIGHT UNITS, NONE=0.'
00330 B=0
00340 FOR I=1 TO 11
00350 PRINT "QUANTITY OF "L0$(I);
00360 INPUT A0(I,4)
00370 IF A0(I,4))0 THEN LET B=B+1
00380 NEXT I
00390 REM....multiply amounts by percentages to total C & N
00400 E0=0:F0=0
00410 FOR I=1 TO M
00420 E0=E0+(A0(I,2)*A0(I,4))
00430 F0=F0+(A0(I,3)*A0(I,4))
00440 NEXT I
00450 REM....calculate G0 the overall C/N ratio
00460 G0=E0/F0
00470 REM....if C/N is within range print out table,
00480 REM....otherwise, jump to readjust amounts.
00490 IF G0)30 THEN LET D=1:C=1:GOTO 600
00500 IF G0(25 THEN LET D=-1:C=11:GOTO 600
00510 UNDERLINE
00520 PRINT "MATERIAL","WEIGHT UNITS"
00530 NORMAL
00540 FOR I=1 TO M
00550 PRINT L0$(I)TAB(18)A0(I,4)
00560 NEXT I
00570 PRINT "C/N RATIO="G0" THIS IS OK FOR GIVEN MATERIALS"
00580 GOTO 720
00590 REM....adjust material amounts to get C/N within range
00600 IF B(2 THEN 690
00610 IF A0(C,4))=1 THEN 640
00620 C=C+D
00630 GOTO 610
00640 A0(C,4)=A0(C,4)-2
00650 IF A0(C,4))0 THEN 400
00660 A0(C,4)=0
00670 B=B-1
00680 GOTO 400
00690 IF D)0 THEN 740
00700 PRINT "C/N CANNOT BE RAISED ABOVE ";G0;"UNLESS"
00710 PRINT "MORE HIGH CARBON MATERIALS ARE ADDED"
00720 PRINT "DO YOU WISH TO CONTINUE? (Y=YES)";
00730 INPUT P0$:IF P0$="Y" OR P0$="y" THEN 330 ELSE STOP
00740 PRINT "C/N CANNOT BE REDUCED BELOW "G0;"UNLESS"
00750 PRINT "MORE HIGH NITROGEN MATERIALS ARE ADDED"
00760 GOTO 720
00770 REM....to add extra materials to data table,
00780 REM....increase 1ist entry i.e.'11'
00790 DATA 11,"SAWDUST",450,34,.08,"PAPER",170,36,.2
00800 DATA "STRAW",100,36,.4,"LEAVES",60,24,.4
00810 DATA "FRUIT WASTE",35,8,.2,"LAWN CLIPPINGS",20,6,.3
00820 DATA "WEEDS",19,6,.3,"FOOD WASTES",15,8,.5
00830 DATA "CATTLE DROPPINGS",12,30,1.7
00840 DATA "CHICKEN LITTER",10,25,2.5
00850 DATA "FOWL MANURE",7,30,4.3
00860 END
```

SAMPLE RUN

```
>RUN
COMPOST CALCULATOR - 11 TYPES OF MATERIAL USED
UNITS OF WEIGHT MUST BE CONSISTENT
MATERIAL          C/N RATIO   %CARBON   %NITROGEN
SAWDUST             450.        34.       0.08
PAPER               170.        36.       0.2
STRAW               100.        36.       0.4
LEAVES               60.        24.       0.4
FRUIT WASTE          35.         8.       0.2
LAWN CLIPPINGS       20.         6.       0.3
WEEDS                19.         6.       0.3
FOOD WASTES          15.         8.       0.5
CATTLE DROPPINGS     12.        30.       1.7
CHICKEN LITTER       10.        25.       2.5
FOWL MANURE           7.        30.       4.3
PLEASE ENTER MATERIALS IN WEIGHT UNITS, NONE=0.
QUANTITY OF SAWDUST? 5
QUANTITY OF PAPER? 0
QUANTITY OF STRAW? 10
QUANTITY OF LEAVES? 0
QUANTITY OF FRUIT WASTE? 0
QUANTITY OF LAWN CLIPPINGS? 20
QUANTITY OF WEEDS? 0
QUANTITY OF FOOD WASTES? 0
QUANTITY OF CATTLE DROPPINGS? 0
QUANTITY OF CHICKEN LITTER? 5
QUANTITY OF FOWL MANURE? 5
MATERIAL        WEIGHT UNITS
SAWDUST            5.
PAPER              0.
STRAW              10.
LEAVES             0.
FRUIT WASTE        0.
LAWN CLIPPINGS     20.
WEEDS              0.
FOOD WASTES        0.
CATTLE DROPPINGS   0.
CHICKEN LITTER     5.
FOWL MANURE        1.
C/N RATIO= 29.595588 THIS IS OK FOR GIVEN MATERIALS
DO YOU WISH TO CONTINUE? (Y=YES)? Y
QUANTITY OF SAWDUST? 5
QUANTITY OF PAPER? 0
QUANTITY OF STRAW? 10
QUANTITY OF LEAVES? 0
QUANTITY OF FRUIT WASTE? 0
QUANTITY OF LAWN CLIPPINGS? 20
QUANTITY OF WEEDS? 0
QUANTITY OF FOOD WASTES? 0
QUANTITY OF CATTLE DROPPINGS? 0
QUANTITY OF CHICKEN LITTER? 0
QUANTITY OF FOWL MANURE? 10
MATERIAL        WEIGHT UNITS
SAWDUST            5.
PAPER              0.
STRAW              10.
LEAVES             0.
FRUIT WASTE        0.
LAWN CLIPPINGS     20.
WEEDS              0.
FOOD WASTES        0.
CATTLE DROPPINGS   0.
CHICKEN LITTER     0.
FOWL MANURE        4.
C/N RATIO= 27.89855 THIS IS OK FOR GIVEN MATERIALS
DO YOU WISH TO CONTINUE? (Y=YES)? Y
QUANTITY OF SAWDUST? 10
QUANTITY OF PAPER? 0
QUANTITY OF STRAW? 0
QUANTITY OF LEAVES? 0
QUANTITY OF FRUIT WASTE? 20
QUANTITY OF LAWN CLIPPINGS? 0
QUANTITY OF WEEDS? 5
QUANTITY OF FOOD WASTES? 0
QUANTITY OF CATTLE DROPPINGS? 0
QUANTITY OF CHICKEN LITTER? 0
QUANTITY OF FOWL MANURE? 0
MATERIAL        WEIGHT UNITS
SAWDUST            0.
PAPER              0.
STRAW              0.
LEAVES             0.
FRUIT WASTE        6.
LAWN CLIPPINGS     0.
WEEDS              5.
FOOD WASTES        0.
CATTLE DROPPINGS   0.
CHICKEN LITTER     0.
FOWL MANURE        0.
C/N RATIO= 20.000000 THIS IS OK FOR GIVEN MATERIALS
```

THE PROGRAM

Geoff Nicholls has re-worked the author's original program into Microworld BASIC (Microbee). Other machines running BASIC may require modifications to suit the particular version of BASIC employed. Note that the program will adjust the weights of materials initially entered to achieve the desired result (see the sample runs).

(1) Overall, the carbon-to-nitrogen ratio must be between 25:1 and 30:1;
(2) The heap must be well aerated;
(3) The heap must be kept just moist;
(4) It should be about a cubic metre for convenience;
(5) It must be exercised.

Carbon-to-nitrogen ratio

All garden materials contain some carbon and some nitrogen. The compost heap must have an overall ratio of between 25:1 and 30:1 carbon to nitrogen by weight to work correctly. Too much carbon and microbiological activity is reduced, too much nitrogen means loss of valuable nitrogen in the form of ammonia.

Aeration

If the heap is provided with plenty of oxygen the growth of aerobic bacteria will be promoted, and the heap will rot quickly and be sweet smelling. It is the anaerobic bacteria which cause the foul odours for which compost heaps have been known in the past.

Aeration is achieved by siting the heap on an open base such as a plantform of loosely fitted wooden planks, and by turning. More about turning later.

Moisture content

The moisture content of a compost heap should be about 50 to 55 per cent. below about 40 per cent, organic material will not decompose quickly enough. Above 60 per cent, the heap becomes anaerobic and may start issuing foul odours. The moisture content required is about the same as a squeezed sponge, damp but not soggy.

Correct size of heap

The best size for your compost heap is between half and two cubic metres. It is difficult to control temperature rise in heaps larger than two metres without mechanical aids. A heap smaller than half a cubic metre may not work. Particularly in cold weather.

Chopping up the materials to lengths of one to ten centimetres speeds decomposition by increasing the surface area available to the micro-organisms. If you have a garden shredder it is easy to cut garden rubbish finely enough. The job can also be done by running a mower over the weeds and light prunings, etc. Grass clippings can be used directly.

Exercise

This is where the real objections to compost come in: Turning the heap. This needs to be done about every four days for two weeks. Turning the heap has been looked on in the past as a backbreaking task, and so it is, if you use your back. This is not necessary. The heap can be turned by rolling, not lifting. This is best done with a vine hoe, but a garden rake will do.

Using the hoe, dig into the top of the heap, pull it towards you and form a new heap at your feet. The heap is thus turned upside down with very little effort and turned upside down with very little effort and aerated at the same time.

No garden plants need be burnt, even diseased plants can be chopped up and put into the heap. Plant pathogens will be killed provided all materials spend some time in the centre of the heap where it is hottest.

How to make a compost heap

Just follow the steps:

(1) Collect organic materials into separate heaps. See the table for ideas on materials.

(2) Ascertain total weight of each type of material, method as below:

(a) Fill one plastic bucket of any convenient size with material to be weighed;

(b) Weigh on kitchen scales, and note weight. (Careful with that manure, better do it outside. Partners are not impressed by manure on floor. I know.);

(c) Dump the weighed bucketful beside the appropriate heap. Then, estimate by eye the number of bucketsful in that heap. Simply multiply bucketsful by noted weight for one bucketful, to find total weight of that material. This method is sufficiently accurate and becomes more so with practice.

(3) Calculate the carbon/nitrogen ratio.

The formula is below.

$$C/N = \frac{(W1 \times C1) + (W2 \times C2) + \ldots\ldots (WN + CN)}{(W1 \times N1) + (W2 \times N2) + \ldots\ldots (WN + NN)}$$

C/N is carbon to nitrogen ratio.
W1 . . . WN are weight units of materials 1 to N.
C1 . . . VN are carbon percentages for materials 1 to N.
N1 to NN are nitrogen percentages for materials 1 to N.
N1 to NN are nitrogen percentages for materials 1 to N.

The table gives approximate composition of eleven organic materials.

Suppose we have on hand 2 kg of leaves, 1 kg of sawdust and 2.5 kg of cattle droppings. Weight ratios = 2:1:2.5

$$C/N = \frac{(2 \times 24) + (1 \times 34) + (2.5 \times 20)}{(2 \times 0.4) + (1 \times 0.08) + (2.5 \times 1.7} = 26$$

This formula works quite well if the C/N ratio comes out between 25:1 and 30:1 the first time. If it does not then you must change the quantities and try again . . . and again . . . etc. This is where the program comes in. It will input the amounts of materials on hand and adjust quantities to achieve the correct C/N ratio. It will then print out the quantities you should use and the C/N ratio which would be achieved.

(4) Mix materials together, moistening slightly, drag with rake or hoe, don't lift. Adding a small amount of soil or old compost to the mixture will help ensure the presence of bacteria to start the process.

(5) Turn/roll the heap about every four days for two weeks or so.

Go to it

Many people are turning to home-grown foods to avoid artificial fertilizers and pesticides. Kitchen and garden wastes can build first class soil, when handled properly. First class soil grows superb vegetables with flavour you have not experienced since childhood (if at all!). With this program you can generate correctly balanced sweet smelling compost in three weeks.

The table can be used to help in the initial selection of material. *Have a rotting time, won't you now . . .*

TABLE 1: approximate composition of some organic materials

MATERIAL	C/N RATIO	gC/100g	gN/100g
Lawn clippings	20	6	0.3
Weeds	19	6	0.3
Leaves	60	24	0.4
Paper	170	36	0.2
Fruit wastes	35	8	0.2
Food wastes	15	8	0.5
Sawdust	450	34	0.08
Chicken droppings	7	30	4.3
Chicken litter	10	25	2.5
Straw	100	36	0.4
Cattle droppings	12	20	1.7

REFERENCES

(1) *Composting: Making Soil Improver From Rubbish.* Kevin Handreck, Discovering Soils No. 3, CSIRO Division of Soils.

(2) *National Geographic* magazine, April 1983.

(3) *Composting: A Study of the Process and its Principles.* C. G. Golueke, 1972 (Rodale Press).

(4) *The Biochemistry and Methodology of Composting.* R. P. Poincelot, Connecticut Agricultural Experiment Station. Bulletin 727, 1972.

(5) *A Scientific Examination of the Principles and Practice of Composting.* R. P. Poincelot, Compost Science Vol. 15, No. 3 pages 24 to 31 (1974).

(6) *Farmers of Forty Centuries.* F. H. King, 1911 (Rodale Press).

(7) *Compost Science* (Rodale Press). A bimonthly journal containing many articles about compost making and other issues related to the recycling of resources.

(8) *Soil Organic Matter and its Role in Crop Production.* F. E. Allison, 1973 (Elsevier).

(9) *Garbage as you like it.* J. Goldstein, 1970 (Rodale Press).

(10, 11) *The Garden Compost Heap, Parts 1 and 2* by K. Gray and A. Biddlestone in the British Journal *The Garden* Volume 101, November and December, 1976, pp. 540-4; 594-8.

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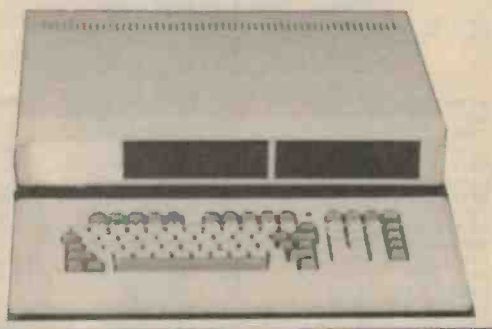

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HI-RES SCREEN TO PRINTER DUMP

Geoffrey Tyerman, Sutherland NSW

This machine code program will dump both hi-res graphics and standard ROM characters from a Microbee computer to an Epson or compatible code printer. It will dump in one of two modes: single density (start address SINDEN) or double density (start address DOUDEN).

The program forms data for the printer in a 8 x 1 dot vertical bar. To produce one Microbee line the printer must make two passes of each line (one Microbee line consists of 16 vertical dots). These two lines are labelled 'top' and 'bottom'. The program stores various program counters/variables in memory locations 10 — 1B (hex).

In order to generate data for the standard character set, the program must read the character ROM. The character ROM is located at memory location F000 — F7FF hex. Yes! This is the same address as the screen address, but to read the character ROM you have to latch it on by using port 11 decimal or B hex.

e.g: to latch on ROM
```
LD   A,1
OUT (0BH),A
```
to latch off ROM
```
LD   A,0
OUT (0BH),A
```
If you are going to use this program as a subroutine be sure to save the register values from previous routines as this program destroys most registers.

HI-RES SCREEN TO PRINTER DUMP

```
ADDR  CODE    LINE   LABEL   MNEM  OPERAND

              00100 ;
              00110 ;       HIRES   HORIZONTAL  PRINTER  SCREEN  DUMP
              00120 ;
              00130 ;       created  by  Geoffrey  Tyerman   1983
              00140 ;
              00150 ;
              00160 ;
              00165 $L OFF
              00197 $L ON
0010          00200 CURR1   EQU   10H      ;top part of line counter
0012          00210 CURR2   EQU   12H      ;bottom part of line counter
0014          00220 LINE    EQU   14H      ;line counter
0015          00230 TOPBOT  EQU   15H      ;top or bottom part of line
0016          00240 CHARCT  EQU   16H      ;character counter
0040          00250 CHAR    EQU   40H      ;no of characters per line
0017          00260 DOT     EQU   17H      ;current dot/column in char.
0018          00270 DATA    EQU   18H      ;pcg/rom location data storage
001A          00280 MODE    EQU   1AH      ;mode - single or double density
              00300 ;
              00310 ;
              00900 ;  SINGLE DENSITY START
0400 3E01     00910 SINDEN  LD      A,1
0402 1801     00930         JR      START
              00940 ;  DOUBLE DENSITY START
0404 AF       00950 DOUDEN  XOR     A       ;  load 'A' with 0
0405 321A00   00960 START   LD      (MODE),A
              01000 ;
              01010 ; initalize  routine
              01020 ;
0408 2100F0   01030 INITAL  LD      HL,0F000H       ;start of dump location
040B 221000   01040         LD      (CURR1),HL      ;  (  screen  )
040E 221200   01050         LD      (CURR2),HL
0411 3E10     01060         LD      A,10H           ;no. of lines
0413 321400   01070         LD      (LINE),A
0416 3E00     01080         LD      A,0
0418 321500   01090         LD      (TOPBOT),A      ;init topbot to top
041B 211105   01095 INITLF  LD      HL,LF   ;init. printer LF to 16/244 "
041E CD1F05   01096         CALL    PRINTR  ;routine to send data to printer
0421 3E40     01105 LINSTR  LD      A,CHAR
0423 321600   01110         LD      (CHARCT),A      ;no. CHAR per line
0426 3E07     01120         LD      A,7             ;bits per char 0-7
0428 321700   01130         LD      (DOT),A
042B 3A1A00   01140         LD      A,(MODE)        ;ld 'A' with mode
042E B7       01150         OR      A               ;test for single
042F 2005     01151         JR      NZ,SINGLE       ;single density
0431 211A05   01152         LD      HL,DD           ;double density data
0434 1803     01160         JR      CONTI
0436 211505   01170 SINGLE  LD      HL,SGD          ;single density data
0439 CD1F05   01180 CONTI   CALL    PRINTR          ;load printer with data
              01200 ; find char at current line
              01210 ;
043C 211500   01220 FINDCH  LD      HL,TOPBOT
043F CB46     01230         BIT     0,(HL)
0441 2805     01240         JR      Z,TPLNCH        ;top line char
0443 2A1200   01250         LD      HL,(CURR2)
0446 1803     01260         JR      LDA
0448 2A1000   01270 TPLNCH  LD      HL,(CURR1)
044B 7E       01280 LDA     LD      A,(HL)          ;current char in 'A'
              01390 ;
              01400 ; find data for char (pcg)
              01410 ;
044C 0604     01420 FINDDT  LD      B,4
044E 5F       01430         LD      E,A
044F 1600     01440         LD      D,0             ;load de with a
0451 B1       01450         OR      C               ;clear carry
0452 CB13     01460 ROTATE  RL      E
0454 CB12     01470         RL      D
0456 10FA     01480         DJNZ    ROTATE  ;rotate 4 times
0458 2100F0   01481         LD      HL,0F000H
045B 19       01482         ADD     HL,DE   ;add to find char data loc.
045C 221800   01490         LD      (DATA),HL
              01590 ;
              01600 ;find print data
              01610 ;
045F 211500   01620 FINDPD  LD      HL,TOPBOT
0462 0608     01625         LD      B,8     ;no. of bits to test
0464 CB46     01630         BIT     0,(HL)  ;is top or bot set
0466 2A1800   01635         LD      HL,(DATA)
0469 2804     01640         JR      Z,PNDT
046B 110800   01650         LD      DE,8
046E 19       01660         ADD     HL,DE   ;find data for sec line
```

```
ADDR  CODE    LINE   LABEL   MNEM  OPERAND

046F 3E01     01670 PNDT    LD      A,1
0471 D30B     01680         OUT     (0BH),A ;latch char rom.
0473 1E00     01685 LOPE    LD      E,0
0475 CDD904   01690 LOPBIT  CALL    TSTBIT  ;test current bit & ret
0478 2003     01700         JR      NZ,ISSET        ;bit is set
047A B1       01710         OR      C       ;clear carry
047B 1801     01720         JR      MOVCRY
047D 37       01730 ISSET   SCF             ;set carry flag as bit is
047E CB13     01740 MOVCRY  RL      E       ;mve data from carry - 'E'
0480 23       01750         INC     HL      ;move to next data locatn
0481 10F2     01760         DJNZ    LOPBIT
              01900 ;  data for print is stored in 'E'
0483 7B       01910         LD      A,E     ;load 'A' with 'E'
0484 CD4580   01920         CALL    8045H   ;basic rom printer routine
0487 3E00     01930         LD      A,0     ;reset character rom so
0489 D30B     01940         OUT     (0BH),A ;  program can read screen
              02000 ;  routine to check that all data for current char has
              02010 ;  been generated . If so move onto next.
048B 3A1700   02020 DONE8   LD      A,(DOT) ;ld 'A' with curr column
048E 3D       02030         DEC     A       ;move to next dot/column
048F 321700   02035         LD      (DOT),A
0492 FEFF     02040         CP      0FFH    ;test for finish
0494 20C9     02050         JR      NZ,FINDPD ;if not finished - FINDPD
0496 3E07     02060         LD      A,7     ;column fin.  Reset column
0498 321700   02070         LD      (DOT),A ;       to   seven
              02100 ;
              02110 ; do next char in line
              02120 ;
049B 3A1600   02130 NXTCHR  LD      A,(CHARCT);ld 'A' with char counter
049E 3D       02140         DEC     A
049F 321600   02150         LD      (CHARCT),A
04A2 FE00     02152         CP      0       ;test for 1 line done
04A4 F5       02155         PUSH    AF      ;save result on stack
04A5 211500   02160         LD      HL,TOPBOT
04A8 CB46     02170         BIT     0,(HL)  ;test for top/bot. line
04AA 2012     02180         JR      NZ,BOTELN
04AC 2A1000   02190         LD      HL,(CURR1) ;ld 'HL' with curr top
04AF 23       02200         INC     HL
04B0 221000   02210         LD      (CURR1),HL
04B3 F1       02230         POP     AF      ;pop result of prev. test
04B4 2086     02240         JR      NZ,FINDCH  ;if not at end of line
04B6 3E01     02250         LD      A,1     ;if at end of line set
04B8 321500   02260         LD      (TOPBOT),A ;  current line to bottom.
04BB C32104   02270         JP      LINSTR  ;  continue on bottom line
04BE 2A1200   02280 BOTELN  LD      HL,(CURR2) ;ld 'HL' with bottom line
04C1 23       02290         INC     HL      ;next char
04C2 221200   02300         LD      (CURR2),HL
04C5 F1       02310         POP     AF      ;pop  result of test
04C6 C23C04   02330         JP      NZ,FINDCH  ;if not fin. goto FINDCH
04C9 3E00     02340         LD      A,0     ;fin.  reset top/bot  to
04CB 321500   02350         LD      (TOPBOT),A ;top
04CE 3A1400   02360 ENDLN   LD      A,(LINE)  ;  load 'A' with no. of
04D1 3D       02370         DEC     A       ;screen lines left and
04D2 321400   02380         LD      (LINE),A  ;dec by one
04D5 C22104   02390         JP      NZ,LINSTR  ;test for no more left
04D8 C9       02420         RET             ;return to program
              04900 ;
              05000 ; test for bit 'A' at location 'hl'
              05010 ;
04D9 4E       05020 TSTBIT  LD      C,(HL)  ;load data into b to test
04DA 3A1700   05040         LD      A,(DOT) ;bit to test in char
04DD FE00     05050         CP      0
04DF 282D     05060         JR      Z,BIT0
04E1 FE01     05070         CP      1
04E3 2826     05080         JR      Z,BIT1
04E5 FE02     05090         CP      2
04E7 281F     05100         JR      Z,BIT2
04E9 FE03     05110         CP      3
04EB 2818     05120         JR      Z,BIT3
04ED FE04     05130         CP      4
04EF 2811     05140         JR      Z,BIT4
04F1 FE05     05150         CP      5
04F3 280A     05160         JR      Z,BIT5
04F5 FE06     05170         CP      6
04F7 2803     05180         JR      Z,BIT6
04F9 CB79     05190 BIT7    BIT     7,C
04FB C9       05200         RET
04FC CB71     05210 BIT6    BIT     6,C
04FE C9       05220         RET
04FF CB69     05230 BIT5    BIT     5,C
0501 C9       05240         RET
0502 CB61     05250 BIT4    BIT     4,C
0504 C9       05260         RET
```

```
ADDR   CODE    LINE   LABEL  MNEM    OPERAND

0505 CB59     05270 BIT3   BIT   3,C
0507 C9       05280        RET
0508 CB51     05290 BIT2   BIT   2,C
050A C9       05300        RET
050B CB49     05310 BIT1   BIT   1,C
050D C9       05320        RET
050E CB41     05330 BIT0   BIT   0,C
0510 C9       05340        RET
              05350 ;DATA FOR PRINTER INITIALIZATION
              05360 ;
0511 1B33     05370 LF     DEFW  331BH   ; ESC.  3
0513 1000     05380        DEFW  0010H   ; 16   0
0515 1B       05385 SGD    DEFB  1BH     ; ESC.
0516 4B       05390        DEFB  'K'     ; K    single denisty
0517 E0       05400        DEFB  224D
0518 01       05410        DEFB  1H
0519 00       05415        DEFB  0
051A 1B       05416 DD     DEFB  1BH     ; ESC.
051B 4C       05420        DEFB  'L'     ; L    double denisty
051C E1       05430        DEFB  225D
051D 01       05440        DEFB  1
051E 00       05445        DEFB  0
              05455 ;
```

```
CODE   LINE   LABEL  MNEM    OPERAND

              05465 ;   OUT TO PRINTER ROUTINE
              05475 ;
051F 7E       05485 PRINTR LD      A,(HL)
0520 23       05495        INC     HL
0521 FE00     05505        CP      0
0523 C8       05515        RET     Z
0524 CD45B0   05525        CALL    B045H
0527 18F6     05535        JR      PRINTR
0000          05545        END
00000 Total errors

BIT7   04F9    BIT6   04FC    BIT5   04FF    BIT4   0502
BIT3   0505    BIT2   0508    BIT1   050B    BIT0   050E
ENDLN  04CE    BOTELN 04BE    NXTCHR 049B    DONE8  048B
MOVCRY 047E    ISSET  047D    TSTBIT 04D9    LOPBIT 0475
LOPE   0473    PNDT   046F    FINDPD 045F    ROTATE 0452
FINDDT 044C    LDA    044B    TPLNCH 0448    FINDCH 043C
SGD    0515    CONTI  0439    DD     051A    SINGLE 0436
LINSTR 0421    PRINTR 051F    LF     0511    INITLF 041B
INITAL 0408    DOUDEN 0404    START  0405    SINDEN 0400
MODE   001A    DATA   001B    DOT    0017    CHAR   0040
CHARCT 0016    TOPBOT 0015    LINE   0014    CURR2  0012
CURR1  0010
```

HIGH RESOLUTION GRAPHIC

Daniel Wong, Parramatta NSW

This program enables the user to draw high resolution graphics on the screen. To draw use these keys to move the cursor: W up; A left; S right; Z down.

HIGH RESOLUTION GRAPHIC

```
00180 X=100:Y=150
00190 CLS:HIRES
00200 HIRES
00210 CURS 65
00220 CURS 10,4
00230 FOR I=10 TO 54:PRINT ".";:NEXT I
00240 FOR J=5 TO 13
00250  CURS 10,J:PRINT ".":CURS 54,J:PRINT "."
00260 NEXT J
00270 CURS 10,14
00280 FOR I=10 TO 54:PRINT ".";:NEXT I
00290 CURS 0:PRINT "PCG CHARCATERS USED ="
00300 PRINT"DRAW ONLY WITHIN THE SQUARE"
00310 ON ERROR GOTO 420
00320 CURS 21:PRINT USED;
00330  SET X,Y
00340  K1$=KEY$
00350  IF K1$="" THEN RESET X,Y:GOTO 330
00360  IF K1$>"Z" THEN RESET X,Y:A=ASC(K1$):
       K1$=CHR$(A-32)
00370  IF K1$="W" THEN LET Y=Y+1:GOTO 320
00380  IF K1$="S" THEN LET X=X+1:GOTO 320
00390  IF K1$="Z" THEN LET Y=Y-1:GOTO 320
00400  IF K1$="A" THEN LET X=X-1:GOTO 320
00410 GOTO 330
00420 REM *** ERROR HANDLING ***
00430  PLAY 1,1
00440  ON ERROR GOTO 420
00450  GOTO 340
```

PUTTING CONTROL CHARACTERS IN A WORDBEE FILE

Michael Dunbar, Murrumbeena Vic.

Wordbee, for the Microbee, is a very good word processor. However, a disadvantage is that when using an Epsom-type printer you cannot send control characters in the middle of a paragraph to alter the printout e.g: to underline or place some words in italics. These control characters usually consist of the ESC character followed by a normal printing character.

This shortcoming was partially overcome with the introduction of Wordbee 1.2, enabling double striking and underlining in the middle of a paragraph. This is achieved by the software; send the character, followed by a backspace, then either the character again, for double strike, or an underline if you want an underline. Control characters are not sent to place the printer in either mode.

However, it is still desirable to be able to print words in italics e.g: botanical names. To do this you have to place the control characters in the middle of a paragraph. A '.ES' for the middle of a paragraph is not supported by either version of Wordbee. The dot command '.ES' is used to send control characters to the printer between paragraphs.

There are two ways of inserting the control characters into the file.

Method 1.

For short files or where the characters are to be inserted near the top of the file.

1. In the locations where control characters are to be inserted place a finger (1), one for each non-printing control character to be inserted.
2. Return to the Menu (LINE FEED).
3. Go to Moniter Level (M).
4. Type E 900.
5. Using the monitor cursor movement controls (A W S Z) locate the fingers, hex 7C.
6. Press M to enter (Modify Mode). Then replace the 7Cs with the desired code in hex; see your printer handbook to obtain the correct codes.
7. Go to step 5 until all the desired changes have been made.
8. Press ESC followed by an X, then RETURN. This returns you to the Wordbee file.

Method 2.

For long files where manually searching for the finger characters can be time consuming.

1. In the locations where control characters are to be inserted place a finger (1), one for each non-printing control character to be inserted.
2. Return to the Menu (LINE FEED).
3. Go to Moniter Level (M).
4. Type E 51D. This gives the location of the end of the file.
5. Press ESC, then type S 900 XXYY 7C, where XX is the number at 51E (on the right of the arrow cursor), and YY is the number at 51D (on the left of the arrow cursor).
6. The location of the fingers is now displayed below the memory display.
7. Type A ZZZZ, where ZZZZ is the location of the finger, from the table given in step 6.
8. Replace the fingers with the required control characters; see your printer handbook to obtain the correct codes. When finished press the ESC key to exit so that another set of fingers can be replaced.
9. Go to step 5 until all the desired changes have been made.
10. Press ESC followed by X then RETURN; this returns you to the Wordbee file.

Notes

Once inserted the control characters can be moved using the Block Functions Command (B).

If a file with control characters in it has to be force loaded, the control characters will be replaced by the finger character and will have to be changed back to their original control characters.

The finger was selected as the most suitable character since the Wordbee Force Loader replaces any control characters with the finger character, but this does not stop you using another character.

When looking at a file with control characters in it, they will be shown as graphics characters.

The control characters, 00 hex to 0B hex, cannot be inserted into the file since they cause the printing to stop at the point where these characters occur.

Control characters in the range 80 hex to FF hex have 80 hex subtracted from them by Wordbee when you view the file.

S short machine code program could be written to change the finger characters to ESC characters, loaded and run from the Monitor.

This method can also be used to print some of the printer's graphics characters.

✶ENCOURAGEMENT✶

Ozi-Soft, in conjunction with Computer Technics, is offering to donate a VIC-20 expansion board for the best software item submitted to this column every month.

The board is Australian-designed and manufactured and simply plugs into the VIC-20's expansion slot. It features three sockets that can be independently switch-selected, plus an on-board reset switch. With it you can plug in up to three separate expansion units to your VIC-20 and avoid the hassle of plugging things in and out and turning the computer on and off each time.

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All submissions must be accompanied by a signed letter from you stating that it's your original work. The winning submission will be judged by the Editor and no correspondence will be entered into. All published submissions will be paid for.

Send entries to: **The Editor, VIC-20 Column, ETI Magazine, P.O. Box 227, Waterloo NSW 2017.**

Peter Skilton and Gary Fowler, of Seaford Victoria, the authors of the program 'Calendar', are this month's winners of the VIC-20 expansion board.

LAND THE PLANE

A simple game in which the object is to land the plane without crashing into the towers.

To assist the landing, bombs are provided. These may be released by pressing any key.

The level at which the plane came to grief will be noted for you. The idea is to see how low a level may be achieved before this happens. Note that only two bombs per run will be provided.

Thanks to S. Austin for the idea (ETI, April 1983, p.109)

```
10 PRINT "clear,home": V1=36878: T3=36877
20 FOR X = 3 TO 20
30 FOR Y = 22 TO 3 + RND(1)*20 STEP -1
40 GOSUB 500: POKE P9,160+72*INT(RND(1)+.1)
50 NEXT Y:NEXT X
60 PRINT "LEVEL:";TAB(14);"BOMBS:"
70 FOR Y = 2 TO 22:B=2
80 GOSUB 600
90 FOR X = 0 TO 22
100 GOSUB 700
110 GOSUB 500:P=PEEK(P9):POKE P9,
    114:POKE P9-1,96
120 IF P > 100 THEN X=100:Y=100:GOTO 250
130 POKE P9,114: POKE P9-1,96
140 GET A$: IF LEN(A$)=0 OR B=0 THEN 240
150 POKE V1,15: POKE T3,0: Y3=Y
160 FOR Y1=Y+2TO 22
170 POKE 36876,(256-6*Y1): Y=Y1
180 GOSUB 500 : POKE P9,81
190 POKE P9-22,32
200 NEXT Y1
210 Y=Y3: POKE 198,0
220 GOSUB 800
230 B=B-1
240 GOSUB 500:POKE P9,96
250 NEXT X: NEXT Y
260 IF X > 99 THEN 280
270 PRINT"clear,home":PRINT:PRINT"VERY GOOD"
280 FOR V2=1 TO 15 STEP V2/15
290 POKE V1,V2: POKE T3,220-8*V2
300 NEXT V2
310 PRINT"clear,home":PRINT:PRINT"LEVEL";Z
320 PRINT:PRINT"PRESS RETURN OR"
330 PRINT "PRESS E FOR EXIT":INPUT A$
340 IF A$="E" THEN END
350 GOTO 10
500 P9=7680+22*Y+X
510 POKE P9+30720,0
520 RETURN
600 Z=22-Y:Q=INT((Z+.5)/10):Q1=Z-Q*10
610 POKE 7709,Q1+48:POKE 38429,0
620 POKE 7708,Q+48:POKE 38428,0
630 RETURN
700 POKE 7722,B+48: POKE 38442,0
710 RETURN
800 FOR T= 1 TO 33
810 POKE V1,15*RND(1)
820 POKE T3,128+RND(1)*128
830 NEXT T
840 POKE V1,0
850 RETURN
```

Neil Duncan, Heathmont, Vic.

CALENDAR

A calendar is displayed for any month or year in the Gregorian calendar.

Leap-yearing, or intercalation, has been practised every four years since Roman times. However, in 1582 Pope Gregory III proposed that of all the years which are a multiple of 100, not all should be leap years. Only those which are a multiple of 400 should be intercalated ie: the year 2000 is a leap year, but 1900, 1800 and 1700 were not. In addition, multiples of 4000 should not be leap years.

This program easily fits into the standard 3.6K of available memory and executes quite rapidly on the VIC.

The algorithm calculates the calendar for any month of any year and displays it centred on a white VDU screen. REM statements have been included for clarity so that variables and the operations used may be simply followed.

Notice that lines 290 and 540 have been used to overcome round-off error in the INT function, e.g.: INT (14.9999) = 14 or INT (−1.00002) = −2. The CHR$ statements, as in line 300, merely clearly/home the screen and are shown for typographical convenience.

Once the selected calendar is shown on the VDU the program waits without prompting. Typing in the letter 'M' enables you to change the month only, typing in a 'Y' allows you to alter the year and month for the next calendar, while responding with a carriage return escapes from the program.

```
READY.
RUN

DESIRED YEAR ? 1999
MONTH NUMBER ? 12
```

```
                DECEMBER
SU MO TU WE TH FR SA
                1  2  3  4
 5  6  7  8  9 10 11
12 13 14 15 16 17 18
19 20 21 22 23 24 25
26 27 28 29 30 31
```

```
190 REM
200 REM   Initialize
210 POKE 36879,25
220 DIM B$(22),D$(24),M$(120),Y$(4)
230 DATA "  JANUARY  FEBRUARY    M","ARCH     APRIL      MAY "
240 DATA "     JUNE     JULY      ","AUGUST   SEPTEMBER  OCTO"
250 DATA "BER  NOVEMBER  DECEMBER ","312831303130313130313031"
260 FOR I = 1 TO 5  :  READ D$  :  M$ = M$ + D$  :  NEXT I
270 READ D$
280 REM   Prevent round-off errors
290 DEF FNI(J) = INT(1.00002*J)
300 PRINT CHR$(147);CHR$(19)
310 PRINT "  DESIRED YEAR ";  :  INPUT Y
320 PRINT "  MONTH NUMBER ";  :  INPUT N
330 REM   N = 1,2,.....,12 for Jan,Feb,.....,Dec
340 PRINT  :  PRINT  :  PRINT  :  PRINT  :  PRINT "      ";
350 Y$ = STR$(Y)
360 FOR I = 1 TO LEN(Y$)  :  PRINT MID$(Y$,I,1);" ";  :  NEXT I
370 PRINT  :  PRINT  :  PRINT
380 PRINT "     ";MID$(M$,10*N-9,10)  :  PRINT
390 PRINT " SU MO TU WE TH FR SA"  :  PRINT
400 REM   Y1 = year of the century C  :  T = no. of days in month N
410 C = FNI(Y/100)  :  Y1 = Y - 100*C
420 T = VAL(MID$(D$,2*N-1,2))  :  IF N<>2 THEN GOTO 470
430 REM   Check for leap years
440 IF Y = 4*FNI(Y/4) THEN LET T = 29
450 IF Y = 100*C AND Y>400*FNI(Y/400) THEN LET T = 28
460 IF Y = 4000*FNI(Y/4000) THEN LET T = 28
470 REM   Jan and Feb are considered the 13th and 14th
480 REM   months of the Previous year
490 IF N<3 THEN LET Y1 = Y1 - 1  :  N = N + 12
500 IF Y1 = -1 THEN LET Y1 = 99  :  C = C - 1
510 REM   F = first day of the month (1,2,...7 for Sun,Mon,...Sat)
520 F = FNI(2.6*(N+1)) + Y1 + FNI(Y1/4)
530 F = F + FNI(C/4) - 2*C - FNI(C/40) + 1
540 IF F<1 THEN LET F = F + 7  :  GOTO 540
550 F = F - 7*FNI((F-1)/7)
560 REM   Print out the calendar one line at a time
570 D = 1
580 FOR I = 1 TO 6
590   B$ = ""
600   FOR J = 1 TO 7
610     IF F>(I-1)*7+J THEN LET B$ = B$ + "   "  :  GOTO 650
620     IF D<10 THEN LET B$ = B$ + " "
630     B$ = B$ + STR$(D)  :  D = D + 1
640     IF D>T THEN PRINT B$  :  PRINT  :  PRINT  :  PRINT  :  GOTO 680
650   NEXT J
660   PRINT B$     PRINT
670 NEXT I
680 IF I<6 THEN PRINT  :  IF I=4 THEN PRINT
690 REM   Program pauses - to change the month, type 'M', to change
700 REM   the year and month, type 'Y', and to abort type return
710 GET Y$
720 IF Y$ = "Y" THEN GOTO 300
730 IF Y$ = "M" THEN PRINT CHR$(147);CHR$(19)  :  PRINT  :  GOTO 320
740 IF Y$<>CHR$(13) THEN GOTO 710
750 PRINT CHR$(147);CHR$(19)  :  PRINT "FINISHED"
760 END
```

Peter Skilton and Gary Fowler, Seaford, Vic.

MEGAMEANIES

The objective of this game is to 'kill or be killed', which happens in the end anyway!

There are two Megameanies slowly sweeping over your planet in sine and cosine curves, getting lower each time. They change colour according to their point rating, e.g.: white ones are worth seven and yellow ones are worth one.

You have a single gun and unlimited ammunition to blast the Megameanies out of the sky before they invade you. You can only fire one missile at a time but it moves two spaces for every one of the Megameanies.

For every five Megameanies shot down you obtain five times the normal score for the Meanie. When your score reaches 80 you get an extra game and 20 extra points.

The game uses programmable characters residing from 7168 to 7679 using character set 255.

It also contains many interesting tricks such as POKE 198,0:WAIT198,1 which waits until a key is pressed by first clearing the keyboard buffer and then WAITing for a character to be entered via the keyboard. The alternative method for this is GETA$:IFA$="" "THEN. . . .

Chris Groenhout, Watson ACT

```
5 REM **** (C) CHRIS GROENHOUT 1983 ****
10 POKE36879,8:FY=22:PX=11:GOSUB430:PRINT"■"CHR$(8):POKE36869,255
20 FORM=1TO2:STEP3:E=E+1:FORD=0TO2:FORN=0TO21:POKE38400+N+((M+D)*22),E:NEXTN,D,M
30 IFFF=1THENFF=2
40 FORYY=5TO18
50 FORX=0TO2*π STEP.28:PRINT"■■SCORE@"SC
60 Y=INT(SIN(X)*4+YY):Y2=INT(COS(X)*4+YY):IFY=22THENGOTO190
70 XX=X*3.5:POKE7680+XX+Y*22,63:POKE7680+X1+Y1*22,32
80 POKE7680+XX+Y2*22,63:POKE7680+X1+Y3*22,32
90 X1=XX:Y1=Y:Y3=Y2:IFPEEK(197)=31THENPX=PX-1:IFPX<0THENPX=0
100 IFPEEK(197)=23THENPX=PX+1:IFPX>21THENPX=21
110 POKE8164+PX,62:POKEPX+38864+PX,1:POKE(PX-1)+8169,32:POKEPX+1+8164,32
120 IFPEEK(197)=32ANDC=0THENC=1:CX=PX
130 FORH=1TO2
140 IFC=1THENFY=FY-1:IFFY<0THENC=0:FY=22:POKE7680+CX,32
150 F=7680+CX+FY*22:IFPEEK(F)=63THENGOTO240
160 IFC=1THENPOKEF,28:POKEF+22,32:POKE36877,FY*2+128
170 NEXT
180 NEXTX,YY
190 PRINT"■■ YOU'VE BEEN OVERRUN!"
200 FORA=1TO3000:NEXT
210 PRINT"■AGAIN                    ":POKE198,0
220 WAIT198,1:IFPEEK(631)=89THENPRINT"■":CLR:FY=22:PX=11:GOTO20
230 POKE198,0:POKE36879,27:POKE36869,240:PRINT"■■":END
240 BD=BD+1:SC=SC+ABS((PEEK(F+30720)AND15)-8):PRINT"■■SCORE@"SC
250 POKEF,58:POKEF+1,59:POKEF+22,60:POKEF+23,61
260 IFBD/5=INT(BD/5)THENSC=SC+4*ABS((PEEK(F+30720)AND15)-8)
270 IFSC>79ANDFF=0THENSC=SC+20:E=0:FF=1
280 POKE36877,200
290 FORA=15TO0STEP-.04:POKE36878,A:NEXT:POKE36877,0
300 POKEF,32:POKEF+1,32:POKEF+22,32:POKEF+23,32:FY=22:C=0:IFFF=2ORFF=0GOTO160
310 IFFF=1THENGOSUB400:GOTO20
320 POKE52,28:POKE56,28:FORA=0TO464:POKE7168+A,PEEK(32768+A):NEXT
330 FORA=0TO7:POKE7168+A,PEEK(33256+A):NEXT
340 FORA=1TO48:READDD:POKE7631+A,DD:NEXT
350 FORA=0TO7:READDD:POKE7392+A,DD:NEXT:RETURN
360 DATA1,30,32,67,68,73,138,138,240,12,4,228,18,146,82,82,138,82,89,72,71,32,62
,1,81
370 DATA82,146,36,196,12,48,192,16,16,16,16,56,124,254,198,129,66,165,24,126,219
,189
380 DATA129,16,56,56,56,56,56,56,84,84
390 PRINT"■■      BONUS GAME!":POKE36878,15:POKE36876,222
400 FORA=1TO1000:NEXT
410 PRINT"■":POKE36876,0:POKE36878,0:RETURN
420 PRINT"■■"CHR$(8);
430 PRINTTAB(4)"**********"
440 PRINTTAB(4)"*MEGAMEANIES*"
450 PRINTTAB(4)"**********"
460 PRINT"■■ THE MEGAMEANIES ARE"
470 PRINT"    TAKING OVER THE"
480 PRINT"  UNIVERSE AND IT IS"
490 PRINT"YOUR JOB TO STOP THEM"
500 PRINT"  TAKING OVER YOUR"
510 PRINT"        PLANET."
520 PRINT"■■KEYS TO USE:"
530 PRINT"■■CURSOR KEYS,MOVEMENT."
540 PRINT"■■↑ = LEFT"
550 PRINT"← = RIGHT"
560 PRINT"■■SPACE BAR = FIRE"
570 GOSUB320
580 PRINT"■■PRESS ANY KEY TO PLAY":POKE198,0:WAIT198,1:RETURN
590 GOSUB320

READY.
```

DRAWING BOARD

This program is used on an unexpanded VIC-20. You can space, erase, terminate and clear the screen.

The graphics block (character 102) is put in the middle of the screen to start off.

Full instructions are included in the program.

```
  1 Print "(clr screen) ••••••••••••••••••••"
  2 Print "* Drawing Board *"
  3 Print "••••••••••••••••••••"
  4 Print "(cursor down) (space) THE Controls:"
  5 Print "U = Up; L = Left; R = Right; D = Down"
  6 Print "(cursor down) E to put into Erase Mode"
  7 Print "(cursor down) S to put into Space Mode"
  9 Print "(cursor down) C to Clear Screen"
 10 Print "(cursor down) T to Terminate Program"
 11 Print "(cursor down) And W to put into draw mode again
 16 For T = 1 to 9000: Next
 19 Print "(Clear Screen)"
 20 Poke 368 79, 8
 30 A = 7910
 40 Poke A, 102
 50 Get A$
 60 If A$ = "U" then A = A - 22
 70 If A$ = "D" then A = A + 22
 80 If A$ = "L" then A = A - 1
 81 If A$ = "R" then A = A + 1
 82 If A$ = "C" then Print "(Clear Screen)": Go to 19
 83 If A$ = "E" then go to 1000
 84 If A$ = "S" then go to 5000
 85 If A$ = "T" then W End
 86 Go to 40
1000 Poke A, 32
1010 Get C$
1020 If C$ = "U" then A = A - 22
1030 If C$ = "D" then A = A + 22
1040 If C$ = "R" then A = A + 1
1050 If C$ = "L" then A = A - 1
1055 If C$ = "W" then go to 50
1056 If C$ = "C" then Print "(Clear Screen)": go to 19
1057 Go to 1000
5000 Poke A, 102
5001 Get B$
5002 If B$ = "U" then Poke A, 32: A = A - 22
5003 If B$ = "D" then Poke A, 32: A = A + 22
5004 If B$ = "L" then Poke A, 32: A = A - 1
5005 If B$ = "R" then Poke A, 32: A = A + 1
5006 If B$ = "C" then Print "(Clear Screen)": go to 19
5007 If B$ = "W" then go to 40
5008 Go to 5000
```

Damien Page, Stafford Qld

EXPERIMENTERS MODIFICATIONS TO THE '660 TO OBTAIN A 64 x 64 PIXEL DISPLAY

COLOUR TEST PROGRAM

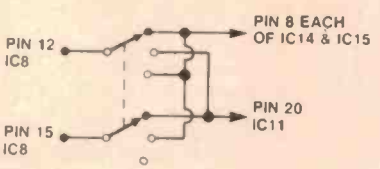
Here are some simple and inexpensive modifications you can make to your '660 to obtain a screen display of 64 pixels across and 64 pixels down, in fact, you can even sample the new mode before making all the hardware modifications at the cost of a switch and a few resistors, like I did to bring you this!

To sum up this project, I will describe how you can make hardware changes to your '660, give you modifications to be made to the monitor program, sample programs to play with and even a machine code sub-routine that will change all your present programs to run on this new mode for an all-up price of no more than $30. In fact, firstly I will tell you how you can sample the end result almost as soon as you finish reading this article!

Modifications to be made are quite simple and involve constructing a "double decker IC socket" (DDIC) to replace your present 2716, cutting a few tracks and having a "mode select" switch to select either the present monitor or the modified monitor contained in another 2716, or even your own monitor program in random access memory. A new IC will have to be installed, this is IC23, a 74LS245, located on-board between the 1802 and the 1864; details later as now I'll show you the new display.

Remove link 1, put a 47k resister between pin 20 of IC11 and + 5 V. You can use the holes provided for R29 but cut the 0 V track and extend the resistor's wire to the nearby supply rail. Cut the track from pin 12 of IC8 to the pins 8 of ICs 14 & 15, place a 47k resistor from here to the supply rail.

Attach suitable lengths of hook up wire to: the feedthrough for pin 12 of IC8, the feedthrough for pin 8 of IC15 and each end of the removed link 1. Remember, these wires will be used in the final modifications and these modifications are also part of the final design. Wire up the switch as shown here.



With the switch in the 'normal' mode, and the '660 back in one piece, you can switch on the power. If the screen comes up, then all should be well. Refer to the "Monitor Duplicator" program, do that, make the alterations to the monitor program (starting at OCOO) as shown in "Modified Monitor" then, whilst pressing the reset, switch over to the RAM mode and up should come your 64 x 64 display.

What you have now is a monitor in RAM. Remember it is volatile. You can now run the sample programs and, if you like it, you can go on to completing the rest of the project. ●

Figure 1.

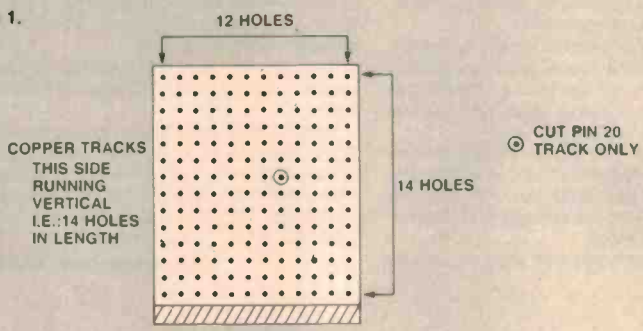


Figure 2.

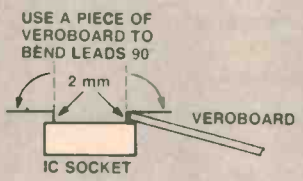
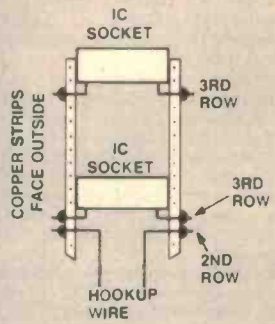
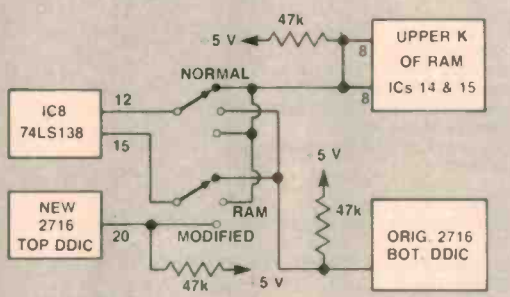


Figure 3.





BLOCK DIAGRAM
— completed modifications

GOING ALL THE WAY

Firstly, that 74LS245; refer to page 40 Nov '81, IC23. Turn back to page 26 and take a look at the pin holes for this IC, in particular the fact that the following pins are actually joined together: 2&18, 3&17, 4&16, 5&15, 6&14, 7&13, 8&12 and 9&11 (phew!). As this IC is a data buss buffer you will have to cut these tracks before installing IC23 so as to make pins 2-to-9 the inputs and pins 18-to-11 the outputs or vice-versa.

In order for this new display to be of real benefit, the modified monitor will have to be put into another 2716 (or 2708) and installed on-board. Assuming you have made the previous modifications, the rest is a piece of byte, I mean cake.

You'll need a piece of Veroboard with 2.45 mm hole centres and copper strips running on each row of holes. Cut two pieces to the size as shown Figure 1. File off the bottom end of each row to prevent shorts when the DDIC is in place. Bend over the leads of each of the 24 pin wirewrap sockets as shown Figure 2.

Now refer to Figure 3 and solder in the upper and lower sockets, ensuring the pin 1 of each socket is facing the same way, these are mounted into the 3rd row of holes from the top and bottom. Then do the other side. Note that the copper tracks are facing the outsides. Identify pin 20 and cut this track in the centre, insert a 47k to the top socket from pin 20 to pin 24, then, using solid hookup wire, solder a piece to each of the 24 bottom 2nd-row holes. The wire must not be too thick and it must extend below the bottom of the board by 5 mm on the inside as per Figure 3. These form the IC socket pins.

Checking that the DDIC is wired correctly, and that there are no solder bridges, you can now carefully remove the original 2716 IC socket and replace with your new DDIC. Make sure the pin 1s are the right way around.

Solder a piece of hookup wire to pin 20 of the top 2716 socket. This goes to the mode switch which you can now finish wiring as shown in the block diagram.

Put your original 2716 in the lower socket and your new 2716 in the top. Check over all your work and wiring before putting your '660 together, check whole board for any foreign objects (solder, bits of wire). ▶

With the mode switch in the modified position switch on the juice and if all is well you should be greeted with the new display. If not, switch off and check from the very start to correct the fault. You must ensure the 47k resistors are in place as these isolate the RAM or ROM when not in use.

Assuming both modes now work you can go on to fully test the new display. ●

WHAT'S CHANGED

A few but important facts must be kept in mind. In the original mode, nothing has changed (as one would expect), but in the modified mode the following are the rules, and in the other mode (RAM) you can make up your own rules.

Chip 8 programs now start running at 0700.

RAM available to programmer, 0700-OFFF and 0480-04EF.

Screen display now starts at 04F0 instead of 0480.

There is no address bar at the bottom of the screen but only the address and data are shown, and they're spaced further apart. ●

PAINTING BY NUMBERS OVER 17 HEX

With the mode switch in the modified mode, load the "colour routines" machine code subroutine at 049F and the colour test program at 0700. You can then test out the new screen. In fact, this program is similar to the one shown in April '82 (did they steal my idea?) but here you can colour the whole screen, and because of this you have to specify a two-digit down co-ordinate.

The top LHC is 0-00-3. This will make it violet (not grey); the bottom RHC green — 7-1F-4. Now what's the BLHC, or the TRHC, or even the KGB???

Unlike the MCSR shown in the April '82 issue, this routine will NOT leave the colour code in RAM starting at OCFO (OC80). However, as this is required for some programs (like PATCHES) this can be achieved by changing the end of the MCSR from 04E6 as shown. ●

```
0700   61F0 6200 60FF A4F0 F055 7101 3100 1708
0710   7201 3203 1708 04A2 F10A F20A 8224 8224
0720   8224 8224 F00A 8204 F00A 04B2 049F 1718.
```

MODIFIED MONITOR

Here is a list of the changes required to be made to the original monitor program as is shown in ETI Nov 81. This will enable the display of 64 x 64 and Chip 8 programs start running at 0700.

ADDRESS	CODE
01D/C1D	56
025/C25	56
02F/C2F	66
033/C33	49
037/C37	5A
03E/C3E	004D
046/C46	27
04A/C4A	7210
C	36F8
E	E2A1
50	F8D4
2	D1C0
4	0166
6	02EB
8	00F8
A	02F2
C	6809
E	693B
60	00BF
2	2066
4	00BD
6	F129
8	206C
A	F029
C	D895
E	7805
70	00EE
0E3/CE3	F0
0EA/CEA	07
13F/D3F	F0
14E/D4E	80E2
50	E220
2	A0E2
4	20A0
6	3C45
8	9832
A	5FA0
C	2080
E	B888
60	3235
2	7B28
4	3036
275/E75	F0
282/E82	07
2D8/ED8	07
2F3/EF3	06
2F6/EF6	B8
2F9/EF9	00
3B5/FB5	9F

Note that 01D refers to location 001D and C1D to 0C1D (RAM equivilent).

MONITOR DUPLICATOR

This machine code routine will duplicate the monitor program from 0000 — 03FF and place it at OCOO — OFFF. Changes can then be made to it and the mode switch placed to the RAM position (whilst you keep the reset key pressed) and zap!, up comes you new display of 64 x 64 pixels.

Load the program at OBEO, bring up this address on the screen then press RESET followed by key six (6). When the screen comes back on, all is done.

```
0BE0   F800 B0A0 AEBF AFF8
0BE8   0CBE 4F5E 1E9E FF10
0BF0   3AEA D0.
```

OLD TO NEW '660

This machine code routine will change all OXMM, 1XMM, 2XMM, AXMM, and BXMM Chip 8 instructions to one page higher, provided X is equal to or greater than six (6).

With your '660 in the modified mode, load this program at 0480 then load your original '660 program (from 0600) into memory from 0700 onward to + 1 page of the end of the program. Any present '660 program that extends beyond OEFF is not suitable.

Programs will still have to be inspected to identify and adjust MCSRs or display data. Consideration will also have to be given to the start of screen memory at O4FO. Run this, as above, with 0480 displayed.

```
0480   F8F7 BEF8 00AE 0EFA
0488   F0AF 32A5 FF10 32A5
0490   8FFF 2032 A58F FFA0
0498   32A5 8FFF B032 A51E
04A0   1E9E 3A86 DE0E FA0F
04A8   FF06 3B9F 0EFC 015E
04B0   309F.
```

COLOUR ROUTINES

Refer to ETI April 1982. VO is now the colour code (VD), V1 is now the across (VE), V2 is now the down (VF). To enable colour — 04A2 (07C1), to alter background — now 049F (0742), and to alter colour — "2 Byte area" now 04B2 (27AB).

```
049F   E9
04A0   61D4 F839 AF96 BFEF
04A8   F82C 5F62 2FF8 205F
04B0   62D4 96BF BBF6 AEEE
04B8   F872 AF0F 732F 0F73
04C0   2F0F 5E72 FA07 BFF0
04C8   FA07 5E1E F0FA 1FFE
04D0   FEFE FE5E F80C 7C00
04D8   BDF8 F0F4 AF9D 7C00
04E0   BD8F 2EF4 ADED F0AF
04E8   9F5D 632D 8F5D E2D4.
```

To record colour code after above from:
O4E6 9F5D 63E2 D4.

WHAT NOW?

Now it's time for you to put on your thinking cap to change suitable games over to this new display. To demonstrate the "Old to New" '660 program, load in "Target Practice" as per Nov '81, then run the MCSR and press RUN.

This game works OK, but not all games will be so, especially any of my games published to date and it's these type of programs that require inspection. A knowledge of machine code would be helpful in this regard and in some cases necessary. The book by Tom Swann (see p 96, March '82) I can highly recommend. Another book on the subject is available from RCA, called "User Manual for the CDP1802 COSMAC Microprocessor", MPM-201c, but his book is not quite so easy to understand for a beginner.

Bill Kreykes, St Albans, Vic.

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This amazing book seems to get bigger each year! This volume contains new projects for 160m, VHF power supplies and lots, lots more!
Cat B-2219

Dick Smith's Australian Semi-Conductor Handbook
This great book contains data, suggested circuits & new information on an enormous variety of commonly used devices.
Cat B-4200
$7.95

Dick Smith Multimeter with Logic Probe

Not just a superb 20k ohms/volt multimeter with 18 ranges, it also has in-built LED's for instant recognition of high, low, pulse states.
Cat Q-1026
ONLY **$32.50**

NEW! ARLEC SUPERTOOL

Don't buy an ordinary PCB drill: take a look at the new Arlec Supertool. It polishes! It cuts! It grinds! It engraves! It sands! It mills! It drills! The Fantastic Supertool makes a super hobbyist!
Cat T-4754
Great Value
$39.95

BUY 5 GET ONE FREE!

YES! That's right. You buy 5 at normal price Dick will give you one extra FREE!

PLUGS & SOCKETS

2.5mm Sub Mini Plug Cat P-1125	30¢
2.5mm Sub Mini Socket Cat P-1220	25¢
3.5mm Line Socket Cat P-1236	40¢
3.5mm Mono Plug Cat P-1132 (Red) Cat P-1134 (Black)	40¢
3.5mm Mono Socket Cat P-1231	35¢
6.5mm Mono Socket Cat P-1261	70¢

YOU REAP THE BENEFIT!

NEW! VZ-200 SOFTWARE

SPELLOMATIC 1 & 2: Will help both children and adults learn commonly misspelt words (oops!). Cat X-7285
SPELLOMATIC 3 & 4: Similar to the above, includes the games, SPOT the GOODIE and JUMBLE DECIPHER. Cat X-7286
FLASHCARD 1 & 2: This series will help the child to learn both words and phrases by recognition. Cat X-7287
FLASHCARD 3 & 4: Similar to the above, includes specially selected phrases from the BASIC Sight List of words and common nouns. Cat X-7288
TENNIS: Play singles or doubles multi 4-level tennis game. Incredible graphics! Cat X-7264
CHECKERS: You against the computer – who will win? Different levels of play. Cat X-7265
PLANET CONTROL: Similar to Cosmic Patrol – Arcade favourite! Pilot a dune buggy, watch out for craters and obstacles. Cat X-7266

VALUE **$12.50** each

Wow! Incredible Yaesu VFO bargain!

FV-107

Superb! Will suit most transceivers and has tons of room inside!
Cat D-2870
WAS ~~$99.00~~ ONLY **$69.00**

SAVE $25 Yaesu YM-38 scanning mike

Goes with most transceivers- dual impedance. Comes wired with pin plug suits 757 GX and most new transceivers.
Cat C-1113
WAS ~~$55.00~~
VALUE **$29.50**

DICK SMITH Electronics

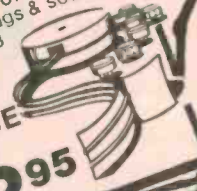
See page 143 for full address details.

A702

TAKE ADVANTAGE OF DICK'S DESPERATION!

STOCK UP NOW- THIS IS THE TIME TO BUY!

SCOOP PURCHASE!
'Invisible' Speaker Cable System
Huge scoop purchase of unique home speaker wiring system. Under carpet, wallpaper, etc - 10m cable tape plus four plugs & sockets.
Cat W-1288
OVER $10 VALUE FOR
$2.95



HEAR HEAR! Parabolic Microphone Kit.
A birdwatcher's special (either feathered or skin variety!) You'll be amazed at the range a parabola gives. Cat K-3096
See November EA 1983
You'll be amazed!
$9.95

BUY 5 GET ONE FREE!

PLUGS
Red P-1420
Black P-1422
RCA **40¢** (10 up 35¢)

Stereo P-1442
75¢ (10 up 65¢)

4 WAY P-1444
$1.25 (10 up $1.10)

2.1mm PLUG P-1641
45¢ (10 up 40)

Microphone

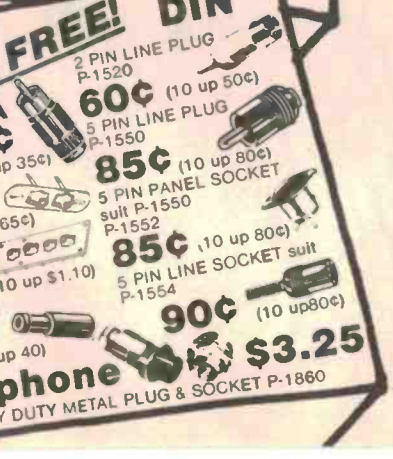
DIN
2 PIN LINE PLUG P-1520
60¢ (10 up 50¢)

5 PIN LINE PLUG P-1550
85¢ (10 up 80¢)

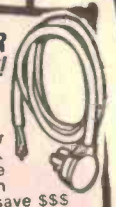
5 PIN PANEL SOCKET suit P-1550
P-1552
85¢ (10 up 80¢)

5 PIN LINE SOCKET suit P-1554
90¢ (10 up80¢)

$3.25
2 POLE HEAVY DUTY METAL PLUG & SOCKET P-1860



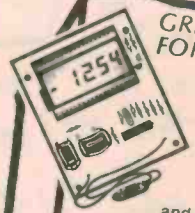
GREAT VALUE FOR PROJECTS!
240V Lead & Plug
Fantastic value for project builders. 1.8mm3-core cable complete with moulded plug - save $$$ over seperate bits
$4.75



SCOOP PURCHASE!
MINIATURE HI-TORQUE CARBON BRUSH ELECTRIC MOTOR
This is a top-quality motor with CARBON BRUSHES, NOT cheap bronze! Size: 35mm long X 28mm dia. Would cost at least $5 anywhere else. Cat M-9950
Dick's Price ONLY
95¢

Building a colour organ or light chaser? Here is the **Spot Lite Holder**
NEW LOW PRICE
This Spot lite holder is ideal to use with the Musicolour or Chaser Kits. ONLY **$5.95**
Cat P-5620
Colour lamps also available

GREAT FOR PROJECTS!
LCD Panel Meter Kit
Versatile and accurate, LCD readout for low power consumption. Easy integration into pannels makes it ideal for amateur and professional use in projects or updating analogue equipment.
Cat K-3450 **$29.50**



NEW! LET CALLER KIT

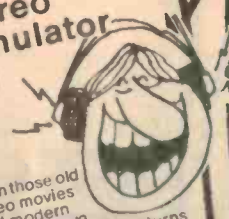
ANYONE FOR TENNIS?
When you play McEnroe he won't be able to dispute any calls! Portable, battery operated - use on any Court with wire rope for net.
Smashing value!
$19.95
Cat K-3098

Panel lettering sets
Each packet contains hundreds of words, letters, numbers & symbols.
Size 2(2.3mm high)Black
Cat N-1800
Size 1 (3.1mm high)Black
Cat N-1804
(2.3mm high)
White
Cat N-1806
$6.95 EACH

NEW into electronics **Gift Pack**
FUNCWAY
Contains Fun Way Vol.1 Book and components to build 20 pojects on our new styled 'breadboard' base (no soldering required) Now packaged in a handsome gift box for. Cat K-2605
ONLY **$24.95**

IT'S AMAZING

Stereo Simulator Kit



Wish those old video movies had modern stereo sound? This low-cost gadget turns almost any mono signal into amazingly good synthetic stereo! Cat K-4321 See EA April 1983

ONLY $19.95

THE DICK SMITH Magazine File

Maximum size of magazines insertions is 280mm high by 210 mm wide. Cat B-4045

VALUE! ONLY $4.50

GREAT FOR TRAVELLERS!

FULLY APPROVED

Mains Power Adaptors

Includes British 240V, European 240V & US 120V types, useful from Tahiti to Norway (Dual voltage appliances or transformer needed for 120V). Cat P-5650

ONLY $16.50

TOP VALUE

CERAMIC CAP PACK

$7 VALUE

Ceramic Cap. Pack

Over 60 top quality ceramics, none less than 50VW, some as high as 630VW. Includes selection from complete range 10pF to 0.1uF. Cat R-7050

ONLY $4.75

TOP VALUE

METAL FILM RESISTOR PACK

WORTH $18

Metal Film Pack

Our new 1% metal film types in a computer selected pack. Now there's no excuse not to use 1% resistors in all your projects: especially at this price! Cat R-7015

ONLY $9.95

MICRO SWITCH...AT A MICRO-PRICE!

PREMIUM QUALITY

250V/3A SPOT Size 20mm X 100mm X 6.5mm Cat S-1922

DICK'S PRICE (No, it's NOT a misprint!)

JUST 95c 10 UP PRICE 85c each

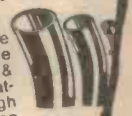
BEAT THE HEAT!

Rotary Blower Fan

Getting a bit hot under the collar? Use one of these superb rotary fans! FANtastic for any device. Use for sucking or blowing! 240V motor.

ONLY $19.95 Cat Y-8500

JUMBO Heatshrink Tubing Pack



You asked for it...here it is! Contains 1 metre each of 5, 6.5, 9.5 & 12.5mm diam heat-shrink. Almost enough to shrink a shrip! Keep some in the junk box - you never know when you'll need it. Cat W-4062

ONLY $7.50

FANTASTIC BOOK VALUE

GIANT H'BOOK Electrical Circuits Everything from crystal sets to computer circuitry. You're sure to find what you want here! Cat B-1780 NOW $19.50 WAS $22.60

TTL BOOK A complete guide to Transistor Transistor logic (TTL) integrated circuits. Cat B-1248 $19.95

CMOS BOOK Everything that you need to know about CMOS. Cat B-1246 $15.50

BUY BOTH FOR $29.45 SAVE $6.00

MAKE YOUR OWN PCB'S & PANELS

It's so easy to get a professional finish - even at home. Scotchcal Labels are the way: sell adhesive photosensitive aluminium sheets you expose to UV light (even sunlight) develop and stick to your projects!

Exposure film Cat H-5690 ..... $6.95 per sheet.

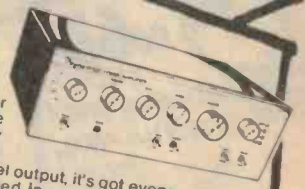
Red aluminum Cat H-5692

Black aluminum Cat H-5694 ..... $7.40 per sheet

Developer (suits all) Cat H-5696 ..... $1.40 per 50ml bottle

INCREDIBLE VALUE - AMAZING SOUND!

MOSFET AMPLIFIER KIT



This 'Top of the Line' amplifier features up to the minute circuitry as well as the new MOSFET output stage. With a huge 50W/channel output, it's got everything you'll ever need in an amplifier. All components fit a single PCB, which makes construction very easy. Cat K-3515

OUR MOST POPULAR KIT!

ONLY $175

NEW ECONOMY 2M ONLY $299 -AMAZING!

Wow! 2 meter handheld for less than $300!! That's the all-new Yaesu FT-203R - the economy handheld you can take anywhere. Incredibly easy to use with thumbwheel frequency selection, but has all the features you need including standard repeater splits, inbuilt S-meter makes it great for fox hunts! Optional headset available shortly for full vox operation. Battery & approved charger. Cat D-2888

That's the new YAESU FT-203R

NEW Dick Smith Portable Multimeter with Logic Range

18 active ranges including logic high, low and pulse! 20K/V sensitivity means it's ideal for most service work, is small enough to fit in the tool box. Cat Q-1026

ONLY $32.50

The APE TAPES

Great Value & Fun

Avoid hang-ups! Use the amazing Ape Tapes. Your callers will be enjoying the voices so much, they won't hang-up. Cat Y-2172 Tape contains 12 different voices.

each $8.95

Dick Smith Electronics

See Page 143 for full address details

A703

TAKE ADVANTAGE OF DICK'S DESPERATION!

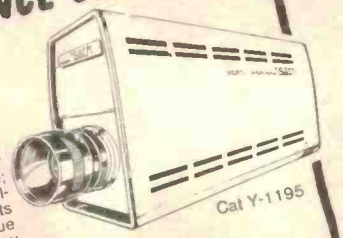
I'M SO OVER-STOCKED I'M SELLING AT DESPERATION PRICES

STOCK UP NOW FOR 1984 AT 1983 PRICES!
AND LESS! MANY HUGE BULK DISCOUNTS AND
LOTS OF 'GOODY PACKS'.

Your own Casino!
ELECTRONIC ROULETTE WHEEL KIT
Wow! All the fun & excitement of Las Vegas ... West Point ... even Forbes St.! Now you can have a completely random roulette wheel – without the bias of commercial units!
Cat K-3389
ONLY $29.50

SAVE $2
Quality Dick Smith
Signal Injector
One of the handiest devices to have in your tool box! Check out both audio + RF circuits. Self contained, battery operated with probe and earth clip.
Cat Q-1270
WAS $12.95
$10.95

LOW COST TV SURVEILLANCE CAMERA
Protect your property, your valuables, your children, your life! This amazing CCTV camera is ideal for nearly 99% of all general use. Use it: to monitor your swimming pool; for security monitoring in shops, banks or even around the home; as a reading aid for visually handicapped, and lots more. Outstanding value for money – don't pay between $1,000 and $20,000! Our price:
Cat Y-1195
ONLY $399



Clear Acrylic Sheet
Ideal for using over panels etc – makes your project look really professional. Or use for inspection panels, protection devices, etc. 3mm thick, 150mm long x 50mm wide. Cat H-5450
ONLY $1
5 up 90c

NEW 20 MHz

Hitachi Dual Trace CRO
Not just a good CRO ... it's a great one! Top brand name with huge 20 MHz bandwidth, dual traces, extra high sensitivity ... it's got the lot! And all for our low, low price!
★ 5 display modes
★ 1 touch wave form shifting.
Cat Q-1243
$699

BACK UP SENSOR
Blind spots in your rear vision? Reverse park by the touch method? An easy to fit back up sensor lets you forget about the dings! Starts measuring at one metre! Cat A-8520
$59

SAVE $5
Now you can record
VIDEO TO VIDEO
Having trouble with video leads? No more! This incredible video lead pack will match ANY video to ANY video with its unique system. Was $19.95
Cat W-1287
$14.95

The not-so-random
BREATH TESTER
Yes! You can actually build your own breath tester! Find out how drunk you are! Features the fully imported TGS sensitive gas sensor. Operates from 12V DC.
Cat K-3391
How much is your licence worth?
$29.95

Solid State Buzzer
A true electronic buzzer with hundreds of applications. Rich clear tone from such a compact unit.
Cat L-7009
$1.99
SAVE 33%
Operates from 5-16V.

The Dick Smith
SOLDER STATION $69
Check out the price of the Dick Smith Soldering Station. This superb station is now within reach of the hobbyist. If you're serious about good soldering, there is only one way to do it – with a temp. controlled iron such as this one. And this one you can afford!
Cat T-2000
PLUS FREE TIP OF YOUR CHOICE!

SUPERB INSTRUMENT CASE

Give your projects a professional finish with a superb case. Ideal for projects using LED displays etc. PCB slots into case with LEDs showing through front panel. Red perspex front. 104 x 44 x 68mm.
Cat H-3194
$4.99
10 up $4.55

Printed Stripboard

High quality silver plated copper strip board similar to the English Veroboard. Continuous pre-drilled stripping on a high grade insulator. Packed in plastic sheets to assure you an untarnished, easy to solder surface. 95 x 304mm.
Cat H-5112
AMAZING VALUE! **$4.95**
10 up $4.50

NEW IMPROVED MODEL!

Masthead Amp.

At last there's a masthead amplifier which can improve your TV reception at a low cost. Ideal for fringe areas, it's designed specifically to suit Australian TV & FM characteristics.
Cat L-4200
Was $49.50
$42

16 DRAWER CABINET

$19.95

Clean up your workroom – Why not put those bits 'n pieces into usable order? Much easier to find! This cabinet of drawers is ideal for small components, screws, nuts & bolts. And it's ideal for the workbench because it's so compact.
Cat H-2588

No trailing wires!

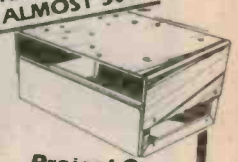
Stereo headset AM/FM radio

Here they are – radio headphones with NO messy wires to get in the way. Fantastic quality for a low, low price. Receives AM & FM. Ideal for joggers, cyclists, commuters, anyone!
Cat A-4335
$34.95

Build your own LED Tacho

Don't spend a fortune buying a tachometer – build your own and save! Displays engine speed in an analogue form in an illuminated row of LEDs. Instructions included – a great kit! Cat K-3240
$24.50

DRASTIC REDUCTION SAVE ALMOST 50%!



WAS $4.95
NOW **$2.50**

Project Cases
Give your project that added touch of professionalism with one of these deluxe project cases. Make it a project you'll be proud of!
Cat H-3107
55(h) x 168(l) x 124(w) mm

DICK'S VALUE PACKS

Polyester
60 top quality greencaps. 100V rating. .001 to 0.22 uF.
Cat R-7040
$8.95

Electrolytic Cap
55 single ended electrolytics. 2.2 – 470uF, 10 – 25V. Terrific value!
Cat R-7030 **$6.75**

Resistor
300 ¼ watt types worth $12. 60 values, quality 5% types.
Cat R-7010
$5.90

50 MATRIX PINS

Make soldering easier with these push-through pins. Suits 2.54mm pitch matrix board or veroboard.
Cat H-5590
$1.65 pk. of 50

Fantastic Saving

DELUXE TOOL/WORKBOX

Don't spend hours searching for things anymore – know where they are at a glance! You'd be amazed just how much this will hold! Large enough for soldering irons; plus compartments small enough for components etc. Ideal for artists, fishermen, hobbyists, technicians etc. Cat H-2600
$29.50
Was $32.50

BUY 5 GET ONE FREE!

Yes! That's right! You buy 5 at the normal price – Dick will give you one extra free!

Banana
4mm plugs
RED P-1710
BLACK P-1712
YELLOW P-1714
35¢ (10 up 30¢)

Quick Connect
Quick Connect P-5012
95¢ pk of 10 (10 up 85¢)
Cover for P-5012 P-5022
95¢ pk of 10 (10 up 85¢)

6.5mm Stereo Plug P-1166
95¢ (10 up 85¢)
6.5mm Stereo Socket P-1266
80¢ (10 up 72¢)
6.5mm Line Sockets Mono P-1264
80¢ (10 up 72¢)
Stereo P-1286
85¢ (10 up 75¢)

TV AERIALS & ACCESSORIES

L-4020 UHF/VHF TV Antenna	$59.95
L-4022 Antenna	$49.95
L-4028 UHF TV Antenna	$21.95
L-4150 Barge Mount	$9.00
L-4152 TV Mount	$5.95
L-4153 TV Mount & Clamp	$6.95
L-4154 TV Chimney Mount	$14.95
L-4156 TV Acc. Mast Section	$7.50
L-4165 U-Bolt	$1.55
L-4218 300 ohm 2-way splitter	$2.85
L-4270 TV Splitter 75 OHM 2-way	$1.80

Remember
it's a known fact – Antennae hold up houses! So get your new aerial today, before your house falls down!

Amaze your friends

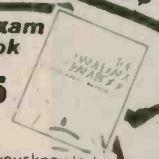
Electronic Door Chime Kit

A different tune every time you press the doorbell! Yes! This door chime, based on the latest microprocessor technology will play over 20 tunes, (or just one should you have a preference!) Great fun to build and use.
Cat K-3502

ONLY $31

The Ham Exam Cram Book

$4.95



Sharpen your knowledge and prepare for your theory exam without wasted effort! Concisely explained examples plus many multiple choice questions and answers.
Cat B-2314

Dick Smith Electronics

See Page 143 for full address details

A704

WAVETEK®

NEW APPOINTMENT

Commencing on the 25th day of December, 1983, Scientific Devices Australia Pty. Ltd. was appointed as the new Australian representative for Wavetek Corporation U.S.A.

Wavetek made this appointment after many months of assessing and negotiation with both Scientific Devices and other leading instrumentation representatives. The now allows Scientific Devices to offer one of the largest and most comprehensive electronics instrumentation product lines in Australia.

Wavetek, with the addition of two new divisions to their structure, namely Nicolet Scientific Corporation and Pacific Measurements, are one of the largest instrumentation suppliers in the U.S.A.

Their products include F.F.T. analyzers, synthesizers, programmable filters, R.F. signal generators, R.F. components, communication service monitors, radio and C.A.T.V. test equipment, R.F. sweep generators, microwave generators, instrumentation controllers, pulse/function generators, arbitrary programmable generators, instrument controllers, network analyzers and power meters.

From the 25th December, 1983, Scientific Devices offer marketing and support for Wavetek products with full service facilities.

Please contact Scientific Devices Australia Pty. Ltd. for further information on this appointment at any one of the offices in Melbourne, Sydney or Adelaide.

- NETWORK ANALYZERS
- INSTRUMENTATION COMPUTER
- REAL TIME SPECTRUM ANALYZERS
- SIGNAL PROCESSING FILTERS
- FREQUENCY SYNTHESIZERS
- FUNCTION GENERATORS
- PROGRAMMABLE FUNCTION GENERATORS
- PULSE GENERATORS
- MICROWAVE SIGNAL GENERATORS
- SWEEP GENERATORS
- SIGNAL GENERATORS
- MOD METER, ANALYZER AND SERVICE MONITORS
- DISPLAY OSCILLOSCOPES
- RF AND MICROWAVE COMPONENTS
- BROADBAND CATV TEST EQUIPMENT

Scientific Devices Australia Pty. Ltd.

2 Jacks Road, South Oakleigh 3167. Phone: 579 3622
31 Halsey Road, Elizabeth East, S.A. 5112 Phone: 255 6575
35-37 Hume St., Crows Nest., N.S.W. 2065 Phone: 43 5015

LOW COST 650 MHz COUNTER

NEW from Global Specialties, the Model 6001 is a benchtop 650 MHz frequency counter offering a very wide range of facilities, including dual inputs, switch-selectable gate times, and the use of both internal and external timebases for transducer, tachometry and flow-metering applications as well as general-purpose frequency measurements.

The instrument is designed for flexibility and ease of use, with a minimum of front-panel controls and comprehensive input and output facilities to suit a variety of applications.

The 6001 covers a frequency range from 5 Hz to 650 MHz; one of the two front-panel BNC inputs is used for signals from 5 Hz to 100 MHz, and the other covers the range 50 MHz to over 650 MHz.

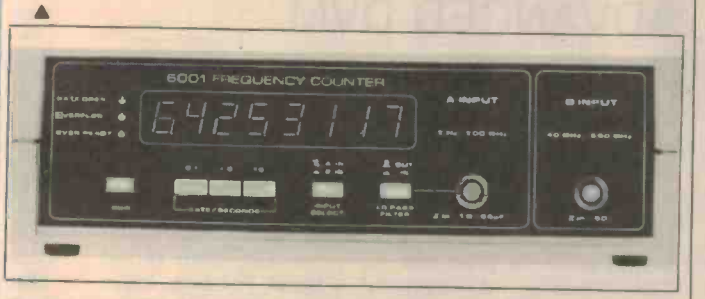
The lower-frequency input has a quoted input impedance of 1M + 10pF, with a switchable low-pass filter providing 3 db/octave roll-off at 50 kHz for audio and ultrasonic measurements, while the higher-frequency input provides a 50 Ohm input impedance and fuse protection.

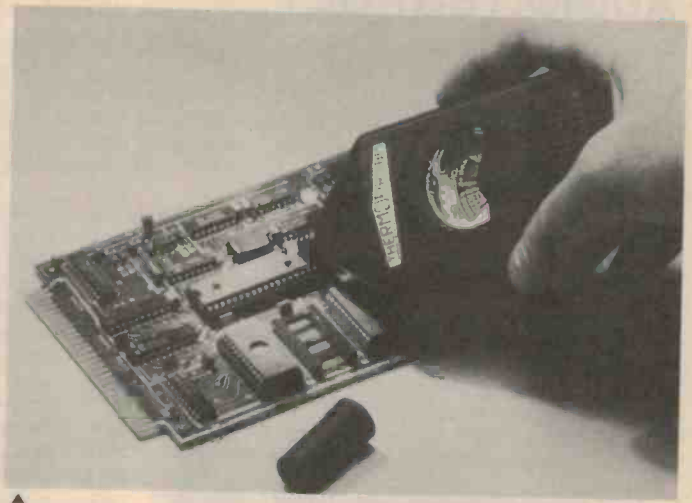
Three switch-selectable gate times are offered: 0.1, 1.0 and 10 sec, giving resolution sof 10, 1 and 0.1 Hz, respectively. A light-emitting diode on the front panel indicates a 'gate-open' condition.

The 8-digit, 11mm high display offers lead-zero blanking, a decimal point in the megahertz position and a contrast enhancement filter to ensure legibility in high ambient light environments. Other front-panel indicators are provided for 'oven-ready', 'overflow' and 'power-on'.

The internal timebase is a precision 10 MHz oven-controlled crystal oscillator, with a claimed accuracy of +/−0.5 parts per million from 0° to 50° Celcius. The external reference can be selected with a rear-panel switch. The oven-oscillator output is buffered, and is available via a rear-panel BNC connector. Inputs and outputs are compatible with standard TTL circuitry.

The global Model 6001 is mains-powered, measures 76 x 254 x 178 mm and weights just 1.4 kg. It comes with a comprehensive instruction and applications manual. Global Specialties is represented by **Vicom International, 57 City Rd., South Melbourne 3205. Vic. (03)62-6931.**





THERMOPROBE TESTS PCBs

A new, low cost, electronic test instrument called Thermoprobe is designed to quickly identify dead active components on printed circuit boards without direct contact.

The solid-state device consists of a thermistor probe connected to a modified wheatstone bridge circuit and is designed to measure minute temperature changes of 1/25 of a degree Fahrenheit (1/45°C).

Since dead resistors, transformers, diodes or ICs do not emit heat they can be quickly identified on the unit's built-in S-meter as the thermistor probe is moved in close proximity to them, claim the manufacturers, Metrifast.

Its small shirt pocket size makes the device extremely useful in field service applications for computers, electronic instrumentation, video and hi-fi equipment.

The Metrifast Thermoprobe is available for US$21.95 postpaid from **Metrifast, 51 South Denton Avenue, New Hyde Park, New York 11040 USA.**

DIGITAL MULTIMETERS MEASURE CAPACITANCE

Lamron is marketing hand held and bench model digital multimeters which give the facility to measure capacitors and conductance or transistors and conductance.

The hand held models have a high resolution 12.5 mm LCD which is visible from acute angles and two types of range selection. Models 56 and 58 use a single rotary switch and models 73, 76 and 79 use push buttons.

A 9 V battery provides approximately 200 hours operation, with low battery voltage automatically detected and displayed. Each range has full auto-polarity operation and overrange indication, while dual slope integration measurement techniques ensure noise-free measurements.

The models capable of measuring capacitance have five range scales and are able to measure up to 20 μF, offering accuracies to 0.1% on dc. With a high impedance of 10M, these instruments are ideally suited to the designer's test bench.

These units are capable of reading from 1 μA to 10 A on the ac and dc ranges, and can make resistance measurements up to 10 000M using the conductance ranges.

A six month guarantee is provided on all models. The hand held units are supplied with a soft carry case, test leads, spare fuse, instruction manual and battery.

For further information contact **Lamron Pty Ltd, P.O. Box 438, Ryde NSW 2112. (02)85-6228.**

AUDIO TEST SET

The Loftech TS-1 from Phoenix Audio Laboratory, is a compact device that combines an audio sine wave generator with a digital meter.

The oscillator's range extends from 15 Hz to 30 kHz, and the meter can be switched to read decibel levels as well as frequencies.

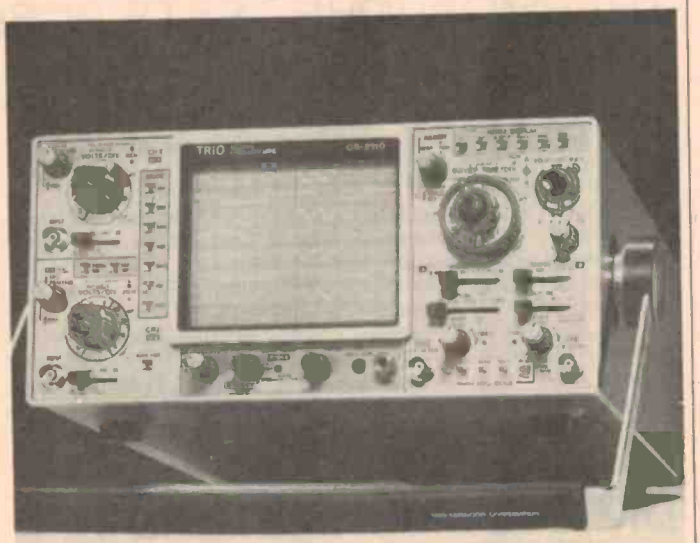
When switched for signal level, the meter reads whole decibels over a range of −50 to +24, with 0 dB representing 0.775 V. The minus sign comes on automatically as applicable. A rear panel adjustment may be used to adjust the 0 dB reference point.

In its frequency display mode, the meter responds from 1 Hz to 99.99 kHz.

It's possible to use the TS-1 simultaneously as both a test signal source and a readout device for other equipment being tested.

Suggested uses of the Loftech TS-1 include calibrating levels of tapes and mixing consoles, verifying the frequency response of audio equipment and checking signal levels at various points in an audio chain as a troubleshooting aid.

For further information contact **John Vestergaard, Hilotek International Pty Ltd, Miles St, Mugrave Vic. 3170. (03)561-2888.**



NEW TRIO SCOPE

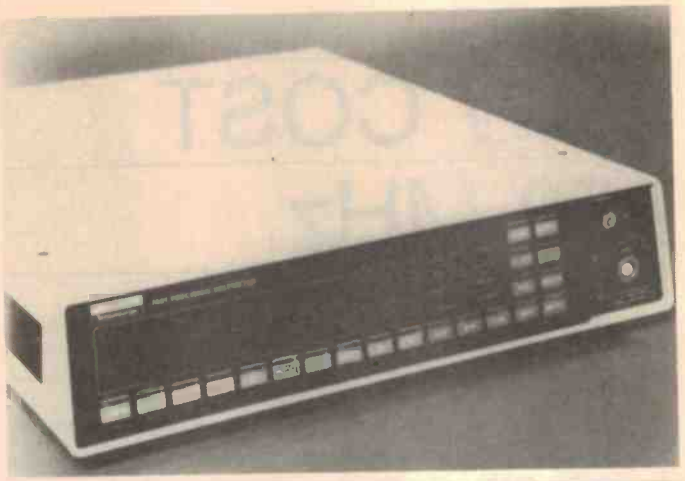
Parameters recently released the new Trio CS-2110 100 MHz portable oscilloscope. The new model replaces the older CS-2100A and features thoroughly upgraded performance in virtually all areas, the company said.

Parameters claims the CS-2110 is capable of observing extremely low signal levels with complex waveforms. Sensitivity is 1 mV/div up to 100 MHz and the -6 dB bandwidth point is guaranteed to 140 MHz, they said.

Utilising the alternate delayed sweep technique, a user can view all four channels and their corresponding delayed signals simultaneously. This gives a total of eight traces. Sweep time is continuously variable from 0.5 seconds to 20 nanoseconds per division.

An internal delay line enables observation of the leading edge of high frequency signals. The CRT has 20 kV of accelerating potential with automatic focus Accuracy is ±2%. The package housing the scope is 284 mm x 138 mm x 400 mm and weighs 7.4 kg, which is reasonably light.

Further information can be obtained from **Parameters Pty. Ltd, PO Box 573, Artarmon NSW 2064. (02)439-3288.**



NEW COUNTERS

Tech Sales has announced the release of the Solartron 7081, which they claim to be the most advanced digital voltmeter in the world.

The 7081 provides less measurement uncertainty and better stability than any other product, they say.

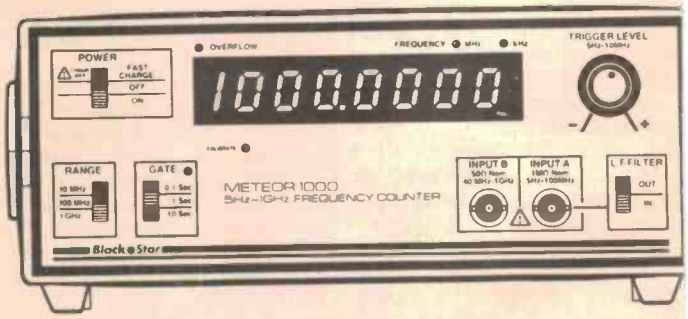
It is the first voltmeter with 8½-digit scale length, having a sensitivity of 10 nV. This, coupled with various methods of digital filtering enables measurements to be made that have not been possible in the past.

As well as having 8½-digit scale length, the 7081 has 1.2 ppm dc stability for 24 hours, a typical uncertainty of 11 ppm for one year, true rms ac measurement, and resistance measurement to greater than 1400M

Added to this, is the comprehensive result processing, measurement history file and full control via RS232C or IEEE-488 interfaces, which means the product can fulfil the requirements of a standards laboratory and automatic test, yet still be appropriate for straightforward bench use.

The system capability is enhanced by an automatic measurement clock and an option 128 channel analogue scanner.

For further information, contact **Tech Sales Pty Ltd, 83-87 Wellington St, Windsor Vic. 3181 (03)51-1306.**



ADVANCED DVM

Hilotek has become the Australian agent for Black Star frequency counters and three models in the range are available.

All of them have eight-digit seven-segment LED displays and operate on 9 V dc. Mains adaptors are supplied but Ni-Cad batteries are optional. Frequency ranges are: Meteor 100, 5 Hz to 100 MHz; Meteor 600, 5 Hz to 600 MHz; and Meteor 1000, 5 Hz to 1000 MHz.

As an introductory offer, these instruments are priced at $256, $305 and $355 respectively (plus sales tax where applicable). Further information is available from **Hilotek International Pty Ltd, Miles St, Mulgrave Vic 3170 (03)561-5888.** ●

LESS 20% FOR 25 OR MORE OF ONE TYPE OF IC OR TRANSISTOR THIS MONTH.

Integrated Circuits & Transistors

2N3819	1.20	2SD288	3.95	7482	1.80	74367	1.50	8228	5.50	74F521	4.22	78L12	.75	4024	1.20	4514	2.90	R28110	
2N3866	2.95	2SD325	2.95	7483	1.10	74368	1.50	8231	199.00	74F533	4.84	78L 15	.75	4025	.80	4515	2.90	330 OHM	1.40
2N3904	1.00	2SD525	3.95	7485	1.20	74373	2.25	8232	199.00	74F534	4.84	78L 18	.75	4026	2.40	4516	1.45	R28115	
2N3906	1.00	2SK45	3.95	7486	1.20	74374	2.25	8237	39.00			78L 24	.75	4027	1.20	4517	8.75	470 OHM	1.40
2N4030	1.50	2SJ49	7.50	7489	3.90	74375	1.75	8238	9.50	MEMORY		79L 05	1.20	4028	1.20	4518	2.50	R28120	
2N4032	2.20	2SJ56	12.50	7490	1.00	74377	2.45	8243	8.50	2101	6.90	79L 12	1.20	4029	1.50	4519	1.90	560 OHM	1.40
2N4033	2.20	2SK45	3.95	7491	1.00	74390	1.95	8251	4.90	2102	2.50	79L 15	1.20	4030	1.50	4520	2.55	R28125	
2N4036	2.50	2SK134	7.50	7492	1.00	74393	1.95	8253	7.50	2112	7.90	79L 18	1.20	4031	2.95	4521	3.90	820 OHM	1.40
2N4121	1.50	2SK176	12.50	7493	1.00	74425	2.55	8255	5.50	2114	2.95	79L 24	1.20	4032	2.75	4522	1.90	R28130	
2N4123	1.50	1N4001	.10	7494	1.50	74226	2.55	8257	16.50	3147	6.90			4033	2.75	4526	1.85	1K OHM	1.40
2N4236	1.90	1N4002	15	7495	1.00	74490	2.65	8259	6.50	2708	5.90	LM309K		4034	3.50	4527	2.65	R28135	
2N4237	1.90	1N4007	.20	7496	1.50	9300	1.50	8271	89.00	2716	5.90	(7805KC)	1.90	4035	1.95	4528	1.15	1K2 OHM	1.40
2N4248	.40	1N5400	.40	7497	2.30	9301	2.50	8272	33.00	2732	7.00	LM317T	2.50	4038	3.25	4529	1.80	R28140	
2N4249	.40	1N5404	.40	74100	1.65	9302	2.90	8273	65.00	2764	12.00	LM317K	4.50	4040	1.90	4530	1.60	1K5 OHM	1.40
2N4250	.40	1N5408	.60	74107	1.20	9304	4.00	8274	42.50	27128	59.00	LM317HV	9.50	4041	1.50	4531	1.65	R28145	
2N4258	.50	OA47	.80	74109	.90	9305	2.40	8275	38.50	4116	3.95	LM323K	6.50	4042	1.00	4532	2.65	1K8 OHM	1.40
2N4355	.50	OA90	.50	74110	1.50	9307	3.80	8276	28.50	4164	10.00	LM337T	2.90	4043	1.60	4534	8.90	R28150	
2N4356	.50	OA91	.50	74111	1.50	9308	2.60	8279	8.50	6116	10.00	LM337K	6.50	4044	1.20	4536	6.50	2K2 OHM	1.40
2N4360	1.00	OA95	.50	74112	1.50	9309	2.40	8282	6.90	6164	99.00	LM338K	9.50	4045	4.90	4538	3.50	R28155	
2N4401	.30	5082-2800	2.95	74113	1.50	9310	1.50	8283	6.50	58725 (6116)		LM350T	6.50	4046	2.50	4539	1.65	2K7 OHM	1.40
2N4402	.30	5082-2811	4.95	74114	1.50	9311	2.50	8284	8.50		9.00	LM350K	7.50	4047	1.90	4541	1.60	R28160	
2N4403	.30	HLMP6620	5.95	74120	1.95	9312	2.50	8286	6.50	2101 (5101)		LM395K	22.50	4048	1.20	4543	2.50	3K3 OHM	1.40
2N4416	1.90			74121	.90	9313	6.00	8287	6.50	(8101)	7.90	LM396K	19.50	4049	1.00	4544	10.50	R28165	
2N4427	2.90	BRIDGES		74122	.90	9314	2.40	8288	25.00	5101	7.90			4050	1.00	4549	7.25	4K7 OHM	1.40
2N4919	2.90	1.5AMP		74123	1.50	9316	1.90	8289	73.00	8101	7.90	78H 05KC	9.00	4051	1.50	4551	1.80	R28170	
2N5088	1.00	W005	.50	74125	1.00	9317	4.20	8291	43.00	2532	12.50	78H 12KC	9.00	4052	1.50	4553	5.50	5K6 OHM	1.40
2N5089	1.00	W02	.60	74126	1.00	9318	4.60	8292	34.50			78HGKC	9.50	4053	1.50	4554	2.35	R28175	
2N5139	1.20	W04	.60	74128	1.80	9319	2.00	8293-10	26.50	OPTO		78P 05KC	14.50	4054	3.90	4555	1.10	6K8 OHM	1.40
2N5179	1.20	6AMP		74132	1.00	9320	6.90	8741	57.50	4N25	1.20	ITEM		4055	3.90	4556	1.25	R28180	
2N5190	2.50	BPC602	2.90	74136	1.00	9321	2.40	8748	35.00	4N26	1.20	RETAIL COST		4056	4.20	4557	7.85	8K2 OHM	1.40
2N5191	3.30	KBPC604	3.50	74138	1.80	9322	1.90	8749	58.50	4N27	1.20	79HGKC	16.50	4060	2.50	4558	2.25	R28185	
2N5192	3.10	KBPC608	4.50	74139	1.50	9324	1.40	8755	33.50	4N28	1.20	78S 40	3.50	4063	2.00	4559	7.25	10K OHM	1.40
2N5193	2.50	10AMP		74141	1.10	9328	4.90	2911	26.50	4N29	1.50	MC1496L	14.50	4066	2.50	4560	3.75		
2N5194	2.95	KBPC10005	3.90	74142	1.45	9334	6.00	2912	27.50	4N30	1.60			4067	9.90	4561	1.80	10 PIN SIPS	
2N5195	3.30	KBPC1002	4.20	74143	1.45	9338	5.90	2920	239.00	4N32	2.50	SPECIAL		4068	1.00	4562	8.45		
2N5210	1.50	KBPC1004	4.90	74144	3.90	9340	9.90	3205/8205	9.90	4N33	2.50	FUNCTION		4069	1.00	4566	3.00	R29100	
2N5245	1.50	35AMP		74145	1.45	9342	5.90	3242	17.50	4N35	2.50	LM 4250	2.45	4070	.90	4568	4.25	100 OHM	1.60
2N5303	8.50	KBPC3502	5.90	74147	1.95	9368	2.20	3245	10.90	4N37	2.00	NE5534 N	2.50	4071	.80	4569	2.50	R29105	
2N5401	1.50	KBPC35014/MD		74148	2.00	9374	3.30	3628	18.50	MCT6	2.50	NE5534 AN	2.95	4072	.90	4572	.75	220 OHM	1.60
2N5457	1.00	A3504	6.90	74150	1.50	9386	2.40	8008-1	62.50	MCT66	6.90	MC3340	1.90	4073	.90	4580	8.95	R29110	
2N5458	.90	KBPC3510/MDA		74151	1.20	75107	2.50	8031-3	29.50	MCT2	1.50	MC3341	2.90	4075	.90	4581	3.10	330 OHM	1.60
2N5459	.90	3510	9.90	74154	1.75	75110	2.50	8035	6.90	1LD 74	5.90	76477	8.95	4076	1.50	4582	2.25	R29115	
2N5461	.90			74155	1.20	75150	2.50	8039	7.90	1LQ 74	6.50	76488	8.95	4077	.80	4583	1.65	470 OHM	1.60
2N5462	.90	74		74156	1.70	75154	2.50	FD1771	19.00	FND357	1.80	76489	9.95	4078	.80	4584	.85	R29120	
2N5485	.90	7400	.60	74157	1.00	75450	1.50	FD1791 (8876)		FND500	1.80	8038	6.50	4081	.80	4585	2.10	560 OHM	1.60
2N5486	.90	7401	.60	74158	1.00	75451	.90		39.00	FND507	1.80			4082	.80	4597		R29125	
2N5489	14.50	7402	.60	74160	1.00	75452	.90	FD1793 (8877)		FND800	3.50	OM350	9.95	4085	2.20	4599	3.45	820 OHM	1.60
2N5590	16.50	7403	.60	74161	1.20	75453	.90		39.00	TIL31A	2.95			4086	2.30	45104	7.25	R29130	
2N5591	18.50	7404	.60	74162	1.20	75461	1.50	FD1795	39.00	TIL81A	2.95	IM65X08CPE	5.00	4089	3.50	45106	7.85	1K OHM	1.60
2N5641	19.50	7405	2.00	74163	1.40	75462	1.50	FD1797	39.00	TIL306	14.50			4093	.75	45107	7.25	R29135	
2N5656	2.50	7406	2.00	74164	1.20	75471	3.00	WO1691	29.50	MAN72 (DL702)				4094	3.35	45109	7.25	1K2 OHM	1.60
2N5770	.30	7407	2.00	74165	1.20	75472	3.00	WD2143	14.50		2.50	XR2206	7.95	4095	2.40	45112	7.85	R29140	
2N5777	1.50	7408	.60	74166	1.70	75491	2.00	WD1931	22.50	MAN74 (DL704)		XR2207	7.95	4096	2.40			1K5 OHM	1.60
2N5830	.30	7409	.60	74167	2.20	75492	2.00	WD1933	34.00		2.50	XR2208	6.90	4097	6.50			R29145	
2N5831	.30	7410	.60	74174	1.45	75493	3.00	WD1983	14.75	BPW50	2.25	XR2209	6.90	4098	2.90	RESISTOR		1K8 OHM	1.60
2N5873	1.40	7411	.70	74175	1.20	75494	3.00	WD1993	59.00	HP5082-2811		XR2211	7.45	4099	3.90	PACKS		R29150	
2N5874	1.70	7412	.70	74176	1.40	8121	5.00	WD2123	26.50		4.95	XR2216	5.90	4104	6.90			2K2 OHM	1.60
2N5944	15.50	7413	.70	74177	1.40	8123	4.00	WD8250	16.50	HLMP 6620	3.95	XR2240	6.95	4160	1.25			R29155	
2N5945	18.50	7414	1.20	74178	2.15	8130	7.95	TR1602 (S1883)		CQY89	1.50	XR2243	7.95	4161	1.25	SIPS RESISTORS		2K7 OHM	1.60
2N5946	19.50	7415	.70	74179	2.15	8131	7.95		8.50	MOC3011	2.95	XR8038	7.50	4162	1.25	PIN 1 COMMON		R29160	
2N5961	1.90	7416	1.20	74180	1.20	8135	6.95	TR1863	8.90	MOC3020	2.50			4163	1.25	6 PIN		3K3 OHM	1.60
2N6027	1.00	7417	1.20	74182	1.20	8136	6.95	COM8116	24.00	MOC3021	2.95	ICC7660	12.50	4174	1.25	R27100		R29165	
2N6049	1.90	7420	.60	74184	1.20	8303	5.50	BR1941	23.00	LEDS		95H90	8.50	4175	1.60	100 OHM	1.20	4K7 OHM	1.60
2N6080	8.50	7421	.80	74190	1.00	8304	6.95	CRT8002A	59.90	3mm RED	.25	11C90	16.50	4194	1.95	R27105		R29170	
2N6083	17.90	7422	.80	74191	1.45	82S23	5.95			3mm YELLOW	.30	LM7555	1.90	4402	1.00	220 OHM	1.20	5K6 OHM	1.60
2N6084	22.50	7423	.90	74192	1.65	82S123	6.95	74F SERIES		3mm GREEN	.30	LM7556	3.50	4404	1.15	R27110		R29175	
2N6124	1.90	7425	.90	74193	.80	8311	5.95	74F00	.79	5mm RED	.15	MC10116L	1.50	4408	6.90	330 OHM	1.20	6K8 OHM	1.60
2N6125	1.90	7426	.70	74194	1.10	8641	5.95	74F02	.79	5mm YELLOW	.30	LM13600	3.95	4409	13.50	R27115		R29180	
2N6130	1.90	7427	.80	74195	1.00	8820	6.95	74F04	.92	5mm GREEN	.30	LF13741	.80	4410	11.50	470 OHM	1.20	8K2 OHM	1.60
2N6133	1.90	7428	.80	74196	1.20	8830	6.95	74F08	.79	ITEM		LF13741-H	1.50	4411	12.60	R27120		R29185	
2N6256	14.50	7430	.70	74197	1.10	8831	6.95	74F10	.79	RETAIL COST		DS75451	.60	4412	5.45	560 OHM	1.20	10K OHM	1.60
2N6259	13.50	7432	.70	74198	1.10	8832	6.95	74F11	.79	5mm ORANGE	.30	DS75452	.60	4415	10.15	R27125			
2N6274	29.50	7433	.70	74199	1.30	8833	6.95	74F20	.79	RED RECT	.30	DS75491	2.00	4416	5.60	820 OHM	1.20		
2N6378	4.90	7437	.80	74221	1.90	8834	6.95	74F32	.79	GREEN RECT	.30	DS75492	2.00	4419	3.45	R27130			
2N6425	4.50	7438	.90	74240	2.90	8835	5.95	74F64	.79	YELLOW RECT	.30			4422	9.50	1K OHM	1.20		
2N6578	5.90	7439	1.00	74241	2.90	8836	3.75	74F74	.89	RED CHROME		DM2502	12.50	4426	2.35	R27135			
3N201	1.50	7440	1.00	74242	2.40	1488	1.50	74F86	1.19	BEZEL	1.20	ADC080	16.00	4428	1.75	1K2 OHM	1.20		
2SA683	2.95	7442	1.00	74243	1.90	1489	1.50	74F109	.99	YELLOW		ADC808	17.00	4433	2.75	R27140			
2SC2028	3.95	7443	1.60	74244	1.90	81LS95	2.75	74F138	1.79	CHROME BEZEL		DAC0800	4.50	MC14433	13.90	1K5 OHM	1.20		
2SC2029	3.95	7444	1.50	74245	2.40	81LS96	2.75	74F139	1.79		1.20	DAC0808	4.50	4435	7.95	R27145			
2SC2166	4.95	7445	1.50	74246	2.25	81LS97	2.75	74F151	1.79	GREEN CHROME		SAK140	9.50	4441	1.50	1K8 OHM	1.20		
2SC1730	1.95	7446	1.20	74247	2.25	81LS98	2.75	74F153	1.79	BEZEL	1.20	ZN414	1.95	4443	3.90	R27150			
2SC1969	6.30	7447	1.20	74248	2.25	8T26	3.00	74F157	1.79			UA170	5.95	4445	2.65	2K2 OHM	1.20		
2SC1973	3.95	7448	1.20	74249	2.25	8T28	3.00	74F158	1.79	VOLTAGE				4446	3.55	R27155			
VN88AF	3.95	7449	1.20	74251	1.10	8T30	3.00	74F175	2.78	REGS		4000	.60	4449	1.00	2K7 OHM	1.20		
2SC372	1.95	7450	.90	74253	1.10	8T96	1.80	74F181	5.98	78050C	1.20	4001	.60	4450	3.75	R27160			
2SC495	2.95	7451	.90	74257	1.50	8T97	1.80	74F182	2.73	7805KC	2.50	4002	.80	4451	3.75	3K3 OHM	1.20		
2SC710D	1.95	7452	.80	74258	1.50	8T13	2.95	74F189	7.44	7812UC	1.20	4006	1.90	4457	5.90	R27165			
2SC735	1.95	7453	.70	74249	2.45	8T14	2.95	74F190	4.86	7812KC	2.50	4007	.80	4458	9.90	4K7 OHM	1.20		
2SC900F	1.95	7454	.80	74273	2.45	8080	8.00	74F191	4.86	7815UC	1.20	4008	1.70	4469	14.90	R27170			
2SC945A	1.95	7455	.90	74276	2.45	8085	8.50	74F194	2.41	7815KC	2.50	4009	.90	4490	5.90	5K6 OHM	1.20		
2SC1014	2.50	7460	.70	74278	3.45	8086	59.00	74F241	3.72	7818UC	1.20	4010	.90	4495	3.95	R27175			
2SC1017	4.95	7461	.90	74279	.85	8088	29.00	74F243	4.34	7818KC	2.50	4011	.60	4500	8.90	6K8 OHM	1.20		
2SC1018	4.95	7462	1.00	74283	2.45	8155	6.50	74F244	3.72	7824UC	1.20	4012	.90	4501	.50	R27180			
2SC1061	2.95	7463	1.20	74289	3.25	8156	11.50	74F251	1.93	7824KC	2.50	4013	1.20	4502	1.80	8K2 OHM	1.20		
2SC1096	2.95	7470	.80	74290	.90	8185	37.50	74F253	1.93	7905UC	1.90	4014	1.90	4503	.90	R27185			
2SC1173	2.95	7472	.90	74293	.90	8202	52.50	74F257	1.93	7905KC	3.00	4015	1.20	4504	2.00	10K OHM	1.20		
2SC1226	2.95	7473	.90	74295	1.65	8203	58.50	74F258	1.93	7912UC	1.90	4016	1.00	4506	.75				
2SC1306	6.30	7474	.70	74298	2.45	8206	115.50	74F350	4.34	7912KC	3.00	4017	1.50	4507	.40	8 PIN SIPS			
2SC1419	2.95	7475	.70	74299	1.75	8212	3.00	74F352	1.93	7915UC	1.90	4018	1.90	4508	4.50				
2SC1449	1.95	7476	.80	74351	1.85	8214	4.90	74F353	1.93	7915KC	3.00	4019	.80	4510	1.50	R28100			
2SC1674	1.95	7477	1.20	74352	1.85	8216	3.00	74F373	4.84	7918UC	1.90	4020	1.50	4511	1.50	100 OHM	1.40		
2SC1675	1.95	7478	1.20	74365	1.50	8224	3.50	74F374	4.84	7924UC	1.90	4021	1.50	4512	1.10	R28105			
2SC1307	6.90	7480	1.20	74366	1.50	8226	4.90	74F399	2.78	78L 05	.75	4022	1.50	4513	2.65	220 OHM	1.40		
												4023	.75						

Errors & omissions excepted.

LESS 10% THIS MONTH FOR 10 OR MORE OF ONE TYPE OF IC OR TRANSISTOR.

Integrated Circuits & Transistors

REVISED 7/11/83

ICL7106	13.50
ICL7116	19.50
ICL7117	21.50
ICL7611	6.95
ICL7612	6.95
ICL7660	4.90
ICL7663	4.90
ICL7664	4.90
ICM7211	12.50
ICM7216A	48.50
ICM7216B	44.50
ICM7217A	18.50
ICM7218A	18.50
ICM7224A	21.50
ICM7226A	48.50
ICM7227A	19.95
ICM7213A	15.50
ICM7240	7.50
ICM7242	3.90
ICM7250	7.90
ICM7260	7.90
ICM7555	2.75
ICM7556	2.95

74 S

74S00	1.00
74S02	1.00
74S03	1.00
74S04	1.00
74S05	1.50
74S08	1.00
74S09	1.50
74S10	1.00
74S11	1.00
74S15	1.60
74S20	1.20
74S22	1.50
74S30	1.00
74S32	1.00
74S37	1.70
74S38	1.70
74S40	1.20
74S51	.80
74S64	1.20
74S65	1.20
74S74	1.30
74S86	1.60
74S109	2.50
74S112	1.30
74S113	1.30
74S114	2.50
74S124	5.90
74S132	3.50
74S133	1.20
74S134	1.40
74S135	1.30
74S138	3.30
74S139	3.30
74S140	1.90
74S151	3.10
74S153	2.00
74S157	3.10
74S158	3.10
74S160	5.90
74S161	5.90
74S162	7.90
74S163	7.90
74S168	11.50
74S169	11.50
74S174	4.50
74S174	4.50
74S181	8.50
74S182	3.40
74S188AN	4.10
74S189	8.50
74S194	3.30
74S195	2.90
74S196 82590	4.90
74S197 82591	4.90
74S201	9.90
74S214AN	P.O.A.
74S225	10.90
74S226	7.90
74S240	6.90
74S241	6.90
74S244	9.90
74S251	3.90
74S253	4.90
74S257	3.30
74S258	3.30
74S260	2.90
74S274	P.O.A.
74S275	P.O.A.
74S280	5.90
74S281	P.O.A.
74S283	7.90
74S287	4.90
74S288	4.90
74S299	13.90
74S301	13.90
74S314	P.O.A.
74S330	P.O.A.
74S331	P.O.A.
74S373	9.90
74S374	9.90
74S381	9.90
74S387	3.30
74S412 8212	5.90
74S428 8228	7.90
74S470	9.90
74S471	9.90
74S472	P.O.A.
74S473	P.O.A.
74S474	P.O.A.
74S475	P.O.A.
74S482	11.90
74S489	7.90

74H

74H00	.80
74H01	.80
74H02	.80
74H03	.80
74H04	.80
74H05	.90
74H08	1.10
74H10	.80
74H11	.80
74H12	.80
74H15	.80
74H20	.80
74H21	.90
74H22	.80
74H30	.90
74H40	.90
74H50	.90
74H51	.90
74H52	.90
74H53	.90
74H54	.90
74H55	.90
74H60	.90
61	.90
74H62	.90
74H64	.90
74H65	.90
74H71	1.40
74H72	1.20
74H73	1.80
74H74	1.80
74H76	1.90
74H78	1.90
74H87	7.90
74H101	1.80
74H102	1.80
74H103	2.50
74H106	2.50
74H108	2.50
74H113	1.10
74H114	1.10
74H183	7.90

74C

74C00	.80
74C02	.80
74C04	.80
74C08	.80
74C10	.80
74C14	1.00
74C20	.80
74C30	.80
74C32	.80
74C42	1.90
74C48	2.50
74C73	1.40
74C74	2.40
74C76	1.90
74C83	2.30
74C85	2.30
74C86	1.50
74C89	8.90
74C90	1.90
74C93	1.90
74C95	2.00
74C107	1.20
74C150	6.50
74C151	4.20
74C154	6.00
74C157	3.75
74C160	1.90
74C161	1.90
74C162	2.00
74C163	2.00
74C164	2.50
74C165	2.50
74C173	1.90
74C174	1.90
74C175	1.90
74C192	2.00
74C193	2.00
74C195	2.00
74C200	14.00
74C221	2.75
74C240	2.75
74C244	2.95
74C373	5.75
74C374	5.45
74C901	3.00
74C902	2.50
74C903	2.50
74C904	2.50
74C905	15.00
74C906	2.90
74C907	2.90
74C908	2.75
74C910	14.00
74C911	12.50
74C912	12.50
74C914	4.50
74C915	4.00
74C917	15.50
74C918	2.90
74C920	12.50
74C921	12.50
74C922	7.50
74C923	7.90
74C925	8.90
74C926	8.90
74C927	9.90
74C928	9.00
74C929	9.50
74C930	2.75
74C932	2.50
74C941	2.50
74C989	8.90

74LS

74LS00	.60
74LS01	.60
74LS02	.60
74LS03	.60
74LS04	1.00
74LS05	1.00
74LS08	.60
74LS09	.80
74LS10	.80
74LS11	.80
74LS12	.80
74LS13	.90
74LS14	1.80
74LS15	.80
74LS19	.90
74LS20	.90
74LS21	.90
74LS22	.90
74LS24	.90
74LS26	.90
74LS27	.90
74LS28	.90
74LS30	.90
74LS32	.60
74LS33	.60
74LS37	.70
74LS38	.80
74LS40	.80
74LS42	1.90
74LS47	1.80
74LS48	1.80
74LS49	1.80
74LS51	.70
74LS54	.80
74LS55	.80
74LS63	2.80
74LS73	1.00
74LS74	2.50
74LS75	1.00
74LS76	1.00
74LS77	1.00
74LS78	1.10
74LS83	1.50
74LS85	1.75
74LS86	.80
74LS90	1.20
74LS91	1.20
74LS92	1.20
74LS93	1.50
74LS95	1.20
74LS96	1.20
74LS107	.90
74LS109	.90
74LS112	.70
74LS113	.70
74LS114	.80
74LS122	1.30
74LS123	1.30
74LS125	1.20
74LS126	1.20
74LS132	1.50
74LS133	4.90
74LS136	1.50
74LS138	1.50
74LS139	1.50
74LS145	2.10
74LS147	2.50
74LS148	1.90
74LS151	1.20
74LS152	1.95
74LS153	1.00
74LS154	2.95
74LS155	1.50
74LS156	1.50
74LS157	1.90
74LS158	1.00
74LS160	1.00
74LS161	1.00
74LS162	1.50
74LS163	1.10
74LS164	1.40
74LS165	1.00
74LS166	2.55
74LS170	2.45
74LS173	1.20
74LS174	1.20
74LS175	2.80
74LS181	4.00
74LS190	1.50
74LS191	1.20
74LS192	1.20
74LS193	1.20
74LS194	1.20
74LS195	1.75
74LS196	1.75
74LS197	1.75
74LS221	2.00
74LS240	2.40
74LS241	2.40
74LS242	2.40
74LS243	2.40
74LS244	2.50
74LS245	2.95
74LS247	1.30
74LS248	1.50
74LS249	1.60
74LS251	1.50
74LS253	1.20
74LS257	1.20
74LS258	1.20
74LS259	2.25
74LS261	2.50
74LS266	1.20
74LS273	1.95
74LS275	6.80
74LS279	1.00
74LS280	2.60
74LS283	1.50
74LS290	1.50
74LS293	1.30
74LS295	1.75
74LS297	16.50
74LS298	1.20
74LS299	3.90
74LS320	3.95
74LS321	3.95
74LS322	6.75
74LS323	6.50
74LS324	2.20
74LS326	2.20
74LS327	2.20
74LS352	2.20
74LS353	2.20
74LS354	3.95
74LS365	1.00
74LS366	1.00
74LS367	1.00
74LS368	1.00
74LS373	2.00
74LS374	2.00
74LS375	1.00
74LS377	2.15
74LS378	1.20
74LS379	1.90
74LS386	1.00
74LS390	1.80
74LS393	1.80
74LS395	2.00
74LS396	2.50
74LS398	3.00
74LS399	1.90
74LS424	5.50
74LS440	5.50
74LS441	5.50
74LS442	5.50
74LS443	550
74LS445	2.20
74LS446	5.50
74LS447	1.90
74LS448	5.50
74LS449	5.50
74LS490	3.20
74LS540	5.95
74LS541	7.95
74LS621	2.75
74LS622	2.75
74LS623	5.95
74LS629	5.95
74LS640	3.95
74LS641	2.75
74LS642	2.75
74LS643	2.75
74LS644	2.75
74LS645	2.75
74LS668	1.75
74LS669	1.75
74LS670	2.75
74LS673	12.55
74LS674	12.55
74LS690	3.95
74LS691	3.95
74LS692	3.95
74LS693	3.95
74LS696	3.95
74LS699	3.95

CDP

CDP1802	16.50
CDP1864	17.50

CPU

6502	13.00
6502A	14.00
6503	13.00
6504	13.00
6505	13.00
6507	13.00
6520	5.50
6521	5.90
6522	13.00
6522A	13.00
6532	14.00
6545	22.50
6551	12.90
2650	21.00
2651	23.00
6800	8.00
6802	10.00
6808	12.50
6809	17.00
6810	3.50
68B10	
6820	5.50
6821	5.50
68B21	
6840	6.50
6844	15.00
6845	25.00
6847	7.50
6850	3.50
68B50	
6860	10.00
6875	15.50
Z80CPU	7.00
Z80ACPU	8.00
Z80BCPU	16.00
Z80P10	4.50
Z80AP10	6.50
Z80CTC	6.50
Z80ACTC	8.50
Z80DMA	16.00
Z80ADMA	19.00
Z80AS10	15.00
Z80S10	13.00
AD570	69.50
AD590	9.50
AD7524	17.50
AY-3-8910	14.50
AY-3-2513	14.50
MSM5832	16.50
MM58174	19.50
MM5303	7.50
MM5309	14.50
MM5369	4.95
LH0002	9.50
LH0042CH	7.50
LH0070	7.50
LH0071	7.50
TL061	1.50
TL062	2.90
TL064	4.90
TL071	1.20
TL072	2.90
TL073	3.20
TL074	4.90
TL081	1.90
TL082	2.50
TL083	2.90
TL084	3.45
TL494	4.90
TCA220	9.50
TCA280	4.50
TDA1024	2.90
TA7205P	3.90
TEA1002	17.50
UAA170	5.95
UAA180	3.75
LM10CH	7.50
LM301	1.00
LM301H	1.50
LM302H	6.50
LM305H	1.50
LM307CN	1.00
LM307H	1.60
LM308	1.20
LM308H	1.80
LM309K	1.90
LM310N	3.20
LM310H	3.20
LM311	1.00
LM311H	1.80
LM317T	2.50
LM317K	4.50
LM318	3.50
LM318	3.50
LM324	1.50
LM325	4.50
LM326	4.50
LM329DZ	.90
LM344Z	1.70
LM335Z	2.20
LM336 2.5V	2.95
LM338K	12.50
LM339	1.20
LM348	1.80
LM349	1.60
LM350K	8.50
LM351N	1.00
LM353	2.50
LM356N	1.40
LM357	1.40
LM358	1.40
LM361	3.50
LM377	4.90
LM378	3.95
LM379-S	7.95
LM380 8PIN	1.80
LM380 14PIN	1.90
LM381	2.00
LM382	2.20
LM383	3.90
LM384	3.50
LM386	1.95
LM387A	LM3.95
LM387	2.00
LM390	2.95
LM391	2.90
LM393	1.00
LM394	4.95
LM395T	9.95
LM396K	22.50
LF398	5.90
NE544	6.50
NE555	.80
NE556	1.80
NE558	6.90
NE560	4.60
NE561	4.60
NE565	1.60
NE566	2.90
NE567	2.00
NE570	5.90
NE571	5.90
NE592	6.90
NE594	9.50
LM709-14	1.50
UA710CN	1.00
LM711	1.20
LM723	.75
LM723CH	1.50
LM725	4.75
LM733	1.50
UA739	2.75
741	.80
UA747	1.30
UA748	1.00
MC1310	9.50
MC1312	7.95
MC1314	7.95
MC1315	8.95
MC1327	7.95
MC1350	1.95
MC1408L8	7.50
MC1437	4.95
MC1445	5.95
MC1456	1.95
MC1458	1.20
MC1466L	14.50
MC1469R	6.90
MC1488	2.50
MC1489	2.50
MC1494	8.40
MC1495	8.90
MC1496	2.50
LM1596	3.00
MC1648	8.90
LM1812	10.50
LM1830	3.90
LM2907	3.50
LM2917 8PIN	3.40
LM2917 14PIN	3.40
MN3001	17.50
CA3028	2.00
CA3046	1.90
CA3056	6.50
CA3059	5.95
CA3080	1.90
CA3086	1.90
CA3089	3.90
CA3100E	7.95
CA3130E	2.20
CA3130T	2.95
CA3140E	2.20
CA3140T	2.95
CA3240E	11.95
LM3401	1.00
LM3900	1.20
LM3905	1.75
LM3909	2.95
LM3911	2.95
LM3914	5.90
LM3915	5.90
LM3916	5.90
LM3999Z	2.60
RL4136	1.95
RC4145	20.90
RC4194	3.90
MM 5369	4.95

SCR & TRIACS

SC141D	1.50
SC141E	1.95
SC142E	2.95
SC146D	2.85
SC146M	2.95
SC150D	4.95
SC151D	2.95
C103YY	.90
C103B	.90
C106B	.90
C106D	.90
C122D	2.50
C122E	2.95
C1260D	8.50
C1260E	9.90
2N2646	1.20
2N2647	2.50
2N6027	.90

TRANS.

AC125	1.20
AC126	1.20
AC127	1.20
AC128	1.20
AC187	1.50
AC188	1.50
AC149	3.40
AD161	2.90
AD162	2.90
AF118	2.90
AF126	2.90
AF127	1.50
BC 107	.50
BC 108	.50
BC 109	.50
BC 159	.50
BC 177	.60
BC 178	.60
BC 179	.60
BC 182L	.30
BC 212	.30
BC 318	.40
BC 320	.30
BC 327	.30
BC 328	.30
BC 337	.40
BC 338	.40
BC 546	.20
BC 547	.20
BC 548	.20
BC 549	.40
BC 550	.40
BC 556	.20
BC 557	.20
BC 558	.20
BC 559	.80
BC 635	.80
BC 636	.80
BC 637	.80
BC 638	.50
BC 639	.50
BC 640	1.90
BC Y70	1.90
BC Y71	1.00
BD135	.90
BD136	.90
BD137	.90
BD138	.90
BD139	.90
BD140	.90
BD201	.90
BD202	.90
BD232	.90
BD233	.90
BS235	.90
BD236	.90
BD237	.90
BD238	1.20
BD262	1.20
BD263	1.50
BD437	1.50
BD488	1.80
BD647	1.80
BD648	1.80
BD677	2.00
BD681	2.00
BD682	2.00
BDV64B	5.50
BDV65B	5.50
BDX63	6.50
Y96 (BUX 80)	4.90
BDY97 (BUX 80)	4.90
BF115	1.50
BF167	1.20
BF173	1.20
BF177	1.20
BF180	1.20
BF182	.90
BF183	.60
BF184	.60
BF198	.60
BF199	.60
BF200	1.20
BF245	1.50
BF337	1.50
BF338	1.90
BF458	1.00
BF459	1.00
BF469	1.20
BF470	1.20
BF494	.90
BF495	.90
BFW10	1.50
BFW11	1.50
BFW16	1.50
BFY50	1.20
BFY90	1.90
BFX90	1.50
BU126	2.50
BU208	3.90
BU326	3.00
BUX80	4.90
MFE131	2.90
MFE3001	9.90
MFE3003	6.95
MJ413	5.90
MJ802	7.50
MJ901	4.50
MJ1001	3.90
MJ11011	9.90
MJ11015	14.50
MJ11016	14.50
MJ15003	6.50
MJ15004	6.50
MJ15024	10.00
MJ2501	8.90
MJ2955	1.50
MJ3001	6.90
MJ4032	12.50
MJ4035	11.90
MJ4502	6.90
MJE340	2.00
MJE350	2.50
MJE371	2.90
MJE521	2.50
MJE700	3.50
MJE800	2.90
MJE2801	3.95
MJE2955	4.90
MJE3055	3.90
MJE13005	5.90
MJE13007	7.90
MJE13009	12.50
MPF121	2.50
MPF131	2.50
MPSA05	1.00
MPSA06	1.00
MPSA10	1.00
MPSA12	1.00
MPSA13	1.00
MPSA14	1.00
MPSA20	1.00
MPSA42	1.00
MPSA43	1.20
MPSA55	1.00
MPSA56	1.00
MPSA63	1.00
MPSA65	1.00
MPSA92	1.00
MPSA93	1.20
MPF102	.90
MPF103	.90
MPF105	.90
MPF106	.90
MPF109	.90
MPSL01	1.50
MPSL51	1.50
MPSU02	1.75
MPSU52	1.90
MPSU56	1.75
MPU131	1.75
MRF221	19.50
MRF237	3.90
MRF238	19.50
MRF245	43.50
MRF421	43.50
MRF454	34.00
MRF455	27.00
MRF455A	27.00
MRF475	4.70
MRF603	19.50
MRF641	32.00
MRF646	43.00
MRF901	2.75
MPF131	1.60
TIP31A	.90
TIP31B	1.00
TIP31C	1.20
TIP32A	.90
TIP32B	1.00
TIP32C	1.20
TIP41A	1.90
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2N3440	1.80
2N3441	2.90
2N3442	3.50
2N3563	.30
2N3564	.30
2N3565	.30
2N3566	.30
2N3567	.30
2N3568	.30
2N3569	.30
2N3638	.30
2N3640	.30
2N3641	.30
2N3642	.30
2N3643	.30
2N3644	.30
2N3645	.30
2N3646	.30
2N3702	1.20
2N3704	1.40
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MOTOROLA'S MOS MODEMS

Motorola has announced a set of MOS ICs for 300 and 1200 baud modem applications to suit Bell 103/113 (300) and Bell 202 as well as CCITT V.21 (300) and CCITT V.23 (1200) communications standards

The MC145445 comes in a 22-pin package and is TTL compatible. When paired with the MC145440 filter, it makes up a 300 baud Bell 103 modem or, when paired with the MC145441 filter it provides a CCITT V.21 modem.

These devices, using differential delay demodulation, provide high performance, low cost modems with the lowest bit error rate of 300 baud IC modem solutions, Motorola claim.

The MC145445 features eight selectable RTS/CTS delay options, answer-back tone generator and a carrier detect input.

The MC145450 is a 1200 baud modem intended for use in Bell 202 and CCITT V.23 standard applications.

It is TTL compatible and can be pin-programmed for either Bell or CCITT operation. The 22-pin DIL package derives internal timing from a standard 3.6864 MHz crystal.

For CCITT V.23 applications, the chip is Mode 2 compatible with a baud rate of up to 1200 bits/sec on the main channel and up to 75 bits/sec on the backward channel.

A logic-controlled mode input selects the frequency pair used for modulation and demodulation, as well as the transmit and receive baud rates. The CTS signal can be delayed in eight steps over a 0-426.6 ms range under logic control. Additional functions include logic-controlled self-test, transmit test, answer-back and soft turn-off.

We have no information of delivery schedules or prices as yet. Motorola distributors in Australia are VSI and Soanar.

PC MOUNT RELAY SWITCHES 30 AMPS

Inexpensive printed circuit board mount relays for ac or dc loads up to 30 amps are now availalble from Potter & Brumfield, through their Australian Distributor, Tecnico Electronics.

T90 series relays are designed for use in appliances and heating, ventilating and air-conditioning equipment. Additional applications are anticipated in load management, automotive and other markets where logic systems need to be interfaced with high current loads.

Measuring only about 24 x 30 x 17 mm high, open-style T90 series relays feature printed circuit terminals arranged on a 0.05" x 0.1" (1.3 x 2.5 mm) grid. Snap-on plastic dust covers are available as an option.

Silver or silver-cadmium oxide contacts are offered in 1 form A (SPST-N/O), 1 form B (SPST-N/C) and 1 form C (SPST) arrangements. Maximum contact rating is 30 amps, inductive or resistive, at 240 volts ac. T90 relays will also switch loads as low as 0.5 amps at 5 volts dc or

12 volts ac.

T90 series relays are available with dc coils for 5, 6, 9, 12, 18 or 24 volts. Coil resistance ranges from 18 Ohms for 5 volt models to 456 Ohms for 24 volt models. Nominal coil power is 1.25 watts. Class B (130°C) insulation is standard.

Initial breakdown voltage exceeds 1500 volts rms from contact to contact and from contact to coil. T90 relays are designed to operate in ambient temperatures from −55°C to +85°C.

For additional information, contact, **Tecnico Electronics, 67 Mars Road, Lane Cove, NSW 2066. (02)427-3444.**

FIVE-LEGGED DRIVERS

Two new universal, high current drivers are now available from RIFA. They are intended for resistive loads, solenoids, relays and low-power lamps.

The PBD3544 and PBD3545 are complementary drivers (source/sink versions). They have a continuous output capability of 2 A at 45 V. Both feature an error detection function which is claimed to enhance serviceability by allowing their incorporation into diagnostic circuitry in the host product.

The PBD 3544/45s contain extensive protection circuitry which renders them virtually indestructible when driving a wide variety of loads. Important operational characteristics include short-circuit protection, thermal overload protection, internal protection diodes, open circuit detection. The inputs are LS-TTL and CMOS compatible. Encapsulation is a 5-pin TO-220.

Details from **RIFA Pty Ltd, PO Box 95, Preston Vic 3072. (03) 480-1211.**

NEW ISOLATION TRANSFORMERS FOR MODEMS

The ever increasing use of microcomputers has created a demand for modem interfacing to link computers via telephone or radio.

To meet this need, Ferguson Transformers has added two new Telecom-approved line isolation transformers to their range. Both are intended for printed circiut board mounting and are capable of handling most data transmission requirements.

Designated MT-620 and MT-627, both have a matching impedence of 600 Ohms. The MT-620 provides a flat response between 300 Hz and 2200 Hz with rapid attenuation to 20 kHz. As a result, crosstalk and noise outside the required bandwidth are greatly reduced.

Where a flat response is required across the whole bandwidth, the MT-627 covers the entire range from 300 Hz to 20 kHz.

Other applications include radio to telephone patching and centralised word processing.

The two new transformers join a range of printed circuit board mounted power transformers of similar design with secondary ratings from 9 to 30 V and 2.5 to 12 VA.

The MT-620 and MT-627 are wholly designed and manufactured in Australia to suit Australian conditions and are available from stock. Further information is available from **Ferguson Transformers Pty Ltd, 331 High Street, Chatswood 2067 NSW. (02)407-0261.**

Component NEWS

SOANAR NOW MARKETING NEC SEMICONDUCTORS

Soanar Electronics has been appointed as the distributor for the Semiconductor Division of NEC Australia Ltd.

NEC Electron Devices, the Semiconductor Division of the giant NEC Corporation of Japan offers a very competitive source for INTEL integrated circuits.

Backed by the resources of NEC, Soanar will now be stocking the following range at all Soanar Branches throughout Australia: RAMs, EPROMs, single chip 8-bit microcomputers, microprocessors and peripheral ICs.

In addition, Soanar will handle the NEC range of CMOS 4-bit microprocessors which they claim are ideally suited to the Australian market.

A new 1984 microcomputer catalogue is currently being printed and is due for release shortly. For further information **contact Soanar Electronics Pty Ltd, P.O. Box 170, Box Hill Vic. (03)890-0661.**

HCMOS DATA BOOK

Motorola's reference book on the MC54/74HC high-speed CMOS logic family is now available.

The book offers a complete function selector guide, a military/hi-rel selector guide, a design considerations chapter and data sheets. A total of 147 devices are detailed, with 71 circuit descriptions including ac/dc parametrics and 76 parts with pinout and functional descriptions only.

In the extensive fuhction selector guide, the devices are grouped into 15 categories of logic functions. To assist users in choosing a device, the features are described in a vertical column and the devices are listed horizontally. The guide also includes block diagrams for all 147 devices.

The design considerations chapter provides information on power supply considerations and handling precautions.

The ac and dc parametrics are specified for a range of two to six volts and temperatures up to 125°C. The chapter on reliability includes major test descriptions and tabulations of results.

Copies of the High Speed Data Book can be obtained from **Motorola Semiconductor Products, 250 Pacific Hwy, Crows Nest NSW 2065. (02)438-1955.**

SURGE PROTECTION AND TESTING BOOKLET

A 20-page, fully illustrated booklet published by Key-Tek Instrument Corp is an introductory guide to surge protection and testing of systems, circuits and protective devices. The material is keyed to both technical and non-technical personnel.

A question-and-answer format covers the causes of transient spike voltage and current surges, and the problems they create in today's computers and other microelectronic systems.

The booklet outlines circuit design and test techniques for surge protection, and discusses the new IEEE Standard 587 for ac power-line spike surges.

Copies are free of charge to electronics engineers engaged in equipment design or testing, and can be obtained from **The Dindima Group Pty Ltd, PO Box 106, Vermont Vic. 3133.**

Precision temperature measurement and control using the LM335

Brian Dance

Measuring temperature for its own sake or in a control application requires a suitable 'transducer' to provide an accurately known relationship between temperature and output. That's just what the LM335 does.

THERE ARE MANY ways of measuring temperature, but the familiar mercury-in-glass thermometer does have the disadvantage that it is not easily read and remote readout is impossible. The circular clock-face type of thermometers based on bi-metallic strip in the form of a coil are very convenient for hanging on the wall in the home or greenhouse, but have a very limited accuracy. Electronic thermometers providing a very accurate digital indication of temperature are very convenient, although the commercially available types are necessarily moderately expensive.

This article describes the use of a device specially developed by National Semiconductor for the precision measurement of temperature which can be used in circuits whose output is usually fed to a digital voltmeter so that a digital indication of temperature can be obtained.

The LM335

The LM335 is an integrated circuit temperature sensor for use over the range 0° C to +100° C. It is available in economical plastic packaging with the connections shown in Figure 1, although a similar device is available in a TO-46 metal transistor type package with the connections of Figure 2.

The LM335 is a relatively economical device, but the LM235 is a similar product with the same internal circuitry designed for use over the −25° C to +100° C range and the LM135 can operate over the military temperature range of −53° C to +150° C; these last two devices have narrower tolerance than the LM335 specifications. Suffix 'A' versions, such as the LM335A, are also manufactured with more closely specified characteristics. However, it will be assumed that readers will employ the most economical device in the range, the LM335, although the circuits can be used with any of the devices named.

Basically, the LM335 is operated in the same way as a zener diode, as shown in the circuit of Figure 3. The breakdown voltage (that is, the output voltage from this circuit) is directly proportional to the absolute temperature and is 10 mV/K over the specified working temperature range.

The value of R1 in Figure 3 determines the current flowing through the device, but as the dynamic impedance at 1 mA is typically 0.6 Ohm, the device can be operated over the current range of 400 μA to 5 mA with virtually no change in its performance. It should be noted that the absolute maximum forward or reverse current which may safely be passed through the device (even momentarily) is only 10 mA; higher currents may cause irreversible damage to the LM335.

At 25° C and a reverse current of 1 mA, the operating output voltage from the Figure 3 circuit is typically 2.98 V with minimum and maximum limits of 2.92 V and 3.04 V. The value chosen for R1 may be calculated for a current through the LM335 of 1 mA using the equation R1 = $(V+ - V_{out})/0.001$ which equals approximately (V+ - 3) kilohm.

Linear output

A particular advantage of the LM335 is the linear output provided by its circuit, unlike the output of most other temperature sensors which is not linearly related to temperature. Indeed, if the output voltage is plotted against temperature over the working range and the graph is extrapolated back to the absolute zero of temperature, the output read from the graph at the latter temperature will be zero.

Although the LM335 output from the Figure 3 circuit is within the limits stated a calibration connection is included on the chip. It is only necessary to connect a potentiometer across the LM335, as shown in Figure 4, and adjust this potentiometer to 2.982 V output when the device is at 25° C in order to obtain higher accuracy over the whole temperature range.

The single calibration temperature over the whole working range is possible because the output is accurately proportional to the absolute temperature with the extrapolated output falling to 0 V at the absolute zero of temperature. Variations from one LM335 to another are only in the slope of the voltage/temperature graph, so a slope calibration at one temperature corrects for all others. Thus, calibration is far easier than with a non-linear device such as a thermocouple.

Self heating

As with any temperature sensing system, any heat generated by the current passing through the sensing device will affect its temperature and hence the output voltage. The LM335 should therefore be operated at the lowest current which is adequate to drive its internal circuitry. When calculating the value of R1 allowance should be

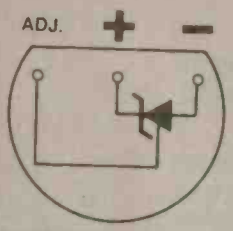


Figure 1. The TO-92 plastic encapsulated LM335.

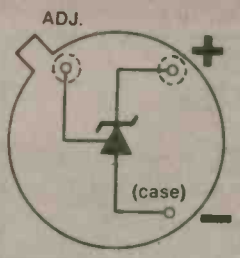


Figure 2. The TO-48 metal encapsulated LM335.

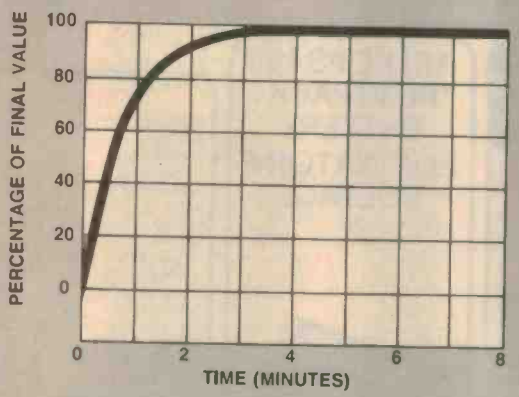


Figure 5. Response time of the LM335 to a temperature change in free air.

Figure 3. The basic LM332 circuit.

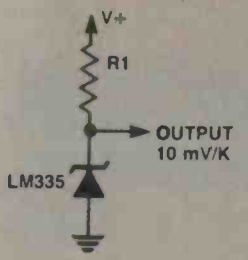


Figure 4. Calibration is simple with this circuit.

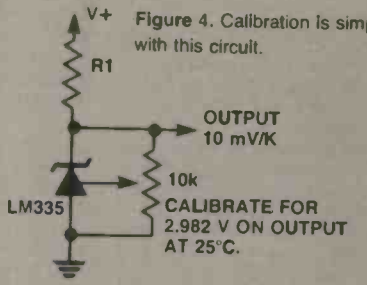


Figure 6. Circuit able to operate from a wide range of supply voltages.

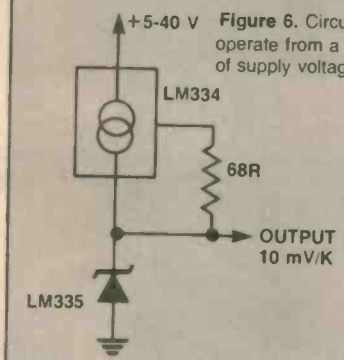


Figure 7. This circuit records the minimum temperature of any of the devices.

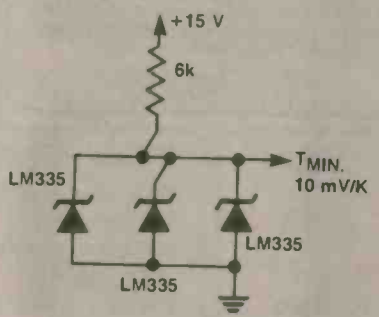
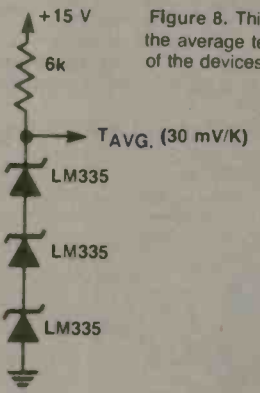


Figure 8. This circuit records the average temperature of the devices.



made for the current passing through any calibrating potentiometer in parallel with the device and for any output current. A current of about 400 μA is about the normal minimum.

If the sensor is used in a situation where the thermal resistance to the surroundings is constant, self-heating errors can be calibrated out, provided the device is operated with a constant current independent of temperature. Heating of the device will then be proportional to the zener voltage and to the absolute temperature; thus, the self-heating error is proportional to the absolute temperature and temperature scale linearity is preserved.

Performance

In a typical LM335 circuit which has not been calibrated, operating at 1 mA, the temperature error is 2° C (maximum 6° C) at 25° C or 4° C (maximum 9° C) over the whole working range. When calibrated the typical error at the temperature limits is 2° C. Non-linearity at 1 mA is typically 0.3° C over the range.

In still air the device requires about three minutes to reach its final temperature after a temperature change has occurred (Figure 5), the time constant being typically 80 seconds. In stirred oil the final temperature is reached within about three seconds (time constant typically one second). The device is stable to 0.2° C (typical) over 1000 hours, even at 125° C.

The dynamic impedance is less than one Ohm at frequencies up to more than 1 kHz (typical), but increases to 20 to 30 Ohms at 100 kHz.

Circuits

The circuits of Figures 3 and 4 are suitable for use when the supply voltage is reasonably constant. If wide variations in the supply voltage are expected to occur, the LM334 constant current device may be used with the external resistor to set the LM335 current at about 1 mA for all supply voltages. (Figure 6.)

If a number of LM335 ICs are connected in parallel, as in Figure 7, the output will correspond to that of the device which is at the minimum temperature. Thus a minimum indication of the temperatures at three locations is easily obtained.

Similarly, a number LM335 devices may be connected in series, as in Figure 8, in which case the output will represent the average temperature of the devices, but will be increased by a factor equal to the number of devices used.

Centigrade Thermometer

The circuits discussed previously are basic ones which provide an output voltage directly proportional to the absolute temperature, but this is not very consistent for feeding to a digital voltmeter to produce a reading directly in ° C. The additional operational amplifier circuit of Figure 9 is required for this purpose.

In this circuit the LM336 provides a precise 5 V reference voltage to pin 3 of the LM308 operational amplifier. The negative feedback to pin 2 is adjusted by means of the 2k potentiometer so that the output of the amplifier is at a potential of 2.73 V. The voltage difference between this output and that from the LM335 circuit is then a measure of the Centigrade ▶

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GENERAL DESCRIPTION

The Shuttle 300 is a direct connect modem, providing full duplex operation, up to 300 Baud, via the RS-232 Port of a Terminal or Personal Computer.

The Shuttle 300 is a basic modem, relying on a telephone for dialling and answering calls. However it does provide the full 12V bipolar output signals required by RS-232C for reliable operation with computers and terminals. The RS-232 connector also provides "Carrier detect" and "clear to send" outputs and uses "Data Terminal ready" and "request to send". Three front panel led's provide visible indication of carrier detect, receive data and transmit data status, while a fourth led is used as a power on indicator.

The "Voice/Data" switch allows selection of telephone or modem operation. An "Answering/Origin" switch allows either answer or originate mode of operation.

Power for the Shuttle 300 is provided by an internal power supply which conforms to Telecom Australia regulations.

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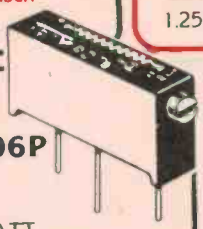

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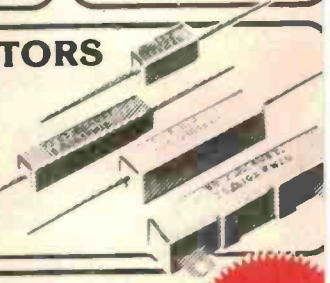

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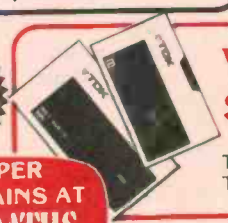

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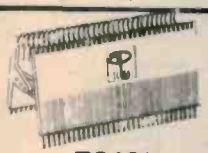

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		74LS13	.44
		74LS14	.44
		74LS15	.44
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		74LS26	.44
		74LS27	.44
		74LS30	.44
		74LS32	.44
		74LS37	.44
		74LS38	.44
		74LS40	.44
		74LS42	.98
		74LS47	.67
		74LS48	.71
		74LS49	1.38
		74LS51	.44
		74LS54	.44
		74LS55	.44
		74LS73	.44
		74LS74	.44
		74LS75	.52
		74LS76	.52
		74LS78	.58
		74LS83	.71
		74LS85	.52
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		74LS151	.58
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		74LS157	.69
		74LS158	.69
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		74LS161	.81
		74LS162	.81
		74LS163	.81
		74LS164	.81
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		74LS169	1.63
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		74LS173	.75
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		74LS190	1.04
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		74LS243	.86
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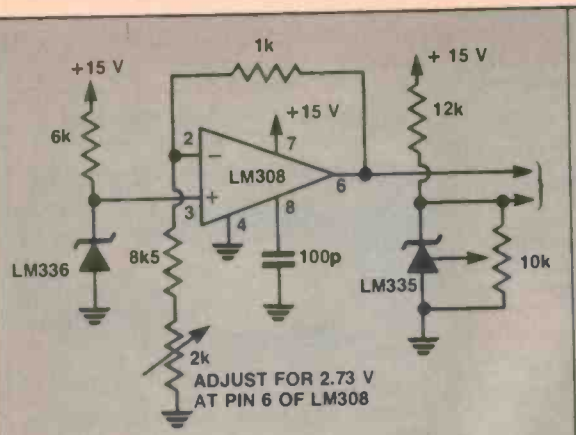

Figure 9. A centigrade thermometer circuit.

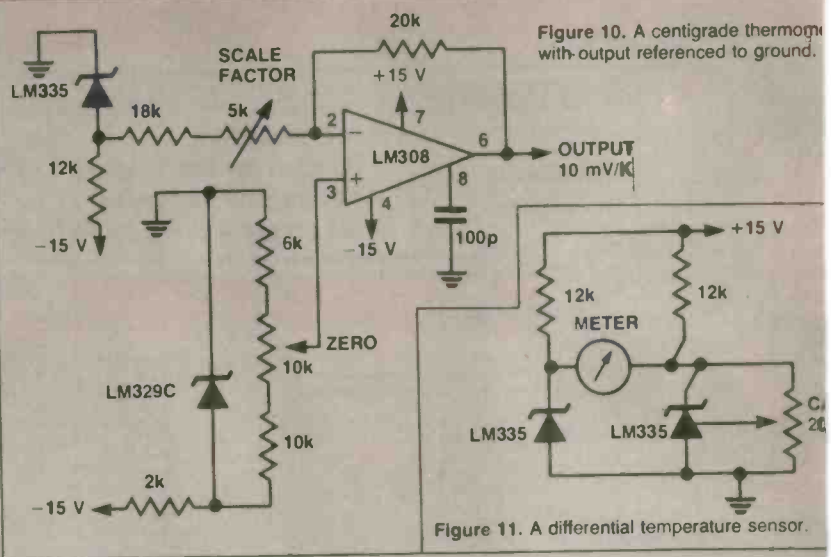

Figure 10. A centigrade thermom with output referenced to ground.

Figure 11. A differential temperature sensor.

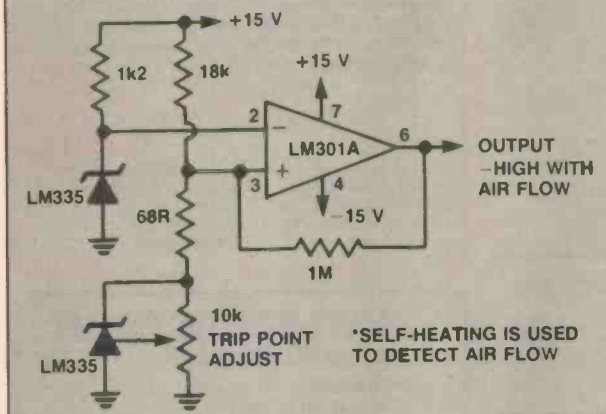

Figure 12. A differential temperature sensor with amplifier gain of ten.

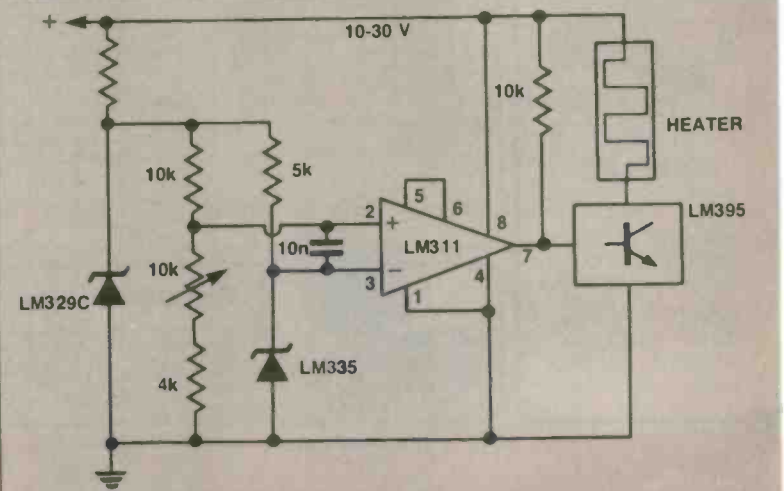

Figure 13. A thermostatic heater controller.

temperature; the 2.73 V reference effectively subtracts 273° C from the absolute temperature indicated by the output from the LM335 circuit to leave the Centigrade temperatures to be displayed by a digital voltmeter set to an appropriate scale.

Neither of the outputs from the circuit of Figure 9 are at ground potential. The slightly more complex circuit of Figure 10 provides an output of 10 mV/° C referred to ground. It employs an LM329C 6.9 V precision reference voltage device to provide a variable preset voltage to the non-inverting input of the LM308 operational amplifier. The latter takes its inverting input to a feedback network involving the LM335 temperature sensing device.

Differential sensors

Two LM335 devices in different positions can be used in the simple circuit of Figure 11 to measure the temperature difference between the two positions. Only one calibration control is required to give a zero difference when the two devices are at the same temperature.

In Figure 12 an operational amplifier is used to compare the outputs of two LM335 devices connected as in Figure 11, but the negative feedback circuit is arranged to provide a gain of ten so that the output from the amplifier is the Centigrade temperature difference in 100 mV/° C.

Temperature controller

A simple temperature control circuit which adjusts the current through a heater to maintain the temperature at some constant desired value is shown in Figure 13. The LM329C provides a precision 6.9 V reference, the fraction of this reference voltage which is tapped off and fed to the non-inverting input of the LM311 being adjusted by the temperature setting potentiometer.

If the temperature of the LM335 is high enough for the voltage from it (which is fed to the inverting input of the LM311) to exceed that of the non-inverting input, the output of the amplifier will be low so that the LM395 passes only a very small current through the heater. If the LM335 temperature falls, the LM311 output rises and switches on the LM395 so that current passes through the heater. The LM395 is actually an IC which behaves like a very high gain power transistor.

Air flow detector

In the circuit of Figure 14, a fairly high current is passed through the upper LM335 so that the device becomes warm. If air flows fairly quickly past this device, it will be cooled and its output voltage will fall. As this voltage is connected to the inverting input of the LM301A device, the output of the latter will become 'high' when such a fast air flow occurs. the lower LM335 (not in the air flow) is used to provide a comparison voltage by keeping the ambient temperature around the two LM335 devices the same.

Fast NiCad charger

Nickel cadmium cells can be fast charged only if precautions are taken to ensure that the temperature of the cells does not rise above a permissible limit. In the circuit of Figure 15, the LM335 diode D2 is placed in close thermal contact with the Nickel Cadmium cells being charged. If the temperature of the cells rises, the output from D2 rises and, as this output is

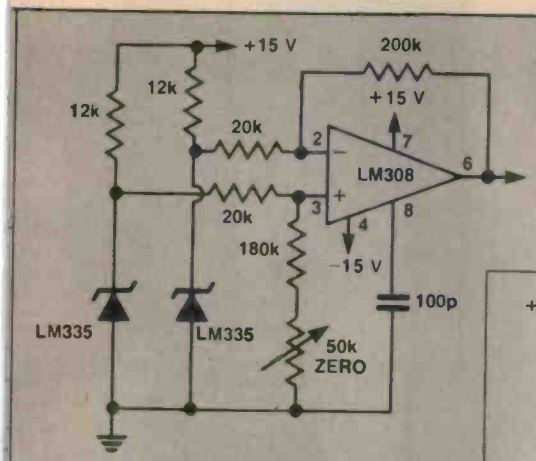

Figure 14. An air-flow detector.

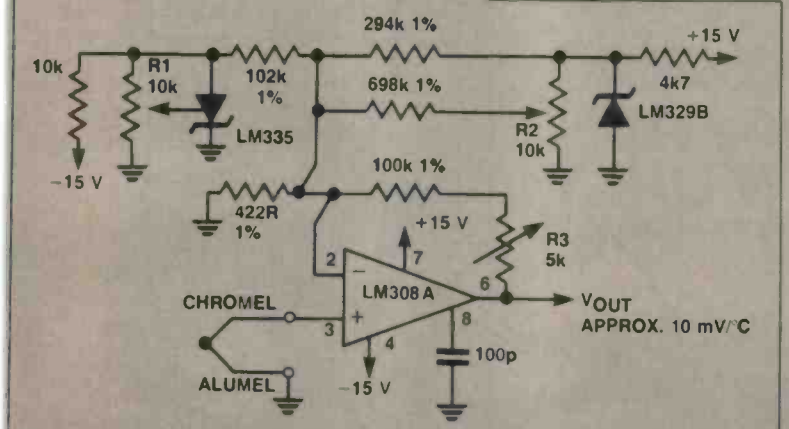

Figure 16. A centigrade calibrated thermocouple electronic thermometer.

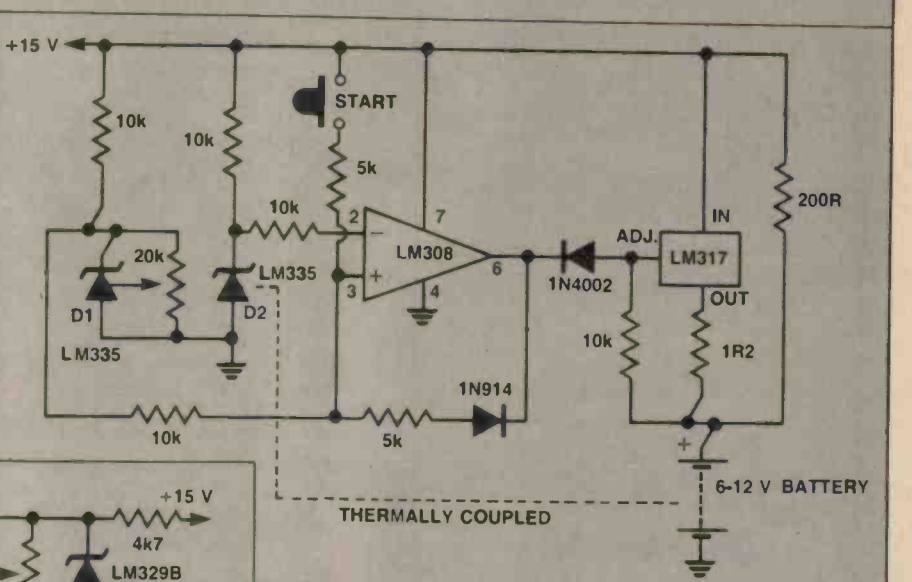

Figure 15. A fast charging circuit for Nickel Cadmium batteries with temperature monitoring and automatic switch-off in the event of over heating.

fed to the inverting input of the LM308, the output of this operational amplifier falls.

Current passing from the 'ADJ' terminal of the LM317 regulator to the LM308 causes the potential at this terminal to fall so that the regulator no longer passes the charging current to the nickel cadmium cells. The non-inverting input potential is derived from the other LM335 which is at the ambient temperature. Thus the temperature of the cells is compared with the ambient temperature, as required. The calibration potentiometer across D1 may be adjusted so that the voltage across this LM335 is 50 mV greater than that across D2. The charging will then be terminated when the temperature of the cells rises by 5° C above ambient.

Thermocouple application

Thermocouples are much used for making temperature measurements over a much wider range than is possible with the LM335, partly because they are very cheap and simple. Although thermocouples can be used for measuring temperatures of up to some thousands of degrees Centigrade using a junction of two different materials, a cold reference junction is required, often an ice bath, except when differential measurements are being made.

Rather than use an ice bath it is often more convenient to employ a technique known as cold junction compensation in which a compensating voltage is added to the output of the thermocouple so that the reference junction potential seems to be at 0° C, although it is actually at another temperature. The added voltage can be made proportional to temperature with the same constant of proportionality as the thermocouple so that changes in ambient temperature have no effect on the output voltage.

The LM335 temperature sensor is very suitable for use in the cold junction compensating circuit owing to its very linear voltage/temperature characteristics. In addition, as the LM335 voltage extrapolates to zero at the absolute zero of temperature, the temperature coefficient of the compensation circuit can be adjusted to room temperature without any temperature cycling.

A thermocouple thermometer calibrated in degrees centigrade is shown in Figure 16. The thermocouple reference junction should be terminated in close proximity to the LM335 so that their temperatures do not differ appreciably. Initially a signal should be applied in place of the thermocouple and R3 adjusted for a gain of 245.7. The non-inverting input of the LM308A should be shorted to ground and R1 adjusted so that the output voltage is 2.982 V at 25° C. The short should now be removed from the non-inverting input and R2 adjusted for an output of 246 mV at 25°C. The thermocouple connections should now be replaced.

Electronic thermometers of this general type can provide a 10 mV/° C output over a 0° C to 1300° C range, but it is important to use good quality cermet trimmers and stable components.

Further thermocouple circuits together with practical information on their construction using LM335 cold junction compensation is available in the *National Semiconductor Linear Applications Handbook*, as Application Note AN-225, April 1979. ●

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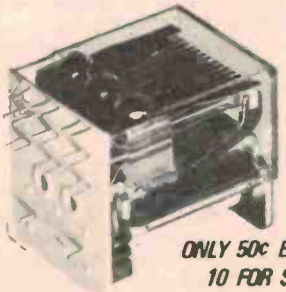

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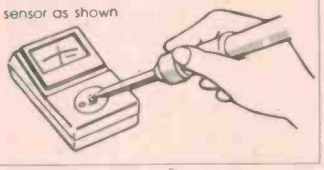

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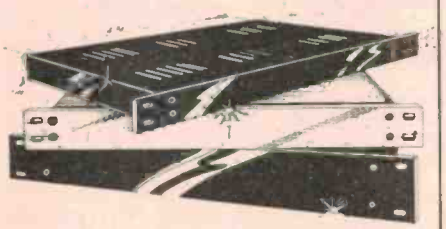

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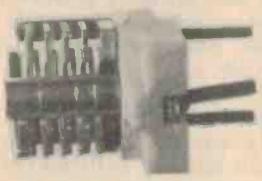

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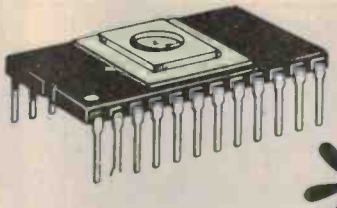

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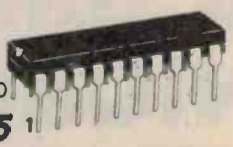

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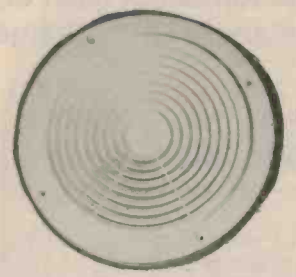

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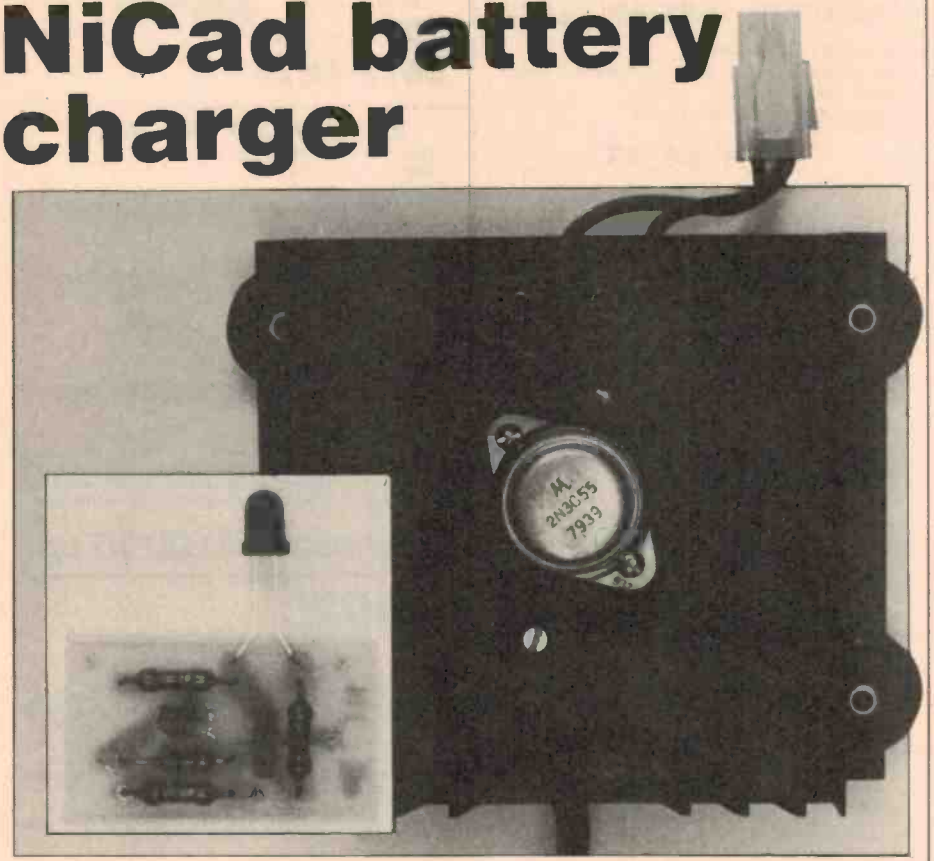
A damn fast NiCad battery charger



This project is specifically designed for modellers, photographers and hobbyists who make heavy demands on NiCad batteries quite routinely. There's nothing more frustrating than having your RC model run out of juice as it runs out of sight, or your flash run out of flash at an inopportune moment. If you use NiCads and need a charge — but quick — this project is for you!

Jonathan Scott

SMALL Nickel-Cadmium cells are often employed to replace frequently-used dry cells because they work out cheaper after a lot of recharges, and also because they save you a lot of walking to the corner store to purchase replacements.

There are, however, some properties of these types of cells which enable them to perform tasks other batteries cannot. Most notably, they have a lower internal resistance for a given cell size: A typical penlight NiCad has twenty times less internal resistance than its equivalent dry cell. This means that a lot of power can be drawn from them in a short space of time. They can thus perform a task which demands lots of power over a short period out of a small set of cells. There is a price to pay for this; namely, short cell life. They also exhibit a low total ampere-hour (Ah) capacity under fast discharge conditions.

The most notable use for these properties is the powering of models, particularly aeroplanes and racing cars. Such devices are expected to weigh little and develop a lot of engine power over a short space of time. A set of dry cells simply cannot achieve this. An electric aircraft will typically carry one or two cells and flatten them inside three minutes; a land craft may carry five or so large cells and flatten these inside fifteen minutes. Of course, the cells suffer a great deal for this kind of treatment and tend to expire after ten to twenty uses in the three minute case, or twenty to fifty uses in the ¼-hour case. There are two upshots of this; firstly, the user typcially wants to be able to recover and re-use the cells often in one day, and secondly, he does not really care if the recharge process thrashes the cells a lot, because their discharge is going to kill them fairly quickly anyway.

Toward the goal of charging cells quickly, ETI published a Fast NiCad Charger (Project 563) some time ago (July 1989). This was a mains powered device which incorporated a timer and some sophisticated electronics to make the unit fairly foolproof. While there is no doubt that this project found a home in many a modeller's kit, it was designed at the general level, rather than a specific market. There is a need for a somewhat simpler and yet more powerful charger, designed to run off a car battery or similar portable power reserve, capable of substantially more rapid a current delivery again. This project is it.

Let me stress once again that this unit is *not for genral use;* there is a detrimental effect on healthy cells when asked to deliver large currents over short periods. This project also does not have the foolproof nature (or the complexity) of the ETI-563 Fast Charger and can completely cook a battery if left on too long. It is designed for use out in the field where the cells it is charging are needed *damn* fast, and at any price. For a more detailed discussion of the merits and limitations of fast NiCad Charging, you are referred to the article accompanying the ETI-563 Fast NiCad Chrger.

Design details

The circuit is basically a constant current source, delivering a preset current (up to 8 amps) into a load, using a dc voltage source of about three volts more than the voltage which will be required by the load. It uses only common components and half watt resistors so can be constructed with a minimum of effort. Notably, no high power "current sense" resistor is necessary as these often tend to be tricky things to purchase or build — where do you get a 0.075 Ohm, 5 watt resistor? All that is necessary for its construction can be purchased from just about any electronics supplier in the country.

Construction

Before proceeding with the construction of this project there are two things which must be decided. The first is the current you wish to set the regulator to deliver, and the second is the scheme you wish to use

to protect the circuit against reverse connection of the supply (typically a car battery). The former is a function of the ampere-hour capacity of the cells you will be charging.

I envisage that the regulator will be used in a fairly rugged environment for charging a single type of cell; therefore the current is set to a predetermined value, eliminating the cost and unreliability of a switch and set of resistors, not to mention the possibility that the switch will be miss-set in operation.

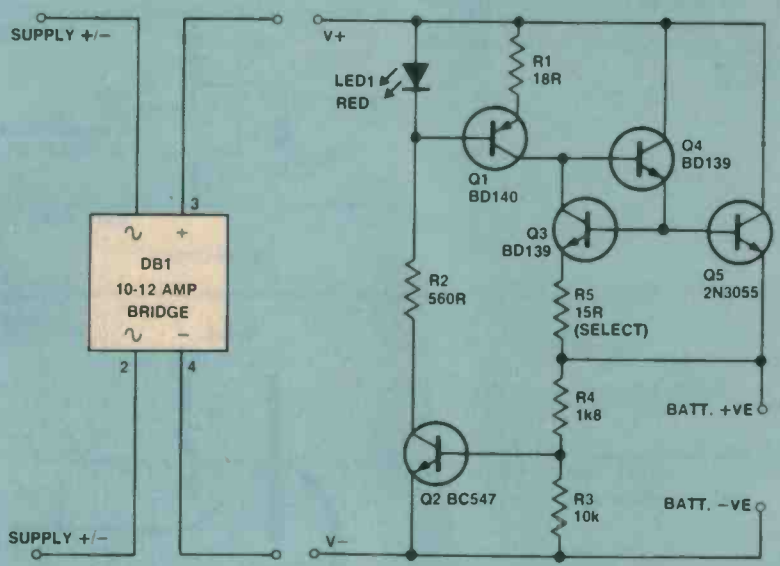
Should you wish to include one, there is nothing to prevent you adding a double or multiple throw switch and a selection of resistors to give a selection of current ranges, but I will proceed here assuming that there will be one current only required. (To effect range selection all that is needed is to switch the emitter resistor of Q3 using a toggle or rotary switch; a pot is not recommended, though a 100R wirewound type would be sufficient).

It seems from experience that the highest safe charge rate for a NiCad is around 4C (C is the cell's Ah capacity) or that current which equals the Ampere-hour rating multiplied by 4/hour. Thus, a 450 mAh battery should be charged for up to about 20-25 minutes at a time at just under two amps. An 1800 mAh battery would accept charging at just over seven amps.

The project described here is capable of up to eight amps guaranteed, and may be 10 A typical. The exact value depends upon many variables concerned with the particular parameters of the specific transistor used for Q5. For a 2N3055, as specified, I have given approximate values required for R5, but the exact value will probably need to be selected, as indicated in the circuit diagram. Fifteens Ohms gave 6 A, on my prototype. Eighteen Ohms gave 5 A and 12 Ohms gave 7 A. To get down to 2 A required 33 Ohms. Using three values as a guide, choose an initial value of R5, but remember that this value may have to be changed later.

The second thing to be decided, once you have chosen the current required, is the protection scheme. There are three ways you can tackle this. I think it would be foolhardy, to say the least, not to include some protection from reversed supply, particularly as the unit is to be used in a hurried situation in the field. The first method is a single diode, the second is to use a diode bridge, and the third is to use a relay.

Clearly, this decision will be influenced by the cell or battery voltage. A NiCad being fast charged drops up to 1.5 volts. The actual regulator section requires typically three (worst case four) volts 'overhead'. If you are using a car battery it can be expected to deliver almost 12 ▶



HOW IT WORKS — ETI 274

Referring to the circuit diagram, it can be seen that Q4 and Q5 form a Darlington series-pass regulator element. Q3 acts as a comparator, while Q1 acts as an active current source load for Q3. Q2 provides short circuit foldback limiting, while LED1 indicates correct operation and provides a reference.

Initially, consider that there are a few volts across the battery connected to the ouput. Q2 is biased on via R4 and has a collector current of typically 15 mA or so. This current is set by R2. Assume that the supply is around 10 to 12 volts. Thus, Q1 will be biased on. If Q1 is in the active state it acts as a current source delivering approximately 55 mA to the collector of Q3 and base of Q4. Q4 and Q5 will be biased on and hence their combined collector currents will be delivered to the battery.

For a collector current of five amps, the internal resistances of a 2N3055 gives a base-emitter voltage not of the 0.8 V value which might be expected from an ideal exponential device, but more typically 1.2 volts. This circuit will use this internal b-e resistance, already allowed for in the transistor's dissipation specification, as the current sensing element.

Now, recall that Q1 is delivering a fixed current to be divided between the base of Q4 and the collector of Q3. Q3, which is in close thermal contact with Q5, has a Vbe which is nearly the same as, and tracks that, of Q5. The voltage component of Q5's Vbe, which is due to its emitter current times the internal b-e resistance mentioned above, is substantially placed across R5. Hence, the collector current of Q3 is nearly a constant multiplied by the emitter current of Q5, the current delivered to the load (battery).

There is an equilibrium point where the current drawn by the load produces a collector current in Q3 which exactly leaves sufficient current left over from that suplied by Q1 to feed the base of Q4. Should the load current rise above this point the collector current of Q3 would rise also, removing some drive current from Q4, reducing the load current. Conversely, if load current falls, Q3 leaves more current for Q4, restoring the load current. Hence, current regulation is achieved. R5 affects the ratio of load current to Q3 collector current and so may be selected to define the load current at equilibrium.

Two further effects are utilised. Should the load voltage fall below about 1.1 volts, the level for one cell, Q2 will be biased off, extinguishing LED1 and shutting down the current regulator Q1. This reduces output current, effectively shutting the circuit down. This will occur should either a short circuit or a reverse battery connection occur on the output. It is thus not possible to reverse charge the cell(s) or to overheat the regulator by operating into a short. This shutdown condition is betrayed by the LED extinguishing. In addition, if the load voltage rises too high for the regulator to run properly, as is the case if there is a bad or open connection, Q1 will saturate, reducing the voltage across LED1, again extinguishing it. Thus, the LED indicates successful delivery of current to the load.

If a diode bridge is installed in the supply line it does not matter which way round the supply is connected. A single diode will simply shut the circuit off if connected wrongly, but drops about 0.8 volts, compared to 1.6 volts with the bridge. If neither of these voltage drops is acceptable, a relay may be used to protect the regulator from reversed supply. The regulator requires about three volts of overhead, so the protection scheme must be selected with the available supply voltage and the required load voltage in mind, as described in the text.

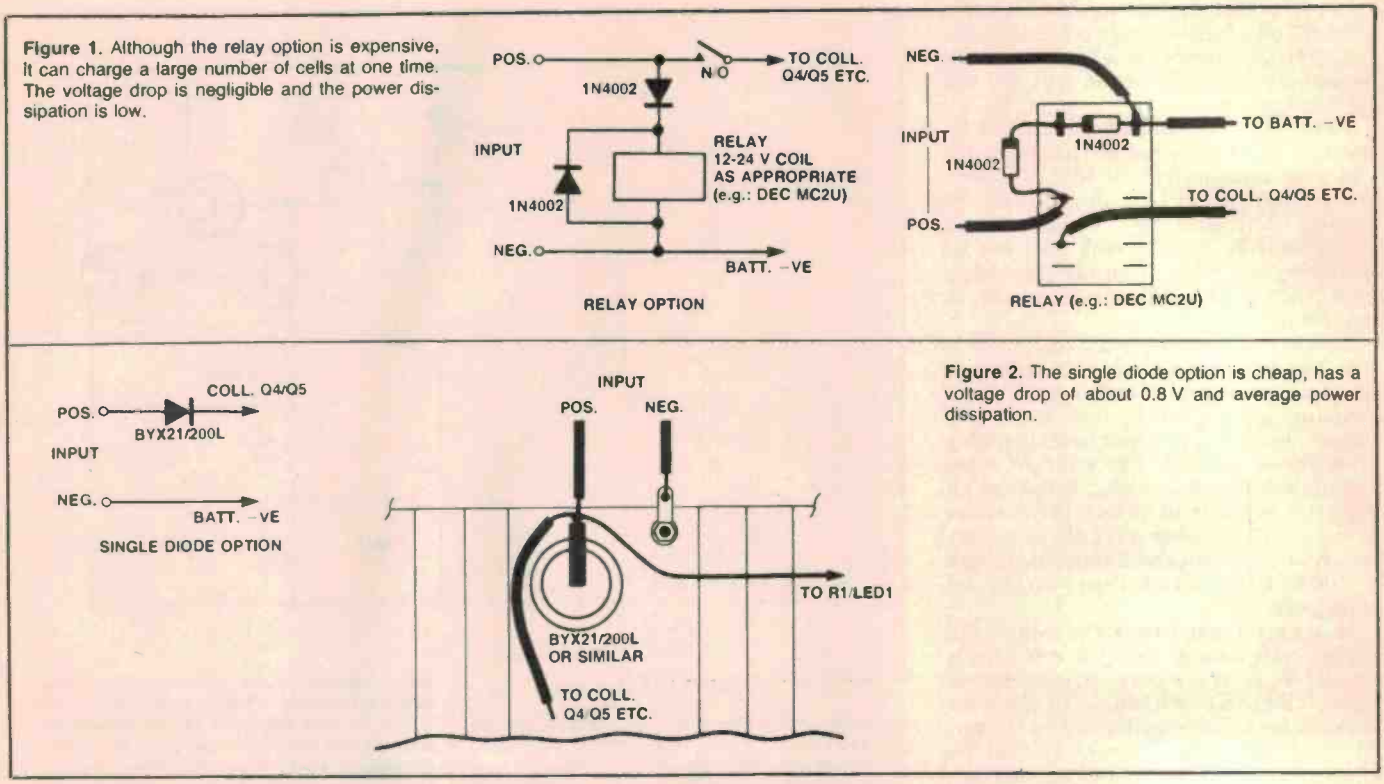


Figure 1. Although the relay option is expensive, it can charge a large number of cells at one time. The voltage drop is negligible and the power dissipation is low.

Figure 2. The single diode option is cheap, has a voltage drop of about 0.8 V and average power dissipation.

volts. Hence, it may be shown that a relay which drops negligible volts allows five cells in series (nominally a 6¼ volt stack) to be handled from one car battery, a single diode allows four, as does a bridge — just. (The sum here is V supply-4 divided by 1.5 for the relay, Vs-4.9 divided by 1.5 for the single diode, and Vs-5.8 divided by 1.5 for the bridge).

Although the bridge costs a little more than a single diode it allows you to ignore the polarity of the supply connections as the circuit effectively 'rectifies' the input to give the correct polarity irrespective of supply orientation. If you can afford the voltage drop, it is the best method, particularly as bridges of the appropriate power rating are simpler to mount and connect to than their equivalent diode counterparts. The relay option (see Figure 1) is expensive and is really only recommended for those situations where it is the only resort to obtain the capacity to handle the required number of cells. The supply can be up to 24 volts nominal, so this should not be necessary.

I recommend the bridge option as this seems the best and most convenient choice. It entails a few dollars more in cost than the single diode, but it is easier to mount and easier to use.

Having decided upon the circuit elements, the current to be delivered and the voltage into which it will be delivered, you are fixed. The next step is to figure out how much heatsink is needed. If you are using a 12 volt supply and delivering 6 A or less a '4"' heatsink is adequate. (These are generally rated to dissipate 2° C/W in still air). However, if the product of supply volts and current is in excess of about 70, a larger heatsink is to be recommended. Remember that the circuit may have to dissipate almost that figure in watts worst case, so it is a good idea to have the capability. In any case, if the 2N3055 case gets hot enough to boil water the heatsink is too small! (It is not unusual for it to get rather too hot to touch when working very hard, so don't let that worry you).

You are now ready to obtain the components and commence the actual construction. The first step is to drill the heatsink. If you are duplicating the prototype, follow the diagram here. Otherwise, you can set out the parts as you see fit. It is good practice to put the main heat disspiating element, the 2N3055, near the centre of the dissipating surface.

I used terminals on the output of the unit and had a fixed automotive grade ('heavy duty') cable for the battery connection, but you should use whatever connection will best suit your application. For instance, you may have some standard kind of plug to fit your models, or whatever, or perhaps you many want to use car battery bolt-on connectors on the input. Be sure to make provision to clamp any cables. Also remove any burrs and dags that could penetrate insulation washers on the transistors.

Next, fit the transistors and diode or bridge, etc, to the heatsink. Fit the terminals and/or clamp the cables in place. When all the parts that need to be secured to the heatsink have been bolted in, put the assembly aside. Now solder the four resistors and two transistors (Q7, Q2) to the small pc board, as shown in the overlay. This can be mounted either on the heatsink (if it's big enough) or inside a zippy box bolted to the heatsink.

Finally, interconnect all the components as shown in the wiring diagram. It is convenient if Q3/4/5 have been mounted close enough together to allow their leads to join directly. Resistor R5 is wired directly in place.

After carefully checking the wiring (remember that a mistake can easily incinerate the whole lot in one fell swoop) apply the supply. Confirm that the 'Batt + VE' terminal is indeed at nearly the full supply. Connect a load. If you have an old set of NiCads, or a headlight globe, use this instead of a good set at first. Measure the current being delivered. If it is too high, replace R5 with a resistor of larger value, or vice versa. You will be able to pick the correct value on the second or third attempt no matter how far out the original estimate. Check that either shorting the output or leaving it open causes LED1 to go out. If this is the case, all is well and you're set to go. ●

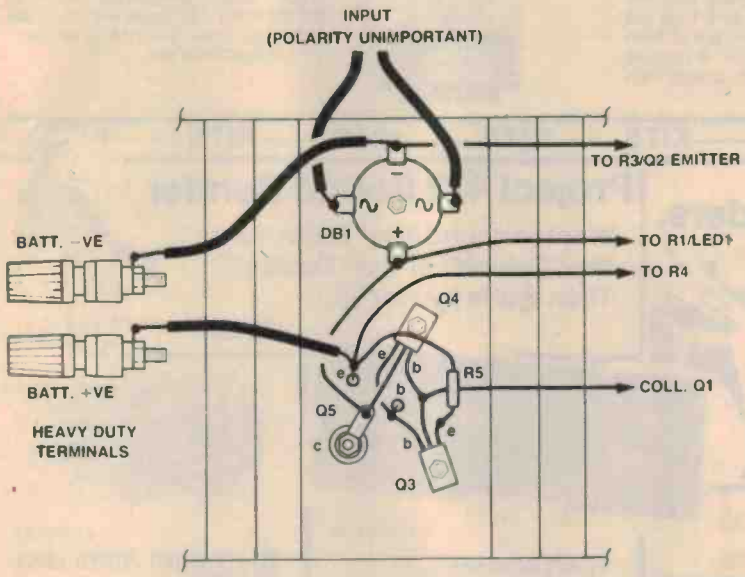


Figure 3. The diode bridge option costs a little more than the single diode but its advantage is that it can be connected in either way ignoring the polarity of the supply connections. It dissipates more power than the other options and has a voltage drop of about 1.7 V.

PARTS LIST — ETI-274

Resistors .....all ½W, 5%
- R1 .....18R
- R2 .....560R
- R3 .....10k
- R4 .....1k8
- R5 .....12-33R, see text

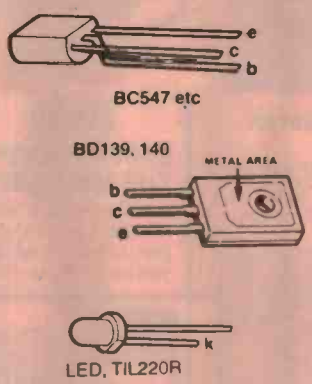
Semiconductors
- DB1 .....10-12 A bridge rectifier (PA40F or similar)
- LED1 .....TIL220R red LED
- Q1 .....BD140
- Q2 .....BC547, BC107
- Q3, Q4 .....BD139
- Q5 .....2N3055

Miscellaneous

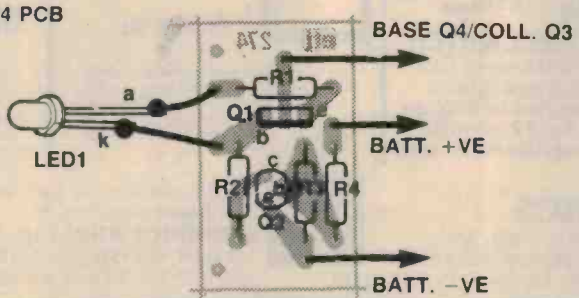
ETI-274 pc board; UB2 zippy box (if required) 60 x 113 x 196mm or similar; 100mm heatsink or larger; heavy duty terminals; heavy duty figure-8 cable (coded red/black); TO-220 transistor insulating and mounting hardware (two sets); TO3 mounting hardware; hookup wire — medium and heavy duty; nuts, bolts, etc.

Price estimate $22-25

COMPONENT PINOUTS



ETI-274 PCB



THIS MONTH'S KITS

ETI-274 damn fast NiCad charger
This project is specifically designed for modellers and photographers who make heavy demands on NiCad batteries quite routinely. There's nothing more frustrating than having your RC model run out of juice as it runs out of sight, or your flash run out of flash at an inopportune moment. If you use NiCads and need a quick charge then this project is for you.

ETI-676 RS232er for the Microbee
The Microbee, among other home computers has a 'sort of' RS232 port in that it doesn't inplement the negative-going portion of its output signal (TxD). Most peripherals with an RS232 input can cope with that, but inevitably, there are those that can't. This project fixes that.

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ETI Nov '83

ETI-673 MICROBEE MULTIPROM INTERFACE
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ETI Nov '83

ETI-272 AUDIO POWER LEVEL INDICATOR
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Project HE-106 — Radio Microphone.

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ETI-649 LIGHT PEN FOR THE MICROBEE
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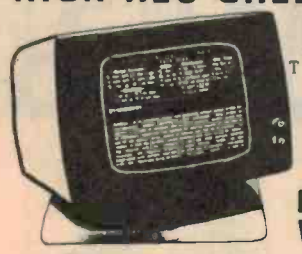

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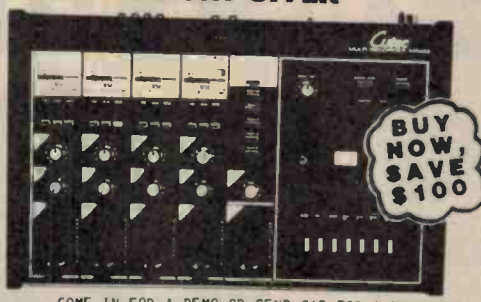

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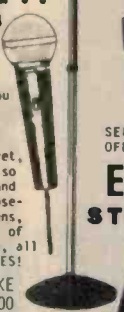
CONTROLS: Channel Faders 60mm slider; Master Fader 60mm slider; F/B Volume Control rotary; F/B Master Level rotary; Effect Send rotary; Effect Return rotary; Phono rotary; Headphone rotary

SIZE: 620W x 356D x 105H millimeters

EQUALIZATION: (Each Channel) Bass +15dB, -15dB; Treble +15dB, -15dB

CARRYING CASE INCLUDED: Attractive black vinyl-covered timber case free!

HELLO... HELLO... TESTING.. .1..2..3



Have you seen our range of PA gear yet? You're mad if you don't! We've got mikes, balanced/unbal., cardioid, electret, dynamic, etc, also stands, booms, and attachments, goose-necks, windscreens, mike mixers and, of course, speakers, all at DISCOUNT PRICES!

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BOOM.....$18.90
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MIKES FROM.....$17.50

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CD-424 14 BIT P.C.M. HIGH RESOLUTION DIGITAL DELAY

* Pro quality with high signal to noise ratio and wide frequency response * Long delay time from 0 to 1,026mmsh * 8 step sub-delay preset from 8/ 764mm/s * superb combination effect with main and sub-delay * 2 inputs and 3 output levels * Low/High equalizer for sound variation

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* 2-way electronic crossover in stereo * 3-way electronic crossover in mono * 8 steps dividing points from 250Hz to 6KHz * Rack mountable compact dimensions (19") * Convenient 2-way input jacks of balanced (50K ohms) and unbalanced (25K ohms)

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•Graphics software available
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3 FDC-1 SINGLE BOARD COMPUTER
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•NEC765 Floppy Disk controller
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256K DYNAMIC RAM

WAS $995 NOW **$695**

NOW SAVE A MASSIVE $300

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• Guaranteed to operate at 4MHz with no wait states (6MHz: 1 wait).
• Adjustable timing allows operation with Z80, 8080, 8085 micros.
• Can be divided into max. 16 banks, each variable in 4K add-ons.
• Each 4K segment can be individually enabled or disabled easily.
• Each bank can be located on any 4K boundary.

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BEST QUALITY FAMOUS MAKERS WAY BELOW NORMAL COST!

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110V AC CHASSIS MTG..	$2.50	$2.20
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15-30V DC OPEN TYPE..	$3.00	$2.55

Alf above either 5 or 6 digit readout.

Ideal for all types of Industrial Control applications, batch-counting, machine-usage, etc. Qty prices on application

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24V DC, 2 SIZES. PANEL MOUNTING.
Internal position indicator switch for remote sensing, highest quality.
PRICED WAY BELOW NORMAL COST!
SLIM-LINE MODEL WITH PCB EDGE CONNECTOR..... $5.00
STANDARD SIZE. PCB EDGE CONNECTOR ($1.50)... $6.90

★ PACK/POST $2 PLUS 5% OF ORDER VALUE. ★

3 CORE MAINS LEADS

3 METRES usually $3.30 **$2 EA.**

10-24 $1.75
25-49 $1.50
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MOVING COIL CARTRIDGE

MODEL MC100

Was $49.50

•Standard ½" mounting.
•Samarium Cobalt magnets for high output- transformer not needed.
•Freq. response 15Hz-35KHz.
•Huge 2.5mV output (1kHz/50mm/s)
•Tracking Force: 2.0 grams.
•0.0mm Diamond stylus.
•Complete mounting kit incl.
•Stylus easily replaced ($15.00)

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3-4.5V OR 24V

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High quality English alarm bells by Chloride-Gent in either 3-4.5V or 24V AC/DC models. Ideal for warning indicators, doorbells, etc.

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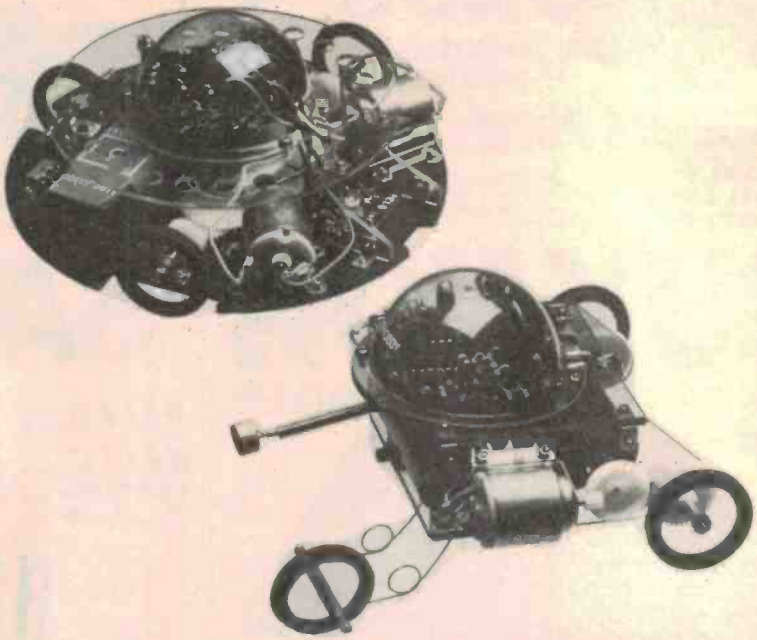
PIPER MOUSE
This 'microbot' is powered by 2 DC motors that drive wheels. When special ultrasonic whistle is blown, the unit goes left, right, straight ahead according to your command. Complete, including perspex dome cover! Be a Pied Piper!
Cat. KJ-6680 **$39.95**

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

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

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



Jaycar Electronics is proud to announce a range of very low cost "Turtle" like robot kits. Don't let the low prices fool you - they are not toys.
The units feature solderless connections with explicit illustrations to ease assembly. Only simple tools (ie. screwdriver, pliers etc.) are needed to assemble.
Note: The "Microbots" work well on their own but can also be used as a platform for robotic development. If you are a robot experimenter you will find them useful as they help resolve the mechanical parts problem.

A VIDEO ENHANCER/ DISTRIBUTION AMP
DESIGNED EXCLUSIVELY FOR AUSTRALIA

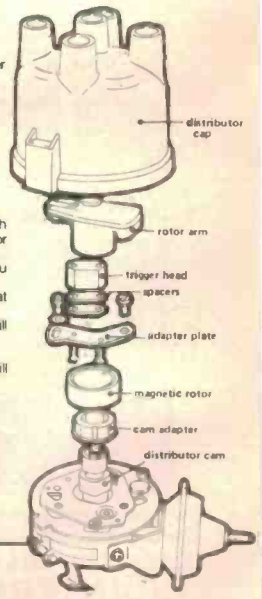
Jaycar has designed a high quality, high performance Video Enhancer which is specifically for the Australian 625 line 50 frame PAL D system. As far as we know it is the ONLY Australian designed, Australian built unit available!!
But, guess what? The Jaycar AV-6501 Enhancer is CHEAPER than its inferior imported Asian counterparts!!
This unit is professionally designed and University tested! It works and it works well.
Cat. AV-6501

ONLY $59.95

IT HAD TO HAPPEN **SEE EA Dec '83**

A professionally engineered electronic ("breakerless") contact breaker system.
Yes, only Jaycar has a complete Hall-effect triggerhead assembly designed to adapt to an extensive number of cars. Each kit contains the following:
- HALL EFFECT TRIGGER HEAD
- MAGNETIC ROTORS FOR BOTH 4 & 6 CYLINDER CARS
- OVER 6 CAM-LOBE ADAPTORS
- OVER 12 DIFFERENT ADAPTOR PLATES FOR YOUR PARTICULAR DISTRIBUTOR
- OTHER HARDWARE (i.e. SCREWS etc.)
- YOU CAN REMOVE THIS SYSTEM AND RE-EQUIP YOUR CAR WITH THE ORIGINAL BREAKER POINTS WHEN YOU SELL THE CAR!
- AS EASY TO INSTALL AS A SET OF POINTS!
- INSTRUCTIONS (SIMPLE-TO-FOLLOW) INCLUDED

This set is designed to fit most European and Japanese cars. In fact it will also fit many Australian cars fitted with Lucas, Bosch, Motorcraft, AC Delco or Autolite electrics. If you wish to check first, please send SAE for car/distributor list.
Because we have no way of knowing, you get the fitting set for ALL of the distributors available. Basically you end up with a jar full of parts you don't need to use! (Perhaps for your next car?)
Quite frankly, we are amazed that we can supply such a comprehensive kit for this price. To produce a kit that will adapt to the dozens of different distributors around is amazing!
Remember, once you have installed a breakerless system it will never wear out and that part of your system will remain in tune FOR EVER.
Cat. KJ-6655
PLEASE NOTE: This system must be used in conjunction with an electronic ignition. The Hall Effect device will not switch enough current to replace the contact breaker points on their own!
NEW PCB FOR TAI KIT INCLUDES HALL EFFECT INTERFACE Cat. HP-6786 ONLY $3.95



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Cat. LE-8776 ..... ONLY $3.95

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Cat. SM-1032 ..... ONLY $4.95

PROGRAMMABLE MASTER RHYTHM GENERATOR
Fully imported

This project was originally described in the U.K. publication "Practical Electronics". We have fully imported "Clef" kit. This attractive kit is presented in an attractive metal cabinet with silk-screened front panel. The Master Rhythm can be programmed (in RAM) to play back - 24 Rhythm patterns - 8 parallel tracks - 12 instruments.
It is also capable of sequence operation - the ULTIMATE UNIT.
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LOW POWER - BATTERY DRIVEN

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A GREAT SELECTION OF MICROBEE SOFTWARE IS ALWAYS AVAILABLE FROM JAYCAR

ASTEROIDS PLUS - Mytek
Asteroids Plus is one of the finest high resolution graphic arcade games available for the MicroBee. It features 3-D point by point resolution graphics, shields, sound effects, intelligent objects, guided missiles, black holes and a score board. If you enjoy playing computer games, you will be captivated by Asteroids Plus.
Cat. XE-6297 ..... $22.50

FORTH
A new language for the MicroBee. Comes complete with interpreter on one side of the tape and supporting programs on the other side. As well as this it includes a very well written, bound manual.
Cat. XE-6965 ..... $47.50

PSYCHOTEC By Dreamcards
Psychotec provides a striking example of artificial intelligence, allowing a dialogue in English between computer and operator, the computer playing the role of psychiatrist and the operator being a "patient" on the couch. Leaves other "similar" types for dead.
Cat. XE-6875 ..... $15.95

MERLIN By Dreamcards
Merlin is a 32K adventure set in England during the dark ages. Your task is to search through the dark forest inhabited by robbers, outlaws and creatures with awesome magic powers to find a legendary sword. An excellent adventure.
Cat. XE-6870 ..... $25.00

LOG - GENERAL PURPOSE INDEX
This program is designed to suit a wide range of records where indexing (and later searching) can be on one or two words, or on a string of up to 15 characters. Each record consists of its index heading, plus up to 12 lines of text. Each line can contain up to 41 characters.
Cat. XE-6890 ..... $15.95

MINE DROP
You are a tank running around a maze gathering all the supplies you can. It sounds easy, but you have a guided missile hot on your trail. Your only defence is a remote controlled mine which you drop and explode at will. A very fast joystick or key controlled game.
Cat. XE-6960 ..... $15.95

PENETRATOR
A low resolution graphic version of the popular game "Scrambler". You must defeat the rockets and bomb the radars in an effort to get to the next stage which is even harder. This game can be either controlled by a Joystick or by keys. Being in Lo-res graphics it is a very fast game. If you are bored with the same land pattern you can devise your own.
Cat. XE-6955 ..... $19.95

METEOR RESCUE - Mytek
Your mission is to rescue stranded astronauts. You are the commander of the Landing Module docked in space with the mother ship. It is your responsibility to guide the landing module through the meteor field, down to the surface of the planet, to land safely on a landing pad. An astronaut will then run to your landing module and you will blast off. You must use your lasers if necessary and dock with the mother ship again. A total of 6 astronauts must be shuttled to the mother ship.
Cat. XE-6285 ..... $18.50

KING KONG - Mytek
Just like the arcade game of a similar name. The game consists of several frames which you must complete to rescue your sweetheart from Kong. Excellent graphics and sound. Joystick compatible.
Cat. XE-7054 ..... $22.00

CHOPPER - Mytek
A fast action packed game which must rate as one of Mytek's best. You have full control of a helicopter and you must fly over enemy lines to rescue your allies. Fast realistic graphics and excellent sound.
Cat. XE-7055 ..... $22.00

SKETCH PAD
A program to help you design your own P.C.G. characters. Simple commands allow easy drawing of circles, polygons and boxes etc. These then can be dumped to tape to be used in a future program. Comes complete with manual.
Cat. XE-7056 ..... $19.95

PRINTERS MATE
This program is two screen dump programs to suit CP80, MX80, DT80, 80DP and FAX80 printers. One program is a screen dump utility while the other prints out memory contents in both hexadecimal and ASCII characters. A must for use with printers.
Cat. XE-7051 ..... $17.50

DUO - ONE
Another two programs for the price of one from Dreamcards. One side has poker, and the other is Casino which is a three reel poker machine. Both use Hires graphics. Excellent value.
Cat. XE-7052 ..... $15.95

EXTENDED TURTLE
A "Turtle" program which has been written by a teacher and has been several months in the writing. This is one of the best Turtle programs written and comes complete with a 40 page clearly written manual with many helpful drawings.
Cat. XE-7053 ..... $29.50

DEFENDER - Mytek
This long awaited program is finally available. Defender needs no introduction. The Defender arcade game is one of the most popular ever produced and the Mytek version is brilliant, a rival for Asteroids Plus.
Cat. XE-7036 ..... $24.50

COULOMBS LAW
This program is another in the series of Physics simulations. The first part is tutorial and the second is a simulation of the experiment.
Cat. XE-7049 ..... $14.95

BACKGAMMON - Mytek
This game conforms exactly to that set down in the official rules of the International Backgammon Association, including the rules of doubling and scoring.
Cat. XE-7050 ..... $18.50

GEO-TECH DRAWING
This is the first in a series to assist students in grasping the fundamentals of geometric and technical drawing. It uses good graphics with excellent explanations.
Cat. XE-7047 ..... $14.95

DISASSEMBLER By Dreamcards
Some may say "Not another Disassembler". But this one has a difference. It allows you to set out where the data fields are so the computer is saving time, not trying to disassemble data. A program you shouldn't be without.
Cat. XE-6915 ..... $15.95

CHEAPIE By Dreamcards
Two top quality programs for the price of one. The best Hangman we've seen yet on side A and a superb version of Battleship on side B. Both have excellent graphics.
Cat. XE-6920 ..... $15.95

COMPOSER BEE
This is a very well written program for music. This program allows you to compose, play, edit, transpose as well as being able to load and save your music. A program that has been a long time in the writing and well worth buying.
Cat. XE-6930 ..... $22.50

PONTOON
A quality fast moving card game where up to 6 players can play against the computer who is banker.
Cat. XE-6940 ..... $14.95

TRSBEE - Mytek
TRSBEE is a package of 3 programs that loads TRS-80 Model 1 and 3 program tapes into the MicroBee without any additional hardware. Although some program editing will still be required prior to their running, the majority of program typing time is saved by TRSBEE. The first program loads TRS-80 BASIC programs into MicroWorld BASIC. Most programs may then be edited and run. The second program in the package loads any TRS-80 machine code file into the MicroBee memory. The third program loads TRS-80 assembler files into the MicroBee EDITOR/ASSEMBLER. Any TRS-80 Model 1 or 3 tape may be loaded. TRSBEE opens up a whole new world of possible software on your MicroBee!
Cat. XE-7005 ..... $32.50

HOUSEHOLD REGISTER
This program will simplify the task of determining the value of your homes contents for insurance purposes, as well as providing descriptions of all listed items in the event of their loss or destruction. Effects are catalogued by their name, description and value. Nine separate rooms are provided, and up to 28 items may be listed in each.
Cat. XE-7000 ..... $15.95

BASIC TUTORIAL
Is a super teaching aid for any classroom. Basic Tutorial is a set of 9 interactive exercises designed for teaching Basic to the computer novice. No previous knowledge is assumed. Basic Tutorial uses a unique double screen technique to display both the normal computer output and the tutorial exercises at the one time. This allows the student to use the MicroBee in the normal way, while the tutorial instructions appear in the lower half of the screen.
Cat. XE-6860 ..... $22.00

MACHINE CODE TUTORIAL - Mytek
Consists of 8 interactive exercises designed for teaching machine code programming and related topics as they apply to the MicroBee computer. Only a general knowledge of the BASIC language is assumed. Machine Code Tutorial is designed to bridge the gap between BASIC programming and being able to understand and use typical Z80 manuals.
Cat. XE-6855 ..... $27.50

DATABEE
This program is a well written data base management system that utilised the MicroBee to its fullest to provide a Data Management System similar to those found on larger and more expensive systems. This comes complete with large bound manual.
Cat. XE-6945 ..... $19.95

ATTENTION: MICROBEE USERS

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If you are a creative programmer who believes that your programs will sell why not write for us? Maybe you can turn your hobby into a profitable business.
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If you think that you have a program that is exciting, unique or simply better than what's around - why not contact us?
Just send a quality recording of the cassette, (yes, you CAN trust us) for us to evaluate.
TOP PRICES PAID FOR GOOD PROGRAMS

NEW! ETI 675 MICROBEE Parallel-to-serial interface
Ref: ETI January 1984
Great kit enables you to convert the serial (almost RS-232) port on your MicroBee to a parallel port suitable for the cheap parallel printers now around.
Cat KE-4665
ONLY $29.50
BASIC KIT

NEW! ETI 656 BUG DEBUGGER
Ref: ETI January 1984
What a great idea! This project enables you to analyse a programming bug in a EPROM. You can also use it for temporary program storage with battery backup. The Jaycar kit comes with all the ETI specified components.
Cat. KE-4655

ONLY $35.00

MICROSOFT BASIC-80 MANUAL
This book explains in detail the MicroSoft BASIC that comes with Disc Drive Systems. It includes information about Disc file loading and instructions on the use of assembly language routines.
Cat. XE-8018 ..... $29.95

NEW SOFTWARE FOR FEBRUARY 1984

COMPOSER BEE II
This program allows you to write music straight onto the screen. You can then either edit, transpose, playback or save the notes onto cassette. This is a program which is educational and entertaining.
Cat. XE-7061 ..... $21.95

DATA MANAGER
Data Manager can hold up to 200 records (32K) or 60 records (16K). Each record consists of 4 lines, a search can then be done on any word in any record and those records displayed.
Cat. XE-7062 ..... $15.95

WILDCARDS II
This book is the sequel to Wildcards Vol.1. It contains much, much more information and a memory map of 7 pages. If you liked the first volume you're going to love the sceond even more.
Cat. XE-8016 ..... $16.00

EMU JAUST
Another excellent hi-res graphic game from Mytek. This is a game with added realism, excellent graphics and fantastic sound. Mytek have far surpassed themselves with this one.
Cat. XE-7058 ..... $22.00

TAPE DOCTOR
A great utility program from Mytek. As well as being able to make backup tapes, it can load bad tapes and in doing so points out the errors in the tape. A very useful program.
Cat. XE-7059 ..... $18.50

DEBUG
Another utility program from Mytek. It operates at assembler level and allows the entering of breakpoints into machine language programs. A very useful utility to use.
Cat. XE-7060 ..... $18.50

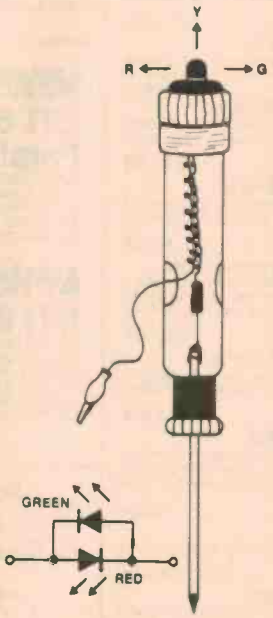
IDEAS FOR EXPERIMENTERS

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

Polarity indicator

This polarity indicator, designed by **Malcolm Fields** of **Kangaroo Flat Victoria**, is for low voltage solid state work with 6, 9 or 12 V dc supplies.

The heart of the device is a simple Radio Shack tri-colour LED (276-035); very easy to see how it works, however, the sneaky bit is that with an ac current the red/green gives a yellow glow — a bonus which appealed to me. The other devices I had contemplated buying were either terribly expensive or unimaginative with two LEDs being used or great extensions I wouldn't dream of poking any instruments into.



I wanted something rugged, comfortable, safe, attractive and useful. I decided to use an ordinary 240 V neon mains tester/screwdriver as the carrier/probe for the tester. Ellistronics has one which has an amber body and plastic sheaf along the screwdriver shaft, topped with a neat red plastic cap and contact.

I emptied out the neon tube and spring and drilled out the contact hole in the cap to take the body of the tri-colour LED (used a bit of epoxy). I used a 390R resistor as the brilliance it provides is adequate and should suit most applications.

I drilled a neat 3 mm hole in the middle of the optical viewing lens in the plastic body and carried a light, black hook-up wire out to a black plastic mini-clip and into the short leg of the LED. Getting the internal contact from the LED through the resistor to the blade is tricky. I used a piece of copper tubing about 3 mm in diameter and 5 mm long and soldered (and crimped) the positive lead to it before forcing it on to the end of the shaft which protrudes about 4 mm into the neon compartment.

I used light wiring internally and sleeved all connections before giving the whole wiring about eight reverse twists which allowed me to screw the cap on nicely. The internal wiring has to be about 7-8 cm long to allow for twisting.

Electric floor heat earth leakage monitor

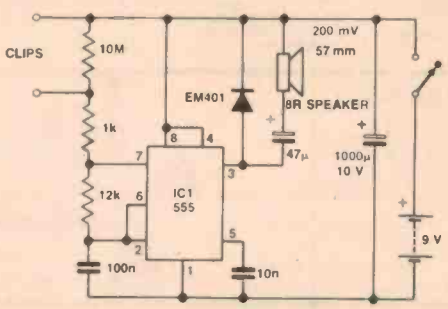
This circuit may look familiar to some since it's very similar to the warbling alarm in Ideas for Experimenters, ETI March 1980, wrote **Alec Phillips** of **Myrtleford Victoria**.

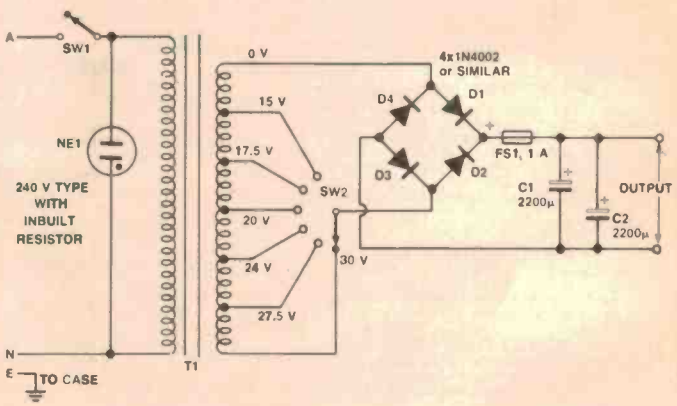
I made it in response to a request from an electrician friend of mine, who needed an audible monitor connected to electric floor heat coils while cement was being poured. One clip is connected to the outer earth casing and the other clip is connected to the centre element.

The circuit is basic and self explanatory. I mounted it in a Clipsal 265/3 PVC box, 102 mm x 102 mm x 70 mm, and used a 200 mW, 57 mm, 8R speaker and a 9 V battery.

Normally the unit just ticks at about 1 kHz but if the heating coil is damaged by a shovel or a cement vibrator, the frequency suddenly increases to approximately 400 Hz, depending on the amount of resistance in the short circuit. Also, any small leakage of ten milliohms or less, will naturally increase the frequency of the output a small, but notable amount.

A special note: this will not do away with the final testing with a high voltage megger after the cement pour is completed, but it has proved very useful during a pour.





Simple variable power supply

David Tindall of **Doncaster Victoria**, 15 years old, designed this simple circuit which he has found very useful.

I think it will appeal to beginners and enthusiasts of my own age.

SW1 is an on/off switch and NE1 is used to indicate what state the power supply is in. T1 steps down the 240 V to six different voltages. Each 'tap' on the transformer (except 0 V) is connected to SW2. SW2 selects one of the six voltages.

The rectifier bridge is made up of four 1N4002 diodes (or similar). Capacitors C1 and C2 are provided to filter the ac ripple which is present. The fuse should be no more than 1 A; when the transformer I used is overloaded it has a nasty habit of becoming very hot.

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S2 ETI 482 50 watt per channel Amplifier
S3 ETI 482A Preamp Board
S4 ETI 482B Tone Control Board
S5 ETI 485 Graphic Equalizer
S6 ETI 480 50 watt Amplifier less H/S & bracket
S7 ETI 480 100 watt Amplifier less H/S & bracket
S8 ETI 480 Power Supply for above
S9 ETI 443 Expander Compressor
S11 ETI 458 Audio Level Meter
S12 ETI 438 Audio Level Meter
S17 ETI 422 50 watt per channel Amplifier*
S18 ETI 426 Rumble Filter
S19 ETI 429 Simple Stereo Amplifier
S21 ETI 417 Over LED Distortion Monitor
S31 EA Musi Colour 4 1000 w/ch
S33 E.A. Musicolour III 1000 w/ch
S34 E.A. Stereo Dynamic Noise Filter
S35 ETI 470 60 watt audio amplifier module
S36 ETI 4000 Series 60 watt stereo amplifier
S37 ETI 451 Hum Filter for Hi-Fi systems
S38 E.A. Stereo Infrared Remote Switch
S39 ETI 455 Stereo Loudspeaker Protector
S40 E.A. Super-Bass Filter Less Power Pack
S42 E.A. Stylus Timer
S43 ETI Series 3000 Amplifier 25w/ch
S44 ETI 477 Mosfet power amp module inc. brackets
S45 ETI 457 Scratch/Rumble Filter
S48 ETI 5000 Power Amplifiers
549 ETI 494 Loudspeaker Protector
S50 EA Infared TV Sound Control
S51 HE 121 Scratch & Hiss Filter
S52 EA 100 watt Sub Woofer Module
S53 EA Stereo Simulator

PRE-AMPLIFIERS AND MIXERS
P1 ETI 445 Stereo Pre-Amplifier
P2 ETI 449 Balance Mic Pre-Amplifier
P6 ETI 419 Mixer Pre-amplifier — 4 ch. Mixer Pre-amplifier — 2 ch.
P10 E.A. Playmaster 145 Mixer
P11 ETI 446 Audio Limiter
P12 ETI 471 High Performance Stereo Pre-amplifier
P13 ETI 477 Moving Coil Cartridge Pre-Amp
P14 ETI 474 High to low Impedence Interface
P15 ETI 467 4 Input Guitar/Mic. Pre-amp Suits
P16 EA Moving Coil Pre-Amp (Battery)
P17 EA Moving Coil Pre-Amp (Plug Pak)
P18 ETI 478mm Moving Magnet Pre-Amp (Series 5000)
P19 ETI 478mc Moving Coil Pre-Amp (Series 5000)
P20 ETI 478 Series 5000 Pre-Amp
P21 EA Vocal Cancelior
P22 ETI 461 Balanced Pre-Amp
P23 HE112 Micromixer
P24 EA Effects Unit
P25 EA Stereo Simulator

GUITAR UNITS
G1 ETI 447 Audio Phaser
G2 ETI 413 2 x 100 watt Bridge Amplifier
G5 ETI 413 100 watt Guitar Amplifier
G14 ETI 452 Guitar Practice Amplifier
G15 ETI 466 300 watt Amp module — less H/S & Transformer
G16 ETI 454 Fuzz-Sustain less foot switch
G17 HE 102 Guitar Phaser
G18 ETI 450A Bucket Brigade
G19 ETI 450B Mixer for above
G20 EA Guitar Pre-Amp
G21 Sonics ME2 Wah Wah Pedal — less pedal
G22 EA Effects Unit

AUDIO TEST UNITS
AT1 ETI 441 Audio Noise Generator
AT2 ETI 128 Audio Millivolt Meter
AT7 ETI 137 Audio Oscillator
AT9 HE 105 Bench Amplifier (less case)
AT10 EA Audio Test Unit
AT11 EA Function Generator
AT12 ETI 464 Audio Test Units

POWER SUPPLIES
PS1 ETI 132 Experimenters Power Supply
PS2 ETI 581 Dual Power Supply (High Powered Version)
PS3 ETI 712 CB Power Supply
PS4 ETI 131 Power Supply
PS6 ETI 105 Laboratory Power Supply
PS7 ETI 111 I/C Power Supply
PS9 E.A. 1976 Regulated Power Supply
PS10 E.A. Dual 30-2 0-30V at 2A or 0-60V at 2A or Dual Pos and Neg 30V at 2A
PS11 E.A. C.B. Power Supply
PS12 ETI 142 Power Supply 0-30 V 0-15 A (fully protected)
PS13 ETI 472 Power Supply
PS15 ETI 577 Dual 12V supply
PS 18 Bench Mate Utility Amp Power Supply
PS 20 ETI 163 0-40V 0-5A

COMPUTER AND DIGITAL UNITS
C1 ETI 633 Video Synch Board*
C2 ETI 632M Part 1 Memory Board V.D.U.*
C3 ETI 632P Part 1 Power Supply V.D.U.*
C4 ETI 632A Part 2 Control Logic V.D.U.*
C5 ETI 632B Part 2 Control Logic V.D.U.*
C6 ETI 632C Part 2 Character Generator V.D.U.*
C8 ETI 632 U.A.R.T. Board*
C9 ETI 631-2 Keyboard Encoder*
C10 ETI 631 A/Sch. Keyboard (less keyboard)*
C11 ETI 660 Computer
C13 E.A. Cassette-Tape Interface
C14 ETI 638 Eprom Programmer
C15 ETI 637 Cuts Cassette Interface
C16 ETI 651 Binary to Hex Number Converter
C17 ETI 730 Getting Going On Radio Tele Type
C19 ETI 731 R.T.T.Y. Modulator
C24 ETI 760 Video RF Modulator
C25 EA Eprom Programmer
C26 ETI 668 Microbee Eprom Programmer
C27 ETI 733 Radio Teletype Computer Decoder
C28 EA Video Amp for Computers
C29 ETI 649 Microbee Light Pen (not incl. case)
*All V.D.U. projects priced less connectors

TEST EQUIPMENT
TE2 ETI 133 Phase Meter
TE3 ETI 533C Digital Display
TE4 ETI 129 R.F. Signal Generator
TE5 ETI 130 Temperature Meter
TE6 ETI 706 Marker Generator
TE8 ETI 122 Logic Tester
TE9 ETI 124 Tone Burst Generator
TE10 ETI 123 C Mos Tester
TE11 ETI 116 Impedance Meter
TE12 ETI 533 Digital Display
TE15 ETI 704 Cross Hatch Dot Generator
TE16 ETI 120 Logic Probe
TE17 ETI 121 Logic Pulser
TE20 ETI 157 Crystal Marker
TE34 ETI 487 Real Time Audio Analyser
TE35 ETI 483 Sound Level Meter
TE36 ETI 489 Real Time Audio Analyser
TE37 ETI 717 Cross Hatch Generator
TE38 E.A. 3 Mhz Frequency Counter
TE41 E.A. Function Generator
TE42 E.A. Transistor Tester incl. BiPolar & F.E.T.S.
TE43 ETI 591 Up Down Pre-setable Counter
TE44 ETI 550 Digital Dial (less case) includes ETI 591
TE45 ETI 144 Expanded Scale R.M.S. Voltmeter
TE46 ETI 148 Versatile Logic Probe
TE47 ETI 724 Microwave Oven Leak Detector
TE48 ETI 150 Simple Analog Frequency Meter
TE49 ETI 151 Linear Scale Ohm Meter
TE50 ETI 152 Linear Scale Capacitance Meter
TE51 E.A. Digital Capacitance Meter
TE52 ETI 589 Digital Temp. Meter
TE53 E.A. T.V.C.R.D. Adaptor less Power Pack
TE54 E.A. XTAL Locked Pattern Generator
TE55 E.A. Decade Resistance Sub Box
TE56 E.A. Capacitance Sub Box
TE57 E.A. Decade Capacitance Sub Box
TE58 E.A. Tantalum Capacitance Sub Box
TE59 ETI 140 1 GHZ Frequency Meter/Timer
TE60 ETI 572 PH Meter
TE61 ETI 135 Panel Meter
TE 61. EA TRANSISTOR TESTER

WARNING SYSTEMS
WS1 ETI 583 Gas Alarm
WS3 ETI 528 Home Burglar Alarm
WS4 ETI 702 Radar Intruder Alarm
WS7 ETI 313 Car Alarm
WS12 ETI 582 House Alarm
WS14 E.A. 1976 Car Alarm
WS15 E.A. 10 Ghz Radar Alarm
WS16 E.A. Light Beam Relay
WS17 ETI 247 Soil Moisture Indicator
WS 18 ETI 250 Simple House Alarm
WS 19 ETI 570 Infrared Trip Relay
WS 20 ETI 585 T & R Ultrasonic Switch
WS 21 ETI 330 Car Alarm
WS 22 ETI 322 Over Rev Car Alarm

AUTOMOTIVE UNITS
A1 ETI 317 Rev. Monitor
A3 ETI 316 Transistor Assisted Ignition
A4 ETI 240 High Power Emergency Flasher
A6 ETI 326 Expanded Scale Volt Meter
A14 E.A. Dwell Meter
A15 E.A. Varlwiper
A16 F.A. Tacho for Tune-ups
A20 ETI 325 Auto Probe
A22 ETI 318 Digital Car Tachometer (less Metalwork)
A23 ETI 319A Varlwiper Mk. 2 (no dynamic braking)
A24 ETI 319B Varlwiper Mk. 2 (for dynamic braking)
A25 ETI 555 Light Activated Tacho
A26 ETI 320 Battery Condition Indicator
A27 E.A. Transistor Assisted Ignition
A28 ETI 324 Twin Range Tacho less case
A29 ETI 328 LED Dll Temp Meter less V.D.D. probe
A30 ETI 321 Auto Fuel Level Alarm
A31 ETI 332 Stethoscope
A32 ETI 325 Auto Probe
A33 ETI 333 Reversing Alarm
A34 EA Low Fuel Indicator
A35 ETI 326 Led Expanded Voltmeter
A36 ETI 329 Ammeter (Expanded Scale)
A37 ETI 327 Turn & Hazard Indicator
A38 ETI 159 Expanded Scale Voltmeter
A39 EA Optoelectronic Ignition
A40 ETI 335 Wiper Controller

PHOTOGRAPHIC
PH1 ETI 586 Shutter Speed Timer
PH3 ETI 5148 Sound Light Flash Trigger
PH4 ETI 532 Photo Timer
PH7 ETI 513 Tape Slide Synchronizer
PH10 ETI 540 Universal Timer
PH12 E.A. Sync-a-Slide
PH14 ETI 558 Mast Head Strobe
PH15 ETI 553 Tape Slide Synchronizer
PH16 E.A. Digital Photo Timer
PH17 ETI 594 Development Timer
PH18 ETI 568 Sound or light operated Flash Trigger inc. optional parts

RECEIVERS/TRANSMITTERS
R1 ETI 711 Remote Control Transmitter Switch
R2 ETI 711R Remote Control Receiver
R3 ETI 711D Remote Control Decoder
R4 ETI 711B Single Control
R5 ETI 711C Double Control
R6 ETI 711P Power Supply
R7 ETI 707A 144 Mhz Converter
R8 ETI 707B 52 Mhz Converter
R9 ETI 708 Active Antenna
R11 ETI 780 Novice Transmitter
R12 ETI 703 Antenna Matching Unit
R31 E.A. 27 Mhz Pre-amp
R32 E.A. 10-30 Mhz Pre-amp
R33 ETI 718 Shortwave Radio
R34 ETI 490 Audio Compressor
R35 ETI 721 Aircraft Band Converter (less XTALS)
R37 ETI 475 Wide Band A.M. Tuner

VOLTAGE/CURRENT CONTROLS
V1 ETI 481 12 volt to - 40V D.C. 100 watt Inverter
V2 ETI 525 Drill Speed Controller
V6 E.A. 1976 Speed Control
V7 ETI 592 Light Show Controller (3 ch.) (1000 w/ch)
V8 E.A. Inverter 12V D/C input 230V 50hz 300VA output
V9 ETI 593 Colour Sequencer (for use with ETI 592)
V12 ETI 1505 Fluorescent light inverter
V13 EA Electric Fence
V14 ETI 1506 Xenon Push Bike Flasher
V15 ETI 1509 AC-DC Inverter
V16 ETI 1512 Electric Fence Tester
V17 EA Fluro Light Starter

MISCELLANEOUS KITS
M1 ETI 604 Accentuated Beat Metronome
M2 ETI 546 G.S.R. Monitor (less probes)
M3 ETI 549 Induction Balance Metal Detector Includes wire for search head
M4 ETI 547 Telephone Bell Extender
M5 ETI 602 Mini Organ (less case)
M6 ETI 544 Heart Rate Monitor
M10 ETI 539 Touch Switch
M22 ETI 256 Humidity Sensor
M23 E.A. Electronic Roulette Wheel
M25 E.A. Digital Metronome
M26 E.A. Voice Operated Relay
M29 E.A. Sound Effects Generator
M30 ETI 551 Light Chaser 3 channel 1000 watt/ch
M32 E.A. Remote TV Headphone
M34 ETI 650 STAC Timer
M40 E.A. Mast Head Amplifier
M41 ETI 576 Electromyogram
M42 E.A. Prospector Metal Locator including headphone
M43 ETI 561 Metal Locator less dowel and tubing potplant stand
M44 E.A. Musical Tone Generator
M45 E.A. Light Chaser 3 channel
M49 E.A. Selectatoff
M50 ETI 1500 Discriminating Metal Locator
M51 E.A. Light Chaser
M52 E.A. Cylon Voice
M53 E.A. Universal Timer Stop Watch
M53 ETI 566 Deep Seeking Meal Locator
M55 ETI 562 Geiger Counter
M56 ETI 607 Sound Effects
M57 ETI 257 Universal Relay Driver Board
M58 EA Simple Metronome
M59 ETI 1501 Neg Ion Generator
M60 ETI 1516 Sure Start for Model Planes
M61 ETI 412 Peak Level Display
M62 ETI 1515 Motor Speed Controller
M63 ETI 1520 Wideband Amplifier
M64 EA Masthead Pre-Amp
M65 ETI 735 UHF to VHF TV Converter
M66 HE 104 AM Tuner
M67 HE 106 Radio Microphone
M69 ETI 733 Radio Teletype Converter for Microbee
M70 ETI 1517 Video Distribution Amp
M70 ETI 499 150 watt Mosfet P.A. Module
M71 ETI 498 499 150 watt P.A. Amplifier.

Also Hobby Electronic Projects.

ALL ELECTRONIC COMPONENTS

118 LONSDALE STREET, MELBOURNE, VIC 3000. TEL 662 3506.

Charging nickel-cadmium cells

T. J. Threlfall of West Perth, WA designed this circuit to prevent accidental overcharge of nickel-cadmium cells when using a really fast charge.

I'm interested in racing 1/12th scale electric radio-controlled model cars. These cars use 6x 1.0 Ah cells and will run for ten minutes or so at an average current drain of 5-6 A. The usual method of recharging is via a 0.5 ohm resistive lead set from a 12 V car battery, average 4 A, for 15 minutes if it is initially fully discharged. A good working rule is 1.5 minutes charge for every one minute running time.

But accidents can happen and even using a timed charger does not prevent disasters as the period can be set for too long a time.

A General Electric handbook on its range of rechargeable batteries shows voltage/time curves for constant-current charging at various rates.

Figure 1 shows the general form of these curves. A curve plotted for my specific situation is shown in Figure 2. In both cases the cell voltage is shown to reach a peak soon after the cell is fully charged, and then cell voltage decreases.

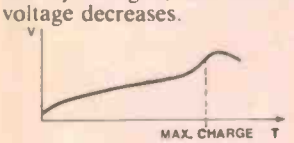

Figure 1. General form of voltage/time curve for NiCd cells, constant current charging.

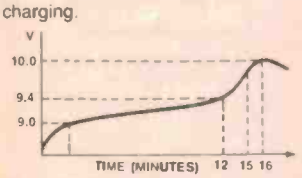

Figure 2. Voltage/time curve charging 6x1.0 Ah NiCd cells at 4 A.

A crude peak detector of the type shown in Figure 3 can be used to turn off a charger soon after the peak voltage is reached. The cells get slightly warm but not hot. Considering the price of batteries, this is a cheap way of doing it.

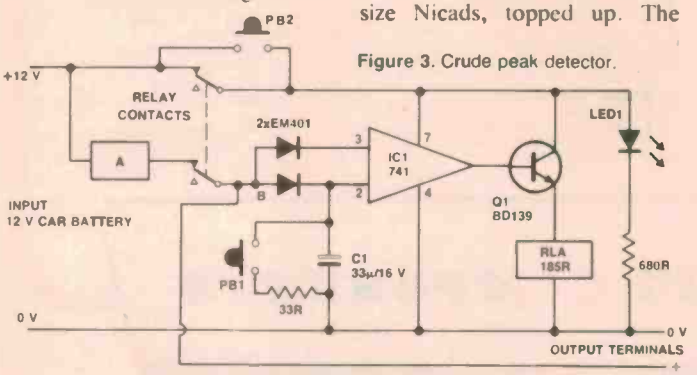

Figure 3. Crude peak detector.

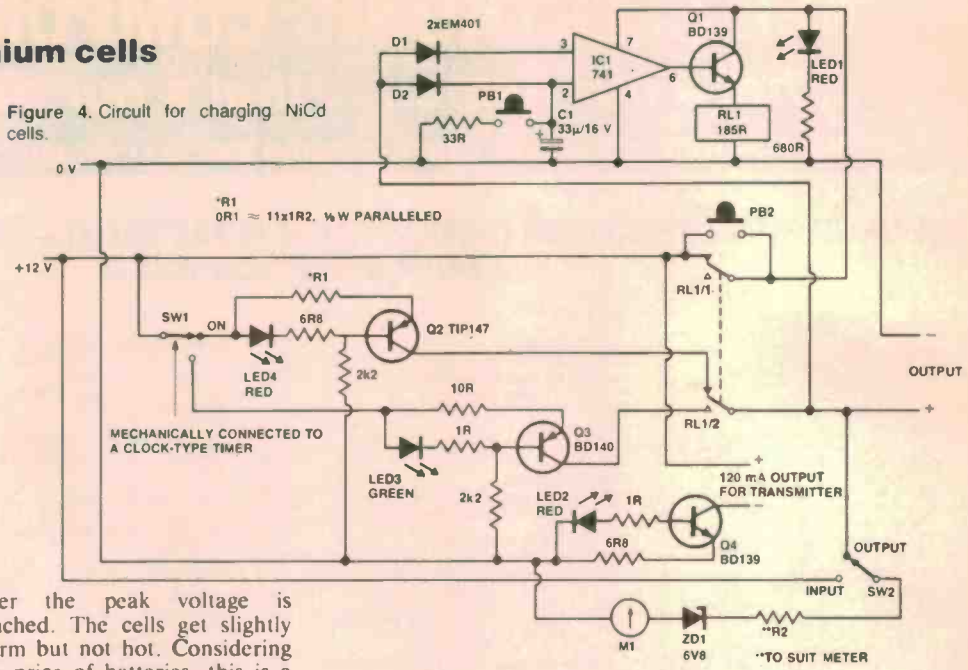

Figure 4. Circuit for charging NiCd cells.

How it works

The charger has two outputs, An unswitched 120 mA constant current output through Q4 is for keeping a radio-controlled transmitter, fitted with 8 AA size Nicads, topped up. The associated red LED indicates current is flowing through the leads (it will still light on a short circuit).

The second pair of output terminals supplies either 4 A (timer and relay on), 115 mA (timer and relay off) or nothing (relay off but timer still on). Q2, for the 4 A supply, is a high-gain PNP transistor. This was used to avoid the extra voltage drop of a Darlington pair which would restrict the output capability when the load of six sub-C size Nicads rises to about 10.5 V.

LEDs in the base leads of Q2 and Q3 indicate current flow in the output leads. Red indicates high current is flowing through the load, green shows a slow charging of the load, while neither LED alight indicates the protection circuit IC1 has switched the relay off while the timer is still on.

The timer used is a 0-60 minute clock-type kitchen timer connected mechanically to a 10 A SPDT microswitch with an extended paddle (as the timer was not strong enough to pull the switch reliably with the standard paddle length).

In operation, when the 12 V supply battery and the load are plugged in the green LED should light. When the timer is set for the approximate charge time required the green LED should go out.

PB2 is depressed, bypassing contacts RL1/1 and supplying power to the protection circuit. PB1 is depressed while PB2 is held down, draining C1. The relay should click on and the red LED4 should light. When PB1 and PB2 are released both LED1 and LED4 should remain on.

Meter M1 is a cheap signal meter prescaled with ZD1 and R2 to read in the range 7-12 V fairly accurately. SW2 allows the state of the 12 V supply battery to be checked with or without a load, and monitors the voltage rise of the load battery.

If the timer is set for too long a period, the voltage at the output terminals will reach a peak and then begin to fall (see Figures 1, 2). As the voltage falls pin 2 of IC1 will remain high. The voltage on pin 3 will drop which will cause the output on pin 6 to go low and turn off Q1 and the relay. The load batteries will drain back through the supply at 5-6 mA until the timer runs out. This is possibly of some benefit as the cells are *slightly* overcharged by the time the relay has turned off.

The emitter-resistor of Q2, consisting of 11 x 1.2 ohm resistors, is slightly bulky and could be substituted by a piece of thin hookup wire if it can handle the current.

The current output of this section of the circuit is not constant, varying from 5 A into a completely-discharged load to 2.5 A when the load voltage reaches its peak of about 10.5 V. As this represents a total voltage drop in the charger of only 1 V, it *is* important that this is not increased by substituting a Darlington pair for Q2. (The car battery used dropped to about 11.5 V at 4 A after a little use).

THE METER BY WHICH ALL OTHERS ARE MEASURED

The 3212 is simply designed so it's easy to use and gives absolute maximum performance at a reasonable price.

It has a high current measurement capacity (AC.DC 10A), overvoltage protection to AC250V in both current (except 10A) and Ohms ranges and it is Autoranging (except current).

It also has Lo Ohms for in-circuit resistance measurements and continuity test results are reported by an audible tone.

The Hioki 3212 is a no-nonsense, down to earth meter with all the features you need to do the job. And do it well.

Special introductory price **$82.** Normally $96.

*Plus Sales Tax.

Specifications

Display: 3 1/2-digit LCD, maximum reading of "1999", autopolarity, unit and other annunciators.

Ranging: Auto (manual ranging in current ranges).

Overrange Indicator: "1" in MSD column blinks, audible tone (No audible tone for Ohms; no indicator or buzzer for DC 1000V, AC 600V).

Battery Low Indicator: BATT mark lights.

Sampling Rate: 2 per second.

Environmental Conditions (Operating): 0 ~ 40°C, < 80% RH. (No condensation)

Maximum Allowable Input: Volts: DC 1000V max. AC 750V max. Ω/A: AC 250V max.

Dielectric Strength: AC 3000V/1 min.

Power Source: Two size AA (SUM-3) batteries; Battery current, 5mW.

Dimensions: 160H x 85W x 30D (mm).

9145 carrying case suppfied.

Option: 9014 HV Probe.

Measurement Range and Accuracy

(Specified for 23°C ± 5°C, < 80% RH)

	Range	Resolution	Accuracy	Notes
DCV	200mV	100μV	± 0.5%rdg ± 4dgt	Input resistance 100MΩ (approx.)
	2V	1mV	± 0.7%rdg ± 4dgt	
	20V	10mV		
	200V	0.1V		
	1000V	1V	± 1.0%rdg ± 4dgt	
ACV	2V	1mV	± 1.0%rdg ± 8dgt	Input resistance approx. 10MΩ (approx.) (40Hz to 500Hz)
	20V	10mV		
	200V	0.1V		
	600V	1V	± 1.2%rdg ± 8dgt	
DCA	200mA	100μA	± 1.5%rdg ± 4dgt	approx. 1Ω (not including fuse resistance)
	10A	10mA	± 1.7%rdg ± 4dgt	approx. 15mΩ >
ACA	200mA	100μA	± 2.0%rdg ± 8dgt	1Ω 40Hz - 500Hz
	10A	10mA	± 2.2%rdg ± 8dgt	approx. 15mΩ >
OHMS	200Ω	0.1Ω	± 0.8%rdg ± 5dgt	Open-terminal voltage 1.5V ± 0.2V
	2kΩ	1Ω		0.65V ± 0.055V
	20kΩ	10Ω		
	200kΩ	100Ω		
	2000kΩ	1kΩ	± 1.8%rdg ± 10dgt	
LPΩ	2kΩ	1Ω	± 1.0%rdg ± 10dgt	Open-terminal voltage < 0.4V
	20kΩ	10Ω		
	200kΩ	100Ω		
	2000kΩ	1kΩ	± 2.0%rdg ± 10dgt	

HIOKI

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For further information about Hioki multimeters or to order a Hioki 3212 multimeter, fill in this coupon. Send it to Nilsen Rowe Australia Pty. Ltd., P.O. Box 349, North Melbourne, Vic. 3051.

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ETI—1502 ELECTRONIC "SLING PSYCHROMETER"—WET BULB/DRY BULB HUMIDITY METER

A "whizzer" of a project. It's an electronic version of the weather man's wet bulb/dry bulb humidity meter. Uses two copper-constantin junctions, one "wetted" with damp gauze or cotton wool. The temperature difference between the two thermocouples is measured by a sample-and-hold circuit so that, when you've finished "whizzing" the temperature difference can be measured with a digital multimeter directly from the volts scale.

P.O.A.

ETI—1518 VIDEO ENHANCER

This simple to build project features three controls for curing video "image ills"—**floor, ceiling and enhancement.** It's designed to be installed either "stand alone" or in with the ETI—1517 Video Distribution Amplifier.

$25.00

P.O.A.

ETI-674 MICROBEE PROPORTIONAL JOYSTICK CONTROLLER

Oh the joy of a "proper" joystick! Most computer joysticks are of the switch type. But, when you want to get into some "real" joystick action, nothing beats a proportional joystick with potentiometers. This straightforward project for the Microbee, in our continuing popular series, simply plugs into the Bee's parallel port.

ETI-268 NICAD FLOAT CHARGER

$9.00 ETI MARCH '83

Keep your NiCad batteries in tip-top condition with this cheap, simple charger.

$18.50 ETI Oct 83

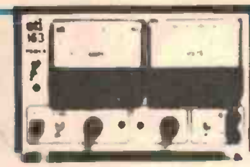
ETI-412 PEAK PROGRAMME METER

This project uses a 10-LED bargraph display module to show audio level from −23 dB to +6 dB. It's simple to build and set up.

ETI Oct 83 **$16.50**

ETI-672 MICROBEE TELETYPE INTERFACE

The "Claytons" of printers is the old surplus teletype—such as the Model 15 etc. For around a tenth the price of a dot-matrix printer, you can have hard copy from your microbee using this simple interface.



ETI MAY '83

ETI-163 LAB SUPPLY **$159**

Fully variable 0–40 V current limited 0–5 A supply with both voltage and current metering (two ranges 0–0.5 A, 0–5 A). This employs a conventional series-pass regulator, not a switchmode type with its attendant problems, but dissipation is reduced by a unique relay switching system switching between taps on the transformer secondary.

ETI-668 MICROBEE EPROM PROGRAMMER **$47.50**

ETI FEB '83

Simple, low cost programmer for the MicroBee can program 2716s, 2732s and 2764s.

ETI-153 TEMP. PROBE

$19.95

ETI JUNE '83

Can measure temperature from −50°C to +150°C. It simply plugs into your multimeter—great for digital multimeters. Accuracy of 0.1°C resolution of 0.1°C.

ETI MAY '83

ETI-323 HEADLIGHT DELAY UNIT **$17.50**

Park your car and turn off the lights. Can I see where you're going? Press the button and the headlights come on to light your way, switching off automatically after 50 seconds. This is a simple, easy to build, low cost project.

$12.50 ETI Oct 83

ETI-671 MICROBEE PRINTER INTERFACE

A simple interface unit for parallel printers.

ETI-162 30 V/1 A FULLY PROTECTED POWER SUPPLY

ETI DEC '83 **$47.50**

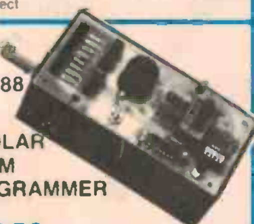
The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0 V to 30 V and selectable current limit. Both voltage and current metering is provided.

ETI-654 APPLE II ANALOGUE/DIGITAL INTERFACE

$159.00 ETI MARCH '83

This project will give your Apple a set of 8-bit digital inputs and outputs plus one analogue input and one analogue output. Applications include driving a robot, recording science experiment results, etc. (digital only shown)

ETI-688 BIPOLAR PROM PROGRAMMER



$47.50 ETI JUNE '83

Every digital workshop should have one! Can be used to program the popular fusible-link PROMs like the 74S188/288, 82S23 and 82S123 etc.

ETI-461 GENERAL PURPOSE BALANCED INPUT PREAMP **$20.00**

ETI Oct '82

This project can be used as a balanced mic amp with low impedance input, a low or high impedance input differential amplifier or a balanced input instrumentation amplifier.

ETI Oct 83 **$475 inc. tax**

ETI-690 LITTLE BIG BOARD

Just what you've always wanted in a computer—a big computer on a little board! This design runs a Z80A at 4 MHz, comes with 64K RAM, two RS232 ports and a floppy disk controller. It will run CP/M 2.2 and the board fits the soon-to-be-popular STD buss.

$75.00

ETI Oct 82

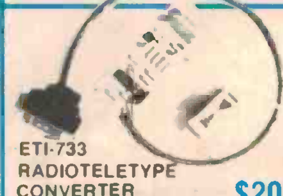
ETI-175 20 MHz HANDHELD FREQUENCY METER

A portable 4½-digit frequency meter that also measures period from 200 us to 200 ms. What's more, it looks so good nobody will believe you built it yourself.

ETI-335 PUSHBUTTON-PROGRAMMABLE WIPER CONTROLLER

$28.50 ETI MARCH '83

No more fiddling with knobs and not getting the delay between wipes that you want—this windscreen wiper controller is simply programmed with two pushbuttons to provide the wiping delay you need.



ETI-733 RADIOTELETYPE CONVERTER FOR THE MICROBEE **$20.00**

ETI APRIL '83

Have your computer print the latest news from the international shortwave news service. Just hook up this project between your shortwave receiver's audio output and the MicroBee's parallel port. A simple bit of software does the decoding. Can be hooked up to other computers too.

KITS—KITS—KITS—KITS—KITS—KITS—KITS—KITS—KITS—KITS—KITS—KITS—KITS—KITS

STOP FUTURE SHOCK

The Hioki 3200 digital multimeter has a large Bussman 600V HRC fuse built into it.

This way, if you make the wrong manual range selection when measuring on high energy power systems, you won't be seriously injured.

Normal multimeters can't offer this full over voltage protection up to AC 600V (Ω, μA, mA ranges).

And the HRC fuse is only one of a whole range of safety features offered by the Hioki 3200.

It's been shock-tested to withstand drops onto concrete of up to one metre.

The internal circuitry has been sealed against dust entry. A neon lamp indicator warns over voltage in ohms and →|← ranges.

The safety collar terminals and safety test leads provide maximum protection against electrical shock.

All the controls and terminals have been positioned according to research in human engineering, therefore minimizing any chance for operator error.

So while all these features may come as a surprise, they certainly won't shock you, now or in the future.

Special introductory price **$119.** Normally $141. *Plus Sales Tax

Measurement Range and Accuracy (specified for 23°C ± 5°C, <80% R.H. after zero adjustment.)

	Range	Resolution	Accuracy	Notes
DCV	200 mV	100μV	±0.3%rdg ± 1dgt	Input resistance > 1000MΩ
	2 V	1mV	±0.5%rdg ± 1dgt	approx 12MΩ
	20 V	10mV		approx 11MΩ
	200 V	0.1 V		
	1000 V	1 V	±1.0%rdg ± 1dgt	
ACV	2 V	1mV	±1.0%rdg ± 4dgt	approx 1MΩ/40Hz ~ 500Hz
			±2.0%rdg ± 4dgt	500Hz ~ 1kHz
	20 V	10mV	±1.0%rdg ± 4dgt	approx 1MΩ/40Hz ~ 1kHz
			±2.0%rdg ± 4dgt	1kHz ~ 5kHz
	200 V	0.1 V	±1.0%rdg ± 4dgt	40Hz ~ 1kHz
			±2.0%rdg ± 4dgt	1kHz ~ 5kHz
	750 V	1 V	±1.0%rdg ± 4dgt	40Hz ~ 500Hz
			±2.0%rdg ± 4dgt	500Hz ~ 1kHz
OHMS	200 Ω	0.1Ω	±0.7%rdg ± 2dgt	Open-circuit voltage: 0.3V or less
	2 kΩ	1Ω		
	20 kΩ	10Ω		

	Range	Resolution	Accuracy	Notes
OHMS	200 kΩ	100Ω	±0.7%rdg ± 2dgt	Open-circuit voltage: 0.3V or less
	2000 kΩ	1kΩ	±1.0%rdg ± 2dgt	
	20 MΩ	10kΩ	±2.0%rdg ± 4dgt	
DCA	20 μA	10mA	±1.0%rdg ± 1dgt	Int. resistance approx 10kΩ
	200 μA	100mA		1kΩ
	2 mA	10μA		100Ω
	20 mA	100μA		1Ω
	10 A	10mA	±1.2%rdg ± 1dgt	< 15mΩ
ACA	20 μA	10mA	±1.5%rdg ± 4dgt	approx 10kΩ 40 ~ 500Hz
	200 μA	100mA	±1.2%rdg ± 4dgt	± 1dgt 40 ~ 1kHz
	2 mA	10μA		100Ω
	20 mA	100μA		1Ω
	10 A	10mA	±1.5%rdg ± 4dgt	< 15mΩ 40 ~ 500Hz

Models
Protected up to AC 250V: 3200, 3200-01 (With carrying case)
Protected up to AC 600V: 3200-50, 3200-51 (With carrying case)

General Specifications
Display: 4-digit LCD, maximum reading of "1999", automatically and other annunciators
Ranging: Auto and manual
Overrange Indicator: "1" on MSD (optional tones, audible tone)
No tone for Ohms, no indicator or audible tone for DC 1000V
AC 750V, 10A
Battery Low Indicator: BAT mark lights
Sampling Rate: 2/per second
Continuity Test & Diode Test
Environmental Conditions: Operating 0-40°C <80 RH
No condensation

Maximum Allowable Input: With DC 1000V or DC ~ AC peak
μA, mA Only →|← AC 600V r.m.s. 1A fuse 10A range
No protection
Power Source: two size AA (SUM-3) batteries Life: 500 hours
(continuous use)
Dimensions: 160H x 85W x 32.5D mm, 310g
Accessories: Test Leads, Fuse 3200-50 0.5A, 1A
(3200 Carrying case supplied)
Options: 9418-10 probe

HIOKI
NILSEN ROWE
Registered office: 200 Berkeley St., Carlton, Vic, 3053.

For further information about Hioki multimeters or to order a Hioki 3200 digital multimeter, fill in this coupon. Send it to Nilsen Rowe Australia Pty. Ltd., P.O. Box 349, North Melbourne, Vic. 3051.

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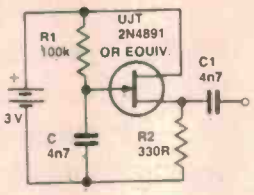
Compact UJT signal injecter

Have you ever needed a compact signal injector for those little 'away from home' jobs? This simple circuit, designed by **N. J. Espie** of **Chermside Qld** is powered by hearing aid batteries and will fit into a pen very nicely.

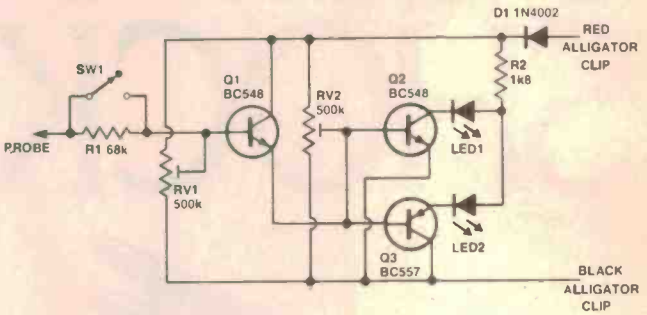


It can be used to test audio amplifiers, medium and shortwave receivers, and will even generate horizontal bars on a TV set if connected across the antenna terminals.

On powering up, capacitor C charges through resistor R1 until the UJT becomes forward biased. The UJT will then provide a discharge path for C via its emitter and resistor R2, resulting in C discharging rapidly until the transistor is no longer forward biased. Once this occurs, capacitor C will again begin to charge up via R1 and so complete one cycle of oscillation.

The rapid discharging of the capacitor through the UJT provides a sharp pulse, rich in harmonics, suitable for outputing via a decoupling capacitor C1 to the probe tip.

For a stronger signal, earth the signal injector to the system under test using an alligator clip.



Logic probe

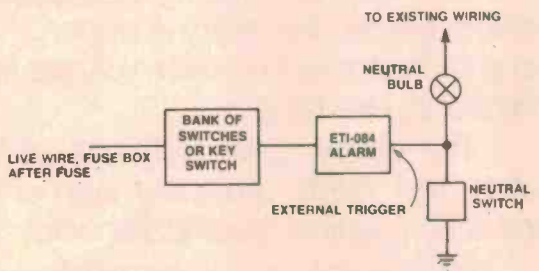
This simple circuit was designed by **Barry Drake** of **Scarborough Qld**.

Connect the circuit to a power supply and set RV1 to about half way. Slowly turn RV2 so that the 'high' LED glows and then slightly turn it back until the 'low' LED glows. Now adjust RV1 until both LEDs come on.

If the probe goes high, Q1 and Q2 conduct and the 'high' LED goes on. If the probe goes low, Q3 conducts and the 'low' LED goes on.

SW1 and R1 were included for voltages greater than one volt.

Motorcycle alarm



A. Glover of Cootamundra NSW has modified the car alarm project, ETI-084, to suit a motorcycle.

The external trigger is connected to the neutral wire (green and red on a Honda 250). Not only does the neutral switch activate the alarm, but all the other switches as well because the neutral indicator bulb connects the ignition wire.

To set the alarm the ignition must be off, the bike must be in gear, and all lights and indicators must be off. The kill switch must be off also because the external trigger will earth via the coils, and the points, if they are closed. Switch on the hidden switch or key switch. Operate any switch and the alarm will trigger.

Use a separate horn hidden somewhere, but be sure the alarm can handle the horn current. A miniature horn is easy to conceal and draws little current, but check anyway.

The circuit has been fitted for a year and although nobody has tried to take the bike, I have trapped myself a few times, mainly because I have not used the indicating LED. The reason for this, is that a thief may realise the bike has an alarm and look for a way of disconnecting it. The positions of horn, alarm and switches have been omitted for obvious reasons. All alarm parts were glued to the board to avoid vibration damage.

Audio turn signal indicator

Todd Gorman of Swan View WA found the flasher unit of his car to be barely audible, especially when the radio was on, so he designed this circuit to suit an XL Charger. However, he points out that the wiring around other flashing units may be different.

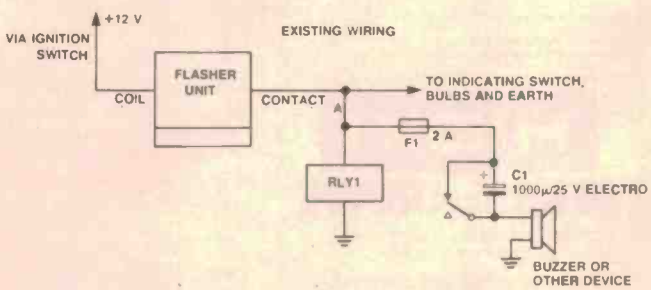
The flasher unit remains on but not earthed until the switch selects the bulbs, which are earthed, providing the pulsing action. It was not practical to connect the buzzer directly from point A as it would sound all the time while driving, and the switch/bulb wiring was too far up in the instrument panel.

The relay will pull in when the ignition is switched on and the capacitor will discharge momentarily sounding the buzzer and then ceasing. When the indicating switch is selected, the relay will click on and off in conjunction with the flasher. C1 will discharge, sounding the buzzer quickly. It then stops while C1 charges up again.

When the indicators stop, the capacitor once more discharges and the buzzer fades until switched on again. The 2 A fuse protects the contacts but if a larger relay was used the fuse could be left out. An on/off switch could be fitted at point A or the negative terminal of C1.

The entire unit was small enough to be housed in a Strepsil tin and placed behind the dash on a small ledge.

If it goes off when it shouldn't, it indicates faulty wiring or an incorrect earth.



CURRENT TECHNOLOGY

This is the sensational new Hioki 3211 Pen – DMM, a technological breakthrough in digital multimeters.

Designed to be held in one hand like a large pen, it is extremely useful for trouble shooting and maintenance work on computer systems and other microcircuits.

The controls and display panel have been positioned according to results from research into human engineering.

The Hioki 3211 Pen – DMM even has a display hold function. This way, you can take readings after the meter has been removed from a point that's difficult to reach.

But you won't really know how good it is until you give it a try.

Special introductory price **$78.** Normally $92. *Plus Sales Tax.

Specifications

Display: 3 ½-digit, maximum reading of "1999", autopolarity, unit and other annunciators.
Ranging: Auto.
Overrange Indicator: "1" in MSD column blinks.
Battery Low Indicator: BATT mark lights.
Sampling Rate: 2 per second.
Environmental Conditions (Operating): 0 ~ 40°C, < 80% RH.
Maximum Allowable Input: Volts; 700 VDC or DC + AC peak. Ω/Cnty.; 250 VAC max.
Dielectric Strength: AC 2000 V/1 min (between input terminals and case).
Power Source: Two SR-44 or LR-44 batteries. Battery current approx. 3mW.
Dimensions: 163L x 19W x 28H (mm).

Measurement Range and Accuracy

(Specified for 23°C ± 5°C, < 80% RH, no condensation.)

	Range	Resolution	Accuracy	Notes
DC V	2V	1mV	± 0.5%rdg ± 4dgt	Input resistance approx. 12MΩ
	20V	10mV	± 0.7%rdg ± 4dgt	approx. 11MΩ
	200V	0.1V		
	500V	1V	± 1.0%rdg ± 4dgt	
AC V	2V	1mV	± 1.0%rdg ± 8dgt	Input resistance approx. 12MΩ (40 Hz to 500 Hz approx. 11MΩ)
	20V	10mV		
	200V	0.1V		
	500V	1V		
OHMS	2kΩ	1Ω	± 0.7%rdg ± 4dgt	Open terminal voltage < 0.45V
	20kΩ	10Ω		
	200kΩ	100Ω		
	2000kΩ	1kΩ	± 1.2%rdg ± 4dgt	
Continuity Test				Open terminal voltage 1.5V (approx.)

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Registered office: 200 Berkeley St., Carlton, Vic, 3053.

For further information about Hioki multimeters or to order a Hioki 3211 Pen – DMM multimeter, fill in this coupon. Send it to Nilsen Rowe Australia Pty. Ltd., P.O. Box 349, North Melbourne, Vic. 3051.

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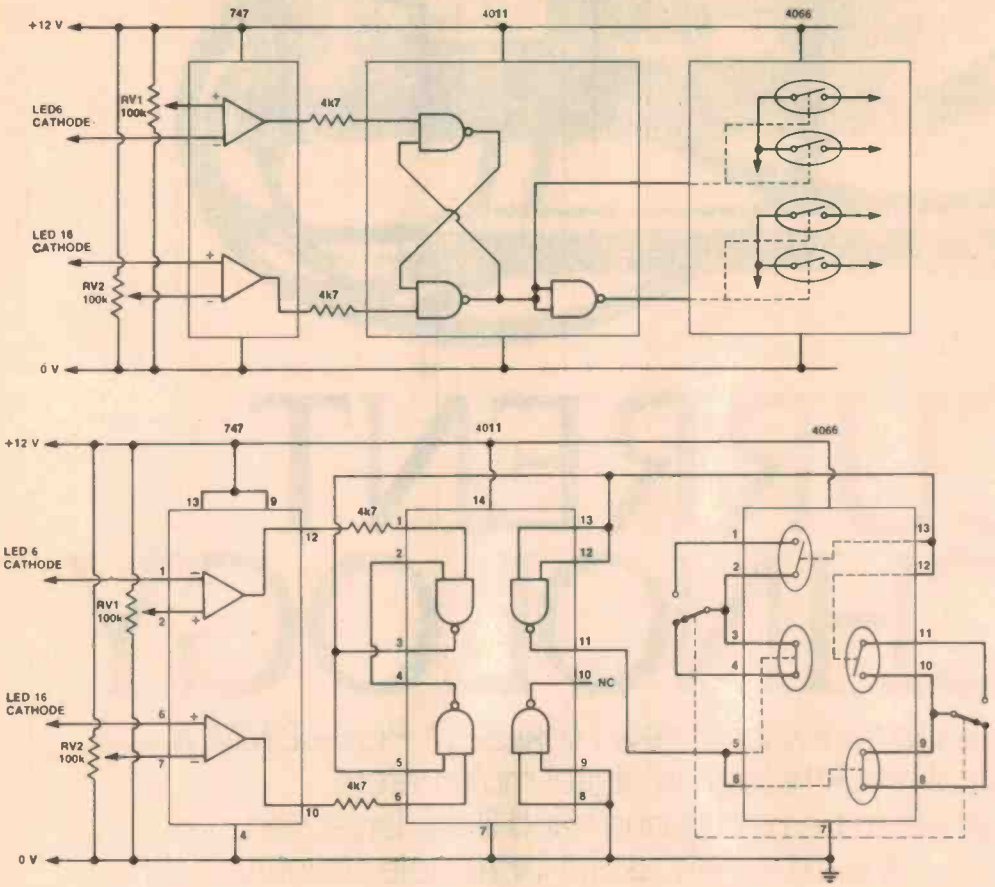


LED tacho autoranger

A modification which automatically ranges the LED tacho project, ETI-324, August 1980, has been designed by **Bill Keenan of West Heidelberg Victoria.**

The flying leads to the cathodes of LEDs 6 and 16 sense the drop in voltage as the LEDs turn on. This is compared to the preset voltages produced by RV1 and RV2, by the comparators of the 747. The highs and lows are fed into the 4011, which is wired as a flip flop. The 4066 and one gate of the 4011 are wired as a DPDT switch, which eliminates the switch in the tacho circuit. One gate of the 4011 is not used, so its inputs are earthed. Pins 4 and 8 of the 4066 go to low range calibration, and pins 1 and 11 go to high range calibration.

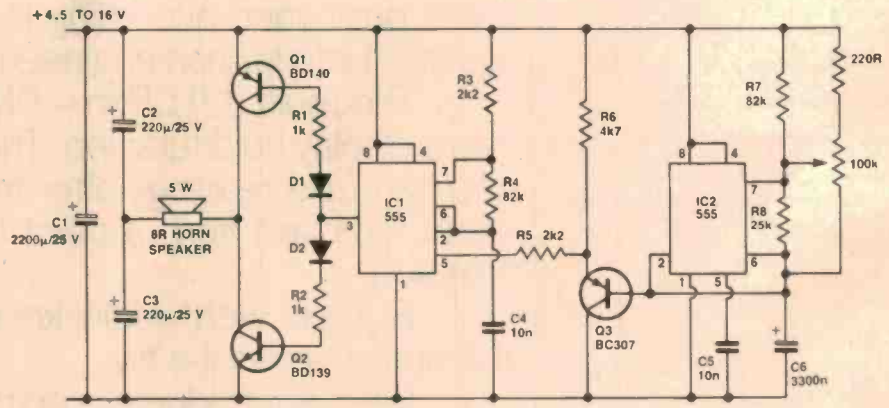
RV1 adjusts the revs at which the tacho swaps to low range and RV2 adjusts the revs at which it swaps to high range. The tacho must be re-calibrated after this modification, due to the 90 ohm resistance across the switches in the 4066.

Cheap high output alarm

Alec Phillips of Myrtleford Victoria has modified the circuit for the American siren from '555 timer applications' in ETI Circuit Techniques Vol 1. The sound is similar to the Victorian ambulance siren and the output is boosted by the addition of C2, C3, Q1, Q2, R1 and R2.

By driving one or two 8 ohm, 5 W horn speakers, the output at close range is quite deafening when using a 12 V supply.

Apart from the output, the only other changes to the original circuit are both timing sections of the 555's — this gives the required frequency and modulation for the particular type of sound required.



For a variety in sound modulation, R7 may be changed to 220 ohms, and R8 changed for a 100k trimpot with the wiper connected to pin 7 of IC2 as shwon. This will change the sound to a rapid 'whip-whip' sound in one direction through to a 'wow-wow' in the other direction. Modulation varies from about 6 or 7 Hz to about 1 Hz just short of the end of the wiper travel.

Note: If the alarm is to be used with two speakers and/or above 6 V, Q1 and Q2 must have moderate heatsinks. If two speakers are used at 9 to 16 volts it gives a better output with 470 µF capacitors for C2 and C3.

Below is a list of current consumption at different voltages using 220 µF for C2 and C3, and one 8 ohm speaker:

16 V, 420 mA; 12 V, 320 mA; 9 V, 250 mA; 6 V, 160 mA; 4.5 V, 100 mA.

Using two speakers, the current increases to nearly twice the amount along with the sound output. As a further note, C1 is essential with any power source as it supplies power storage with the rapidly changing current drain.

Please consider other people when testing and using this alarm. ●

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2K OHM MULTIMETER
11 RANGES POCKET SIZE

SPECIFICATIONS
11 RANGES
DC VOLTAGE: 0-10-50-250-1000 volts
2000 ohms/volt
AC VOLTAGE: 0-10-50-250-1000 volts
2000 ohms/volt
DECIBELS: −10 TO +22dB in four ranges
OHMETER: 0-10 k/ohms, 0-1 megaohms
DC CURRENT: 1-100mA
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D	25c	20c
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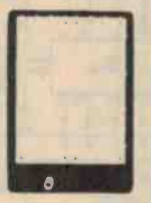

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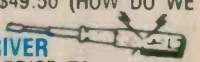

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10 RED LEDS 5mm .90 10 H1044 DELUXE
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IDEA OF THE MONTH

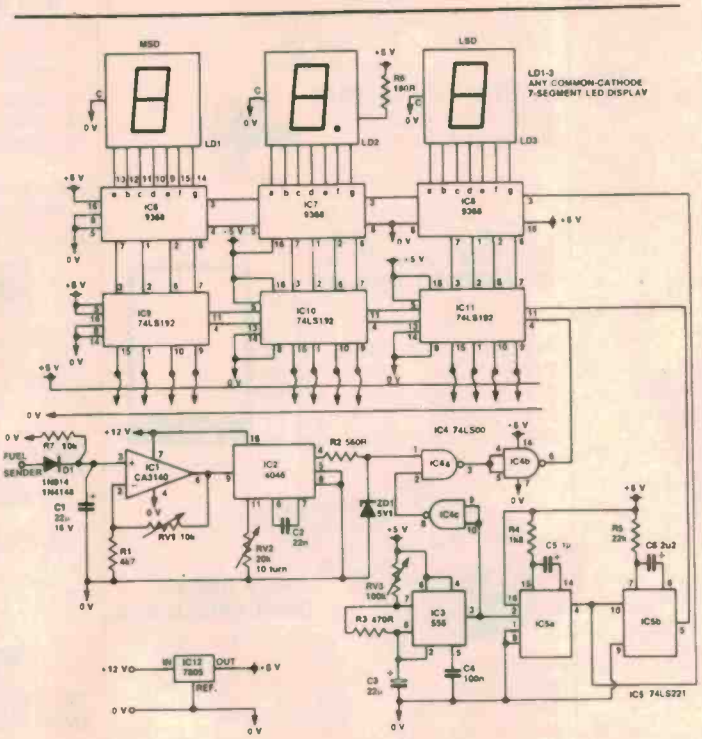
Car fuel gauge

Phillip Wolstencroft,
Wentworthville, NSW

I had the need for an accurate fuel gauge so I set about designing a digital model. The maximum readout of this unit is either 99.9 gallons or 99.9 litres. This could easily be expanded but I doubt the need would arise in most family cars or recreation vehicles.

As most fuel gauge 'senders' put out about 5 V when the tank is empty, 0 V when full, I decided to use a load-preset/countdown method.

Looking at the circuit, the output from the sender is fed via D1 to IC1's non-inverting input. D1, R7 and C1 reduce input fluctuations caused by petrol slosh. R1 and RV1 set the voltage gain of IC1, the output of which is fed to the input of IC2, configured as a voltage-controlled oscillator. RV2 and C2 set IC2's nominal output frquency. The output from IC2 is gated through a NAND gate, inverted and fed into the CLK input of the presettable up/-down counter comprised of ICs 9, 10 and 11. These are all 74LS192s with the carry output of the first fed to the clock input of the following stage, etc. Note that the output of IC2 is clipped by the action of ZD1 to 5 V to suit the input of IC4.



A 555, IC3, and associated components sets the counter update period. IC5 is a dual monostable multivibrator. IC3 begins with its output being low, which allows the CLK pulses to be fed to the counters. IC3 times out and pin 3 goes high, stopping the CLK pulses and triggering the first one-shot, IC5a. This latches the 9368s. When latching has finished, the second one-shot is triggered (IC5b), which loads the preset values present on P0 to P3 of each of the '192 counters. These preset inputs are wired to the binary value of the car's fuel tank capacity. Note that the LED displays do not require resistors. Only the decimal point on LD2 requires a current limiting resistor.

To calibrate it, RV3 is set to the desired update period; RV1 is set so that when the tank is empty, the voltage on pin 6 of IC1 is 12 volts; finally, once these calibrations have been done, RV2 is adjusted so that the displays read a known value of fuel in the tank — preferably fairly low (1 or 2 gals, 4-5 ltrs).

In this circuit, the reading is in gallons, determined by the VCO frequency. Reduce the value of C2 to read in litres — some experimentation may be necessary.

A suitable small heatsink should be bolted to the tab of the 7805 (IC12).

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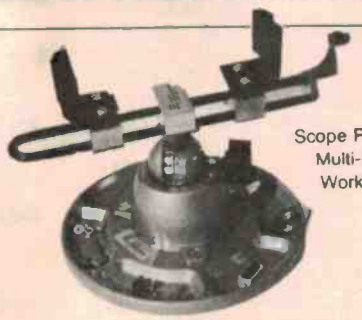

Scope Panavise Multi-Purpose Work Centre.

Scope Laboratories, which manufactures and distributes soldering irons and accessory tools, is sponsoring this contest with a prize 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 Magazine. 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, The Federal Publishing Company Pty 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 Magazine, whose decision will be final. No correspondence can be entered into regarding the decision.

The 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 Magazine.

Contestants must enter their names and addresses 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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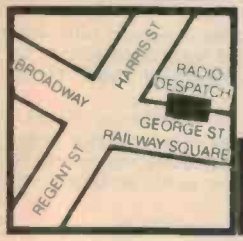

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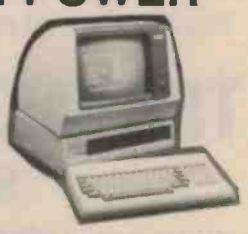

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SHOP AROUND

The LM335

Lab. Notes this issue focusses on the LM335, a solid-state temperature transducer. You should be able to obtain it, and related devices mentioned in the article, from firms such as **Rod Irving Electronics** and **Ellistronics** in Melbourne, **Jaycar** and **Geoff Wood Electronics** in Sydney. You might also try **Radio Despatch Service.**

ETI-644A d-c modem revised

In general, those firms who previously supplied this modem will be supplying kits of the revised version. Try **Jaycar** in Sydney, **Rod Irving Electronics** in Melbourne and **Altronics** in Perth. Jaycar should have kits available this month, they advise.

Several approved line isolation transformers can be used. The original type specified (October '82 ETI), was a type 45035 by Arlec. These are still available, though a touch on the expensive side at around $20 retail. However, it was the only approved model then available retail. Two somewhat cheaper types are now manufactured locally by Ferguson Transformers and should be readily available through retail electronics suppliers. Designated MT-620 and MT-627, both meet the requisite Telecom approval specifications and the revised pc board will accommodate both the Arlec and Ferguson transformers.

As before, we have retained copyright on the pc board and they are manufactured for us. If you're assembling the components from your own resources, then pc boards are available direct from us for $55, post paid. Send your cheque or money order to:

ETI-644A Modem PC Board
ETI Magazine
PO Box 227
Waterloo, NSW 2017

ETI-676 RS232er

This project will likely be stocked by those firms supporting our series of projects for the Microbee: **Magraths** and **Rod Irving Electronics** in Melbourne, but try **All Electronic Components** and **Billco,** too; in Sydney, try **Avtek** and **Jaycar;** in Perth try **Altronics.**

The Intersil ICL7660 supply rail inverter IC is imported by **R&D Electronics** and **All Electronic Components of 118 Lonsdale St, Melbourne** act as their retail distributors.

The DB25 right-angle pc mount plug and socket set we purchased from Avtek, but most savvy suppliers carry them these days.

Ready-made pc boards should be available from **Rod Irving Electronics, All Electronic Components and Jaetronics** in Melbourne, **Altronics** and **Jemal** in Perth and **Better PC Boards** in Sydney. **Avtek** and **Jaycar** in Sydney (York St) should also be able to supply the pc boards for this project.

If you're going to etch and drill your own pc board then negative or positive film artwork can be obtained from 'ETI-676 Artwork', ETI Magazine, PO Box 227, Waterloo, NSW 2017, for the munificent sum of $2 (two bucks), post paid. Make sure you request positive or negative, according to what your resist requires.

ETI-274 damn fast NiCad charger

This is a straightforward project for which all the components can be obtained over the counter at virtually any electronic components supplier. For a kit, try **Rod Irving Electronics** and **All Electronic Components** in Melbourne.

Ready-made pc boards should be obtainable from **Rod Irving Electronics, All Electronic Components** and **Jaetronics** in Melbourne, **Better PC Boards** and **Jaycar** in Sydney, **Jemal** in Perth.

If you want to make your own board, negative or positive film artwork can be obtained for just $1, post paid, from 'ETI-274 Artwork', ETI Magazine, PO Box 227, Waterloo, NSW 2017. Please make sure you ask for positive or negative, according to what you require.

ETI Book Sales

electronics textbooks

ELECTRONICS: IT'S EASY — VOL 1
A0001E *$5.95*
Meters, resistance, capacitance and inductance, emitter followers, op-amps, power supplies, electronic filters.

ELECTRONICS: IT'S EASY — VOL 2
A0002E *$5.95*
Digital sub-systems, counters and shift registers, A-D and D-A conversion, digital instruments and test equipment, computers, transmission links, oscilloscopes.

ESSENTIAL THEORY FOR THE ELECTRONICS HOBBYIST
A0013B *$5.95*
Supplies the electronics hobbyist with the background knowledge which will exactly suit his specific requirements. Minimum maths.

INTRODUCTION TO AUTOMOTIVE SOLID-STATE ELECTRONICS
A0015P *$14.95*
For the professional as well as the home mechanic — explains the functions of most on-board automotive black boxes and logic systems, including anti-skid braking, electronic spark control and diagnostic systems.

DIGITAL COUNTER HANDBOOK
A0332P *$17.25*
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SOLID-STATE POWER ELECTRONICS
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reference and data handbooks

INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE
B0018B *$9.95*
Contains a huge amount of information on modern transistors produced by more than 100 manufacturers. Wherever possible, equivalents are subdivided into European, American and Japanese types.

WALL CHART — HOW TO IDENTIFY UNMARKED ICs
B0019B *$2.95*
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.

WALL CHART — RADIO, ELECTRONICS, SEMI-CONDUCTORS AND LOGIC SYMBOLS
B0020B *$2.95*
Identify those symbols at a glance. A must for beginners and advanced enthusiasts alike. Professionals can always hide it in their desks!

WALL CHART — RADIO AND ELECTRONIC COLOUR CODES AND DATA
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This chart covers all colour codes in use throughout the world. For all radio and electronic components made in Britain, United States, Europe and Japan.

REFERENCE DATA FOR RADIO ENGINEERS
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Largest and most comprehensive collection of equations, graphs, tables, and other reference data needed in radio engineering and design.

CONTEMPORARY MATHEMATICS FOR ELECTRONICS
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This book is split into three sections. Direct current maths introduces the student to the calculator, fractions and dimensional analysis. Alternating current maths covers phasors, quadratics and RMS in both sine and digital waveforms. Active device maths introduces number systems and boolean.

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HOBBY ELECTRONICS PROJECT BOOK
C0031E *$4.95*
Fifty projects, ranging from very simple ones for complete beginners to more elaborate ones for those with more experience.

ELECTRONIC PROJECTS FOR BEGINNERS
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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.

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constructional projects

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MINI-MATRIX BOARD PROJECTS
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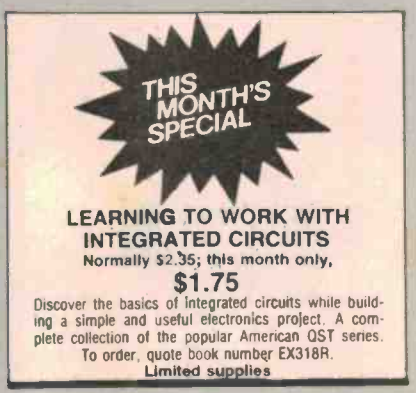

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TEST GEAR — VOL 3
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THE 6809 COMPANION
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INTERFACE PROJECTS FOR THE TRS-80 (MODEL III)
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amateur radio, dx communications

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This occasional column introduces readers to those people on the other side of the counter in the electronics retail business — where you buy your equipment and component requirements. It serves to 'put a face' to the people who own and run the businesses you may deal with in the course of your job or pursuing your hobby, and to give some background on the business itself.

Geoff Wood Electronics

656A Darling St, Rozelle NSW 2039
(02) 810-6845

OUR FIRST 'Over The Counter' column focussed on one of Sydney's long-established electronics retailers, so it's appropriate that this, the second, column should beam in on Sydney's newest — Geoff Wood Electronics.

Following the trade trend to name the business after yourself, you know — Dick Smith, Rod Irving, etc, Geoff Wood really exists. (Akwon Streszlecki — forget it).

Geoff opened for business in early December last year following a distinguished career behind the counter at Radio Despatch Service, unarguably Sydney's *oldest* electronics retail establishment and a veritable institution, and a short stint in the components division of STC-Cannon. Many Sydney electronics engineers, technicians, servicemen and hobbyists would know Geoff from RDS. A veritable legion of trade reps know him, too.

The major speciality of Geoff Wood Electronics is *semiconductors*. In fact, when you go into the shop you can hardly see Wood for the chips! Geoff has installed a 'file' of capstan drawers about two metres high by four metres long and stocked it with a positively *enormous* variety of semis, particularly National Semiconductor products, but also devices from Fairchild, Philips, Motorola and NEC. And there's more to come, so he tells us. He has positively the biggest array of semis seen North of the Goulburn River. (Only Melbourne electronics stores ever looked like this — Sydney has been underprivileged for years).

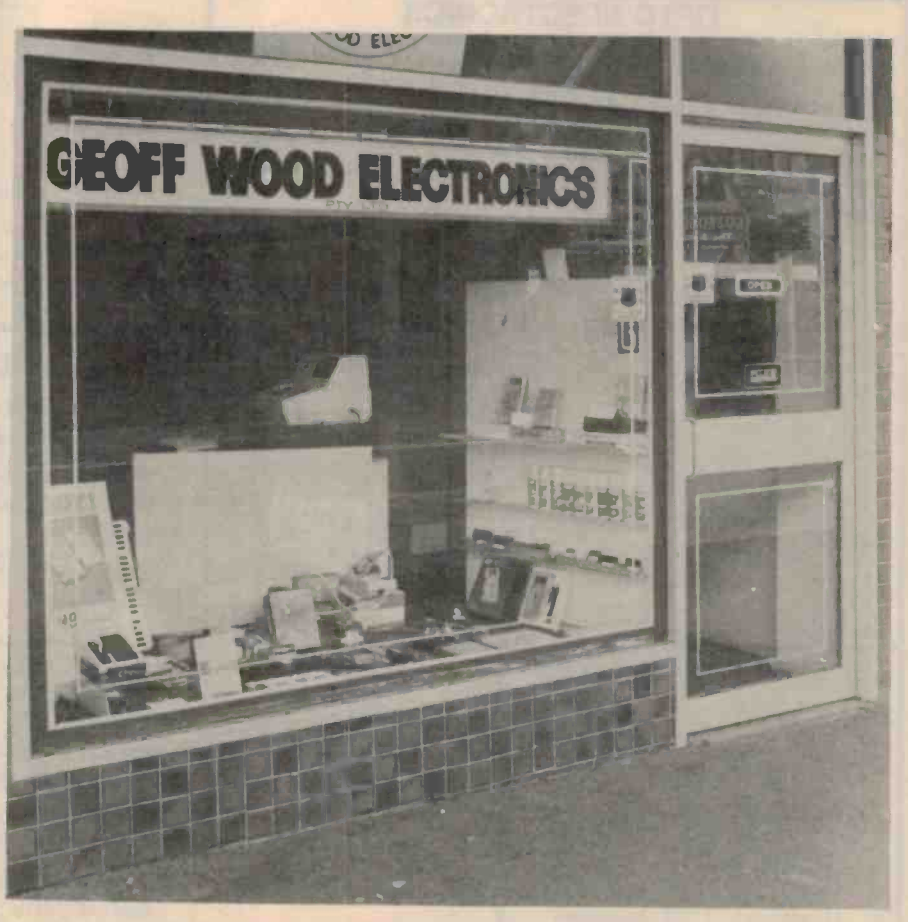
But don't stop at the semis. Geoff stocks relays, resistors, rotary pots, slider pots, capacitors and data books, plus fuses, fans, ferrites and fishing gear. (He keeps that out the back; for private use when the tailor are running and the tide is right).

There's too much to mention individually, but we should mention a few of the more unusual items ('cos you all know about the common-or-garden bits). Geoff can supply low voltage metallised poly capacitors in a variety of values (see Shop-around, ETI December '83, page 148). These useful devices are much smaller than your conventional poly capacitors and much more suited to pc board mounting. They also exhibit low self-inductance and are good for critical audio, RF and bypassing applications.

In semis, Geoff can supply those hard-to-get precision op-amps, like National's LH series and stripline-opposed-emitter (SOE) stud-mount RF power transistors. And LEDs — you wouldn't believe the variety of LEDs: Fat ones, skinny ones, red ones, green ones, clear ones, multicoloured types and flashers (whoopee doo!). Then there's relays. If you're looking for an unusual relay to do a difficult task — ask Geoff. If he doesn't have one or can't get one he'll just as likely tell you — who else to ask!

Geoff Wood Electronics' shop was a little bare when we went in to inspect it — but there are more small bits there than we'd like to count on a rainy day, and he has plans for more to come. If he hasn't got them already, he'll soon be stocking project pc boards, too. His old mate Ian Pogson (funny — seem to know that name from *somewhere!*) helps out and many a familiar face from the trade can be spotted in there almost any week. Always affable, Geoff is willing to give advice and assistance where he can.

So, if you're after that 'off-beat' chip or component, or just run-of-the-mill stuff, call in and check out Geoff Wood Electronics. The shop is located in Darling St, Rozelle, on the eastern side of Victoria Road, one block down from the intersection near the corner of National St (auspicious that, as he's a National Semiconductor specialist). If you can't call in, he does mail order too. ●



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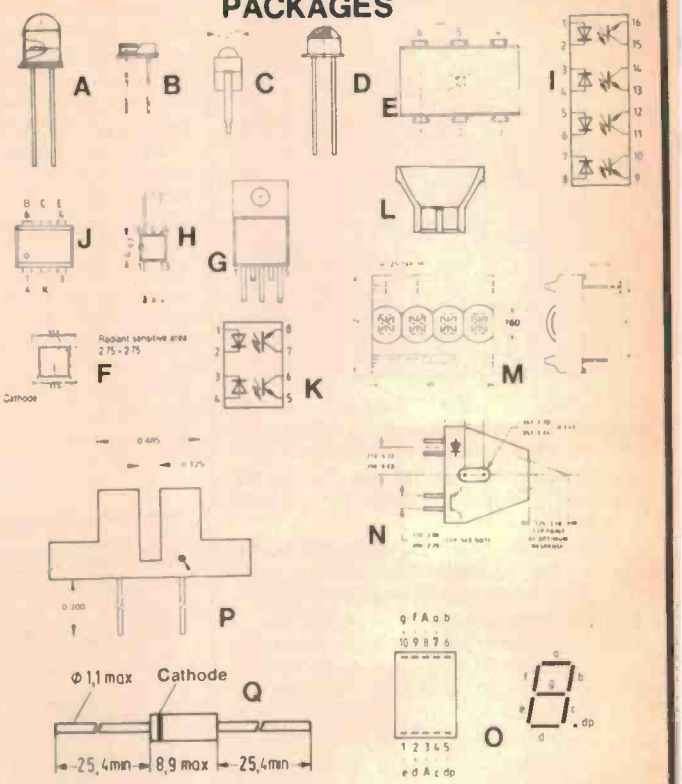
PACKAGES



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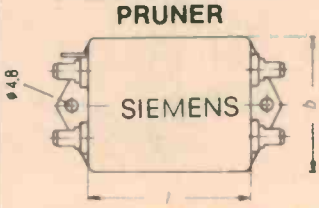

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Precision 10 turn wire-wound
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5K, 20K ..... all $10.50

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3 digit dial to suit 534, mod 15 ..... $25.50

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8 pin ..... 13¢	18 pin ..... 28¢	24 pin ..... 36¢
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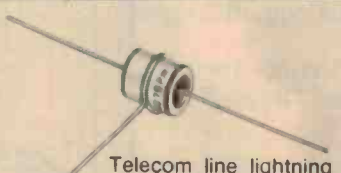

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RF SPECTRUM USAGE CHART PUBLISHED BY D.O.C.

The Department of Communications has produced a colour-coded chart showing complete use of the radio frequency spectrum in Australia.

The chart reflects information set out in the *Australian Table of Frequency Allocations* publication, which in turn is based on the International Telecommunication Union (ITU) Radio Regulations.

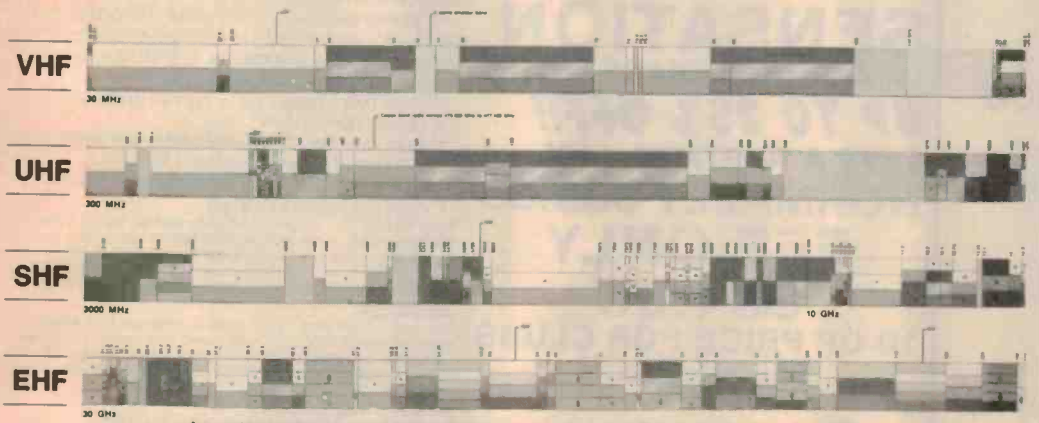
"The new chart provides a quick and easy-to-read guide to Australia's increasingly congested frequency spectrum," a spokesman for the Department said.

"Over the last decade the demand placed on the frequency spectrum has meant that new areas have had to be utilised, such as Ultra High Frequency (UHF) for television. The guide shows the full range of frequency bands from Very Low Frequency (VLF) to Extremely High Frequency (EHF).

"Each of these bands is divided into sub-bands which are used by particular services such as land-mobile radio, broadcasting, aeronautical, maritime or space services. The spectrum used by different services is shown in the chart by different colours.

"All those using the radio frequency spectrum, from broadcasting stations to amateurs, will find the chart a very useful reference guide."

The chart is available from **Australian Government Publishing Service** outlets in all the capital cities for $3.



A section of the chart showing the Australian Table of Frequency Allocations.

'6UP', THE VHF/UHF ENTHUSIASTS' MAGAZINE RETURNS

The 'boom' years for VHF/UHF activity in Australia were the early 1970s — the period when SSB 'took over' the lower end of six and two metre bands and the Great FM Repeater Debate raged.

Many local VHF group newsletters flourished then, but the only national newsletter in that period was '6UP' (an acronym for 'six metres and up', six metres being the 'lowest' of the VHF/UHF amateur bands).

Always practical, occasionally controversial, 6UP was avidly read by *every* active VHF/UHF enthusiast then. Over 30 issues were published between 1971 and 1975. Its passing was sorely missed. it was edited by Val & Roger Harrison VK2ZTB.

Now the wheel has turned full circle and another boom in VHF/UHF activity has arisen — but where are the newletters for the enthusiast?

6UP returns! The all-new, singing-dancing, lemon-fresh, fully-revived 6UP is to reappear as a quarterly, beginning with a bumper issue in March. It will be published by Andrew Kay VK2YLA, of Teknidata Services, with Roger Harrison VK2ZTB as Consulting Editor.

The first return issue will have 'Antennas & Propagation' as its theme, covering moonbounce to meteor scatter, quad-yagis to collinears. Many of the articles are 'classics' from the earlier issues (still much in demand), but there's fresh material, too. Quality production is the aim, with the aid of a word processor and printer, with properly draughted illustrations.

Cover price of the first return 6UP is to be $3.50, plus 90 cents post and handling. Enquiries to **Teknidata Services, PO Box 844, North Sydney, NSW 2060.**

LOS RADIOS

AWA has just released the RMA 900, a microwave, analogue, line of sight (LOS) radio system for carrying telephone, telex, television, data and other communications signals in rural and outback areas.

AWA says the RMA 900 is ideal for mining companies and other organisations needing reliable communications over long distances in country locations. LOS systems can transmit signals over distances stretching thousands of kilometres.

Telecom has initially ordered 200 of the radios, mainly for transmitting telephone communications in the rural areas of several States.

Each of the RMA 900 radio systems carries up to 72 telephone channels and has 1400 frequencies in the 820 to 960 MHz band.

AWA is manufacturing two versions of the 900. The basic model consists of a receiver, transmitter and a diplexer or signal separator connecting the transmitter and receiver on to one antenna.

This model is an unprotected terminal radio so if the signal fails, 'in-the-field' repairs must be made to restore communications.

But the protected terminal version has two receivers and transmitters. If the main transmitter or receiver fails, the second transmitter or receiver automatically switches over to continue the transmission.

Unlike its previous LOS systems, the 900 can have its frequencies changed by simply opening up the modular cabinet and flicking the switches inside.

On other LOS radios, replacement quartz crystals are needed when tuning to a new frequency.

For further information contact **Amalgamated Wireless (Australasia) Ltd, North Ryde Division, Cnr Talavera and Lane Cove Rds, North Ryde NSW 2113. (02)887-7111.**

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MULTIMETER (FANTASTIC)

- Fuse/diode protected
- 4mm Banana socket probes!
- Bifurcated selector switch contacts!
- ABS impact-resistant case!
- Large! Measures 90(w)x135(h)x45(d)mm

SPECIFICATIONS:

DC	AC
0 - 0.25	0 - 10
0 - 10	0 - 50
0 - 50	0 - 250
0 - 250	0 - 1000
0 - 1000	
20,000 ohms/V	9,000 ohms/V
RESISTANCE	DC CURRENT
0 - 5k	0 - 0.05
0 - 50k	0 - 25
0 - 500k	0 - 250mA

dB -20 to +22dB
BATTERY CHECK FACILITY - AA, C & D CELLS
Accuracy DC ±3% F.S. - AC ±4% F.S. OHMS ±3%
BANANA PLUG PROBES AND BATTERY INCLUDED
This is an unbelievable meter bargain. Normally this unit would sell for around $25. Japanese made quality.
Cat. QM-1005

NORMALLY $17.95
THIS MONTH
$14.95
SAVE WELL OVER 10%

LOW COST HI FI
SAVE $5 - A FURTHER 20%

Each kit contains a massive 10" (250mm) woofer, cone midrange and DOME tweeter!! You also get, at no extra charge, the special crossover capacitors!
The system is rated at approximately 20 watts RMS so it is ideal as an economical but reasonably powerful main Hi Fi unit or as a second system for another room or outdoors.
Each 3-way kit comes with a recommended enclosure design which you can build yourself easily!
You would normally pay well over $60 for the equivalent from major kit speaker suppliers so this is an outstanding bargain.
Sensitivity of the system is 93dB/1m/1 watt.
Cat. AK-3700

3-WAY SYSTEM NORMALLY $24.95 a set NOW $19.95

Woofer not to same scale as other components

AMAZING VALUE
2 SETS FOR STEREO (6 spkrs)
NORMALLY $39.95
NOW $34.95

UHF AMPLIFIER SENSATION

AMATEURS PLEASE NOTE!
UP TO 25% OFF!!
SAVE A FURTHER $10!
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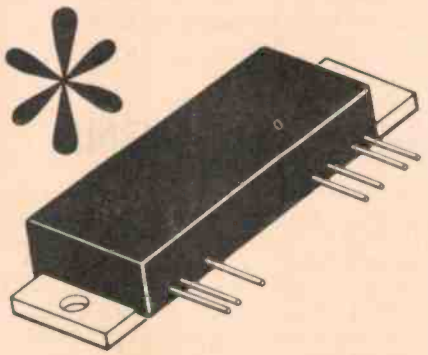
FEB ONLY
$34.95
10 UP PRICE FOR CLUBS
$29.95 EACH



Jaycar has purchased a quantity of genuine Brand New MOTOROLA Brand MHW-710-1 UHF Power Amplifier modules. These units are designed for industrial and commercial FM transmitters!
The unit (pictured) is a rugged, tuned train of RF Power Amplifier transistors featuring thin film gold metal metallization, laser trimmed Nichrome resistors and MOS capacitors. The MHW-710-1 bolts to any flat surface (metal) to assist heat dissipation.
SPECIFICATIONS:
- RF power out @ 12.5V 13 watts - RF power out @ 15V 17 watts!! (Both of the above ratings are likely to be exceeded as Motorola's power ratings are conservative)
- 19.4dB (Min) power gain. Typical drive level to full power 90-150mW
- Frequency band 400-440MHz. Will work to 450MHz and therefore covers the AUSTRALIAN UHF AMATEUR BAND!!
- Circuit diagrams included.

Each MHW-710-1 comes individually packed with full manufacturers data. A manufacturers recommended circuit is included (only a few external components required), as well as a PCB pattern for the circuit. This component makes an ideal base for a "Home Brew" UHF Linear Amplifier! GREAT for UHF Mobile!

SERVICEMEN
The MHW-710-1 has been used extensively in Australian manufactured UHF Mobile 2-way radios. If you own or service a UHF radio that uses this part, now is your chance to grab a spare at an unrepeatable price! The MHW-710-1 sells for A$68 plus tax in the USA.

QUANTITIES STRICTLY LIMITED
To be fair to all, we have limited this offer to 2 per person. Jaycar's scoop offers are so successful that usually hundreds miss out. Even at 2 per customer we will probably run out quickly. Be early to avoid disappointment!
Cat. ZK-8882

BT-151-650R

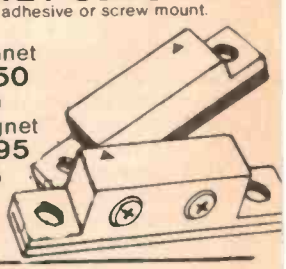
This is the 650 volt version (for extra safety) of the C122E SCR which we use in the popular "Fluorescent Lamp Starter" kit as described in October 1982 EA. Normally $1.50 each. This month only 95¢ each! (Minimum 5 pieces). Makes the Fluoro starter kit very cheap!
Cat. ZX-7022
(PCB's for the kit) Cat. HP-8747 ONLY $1.95)

(3 amp 650V SCR)
ONLY 95¢ each (min 5)

REED SWITCH & MAGNET SETS

Powerful magnet. Self adhesive or screw mount.

N/C Reed & Magnet
Cat. LA-5070 **$2.50**
10 UP **$2.10**
N/O Reed & Magnet
Cat. LA-5071 **$2.95**
10 UP **$2.75**



115 VOLT COMPUTER FANS

We have made a scoop purchase of computer grade Box Fans. They measure a standard 80x80x40mm. But there's a catch! They are only available in 115V! Great if you are making equipment for export to the USA - or use 2 in series! No problem!
Cat. YX-2508

NORMALLY $14.95
THIS MONTH $12.95
SAVE $2.00 OR OVER 10%

TWIN SCREENED AUDIO CABLE

Twin screened round audio cable. (Two screened conductors NOT fig.8)
This cable normally sells for 40¢/metre or $42.00/roll.
Cat. WB-1504

SAVE OVER 50%
ONLY $20 PER ROLL

SCOOP!

FAMOUS XURON BRAND

Quality U.S. made precision plier at a discount price!!
When we were getting these smooth jawed pliers orginally we could not keep up with the demand at $6.95 each.
The importer needed cash and sold us the balance of his stock.
We offer this plier to you for a staggering $3.95!
FEBRUARY ONLY!!
Prices *must* go up when new stocks arrive.
Length 130mm. Max jaw opening 20mm.
Special return spring mechanism. U.S. quality at an Asian price!
Cat. TH-1581
Note the soft-grip (orange) handles!

WAS $7.95
NOW ONLY $3.95
SAVE $4.00!!

UNBELIEVABLE!

FAMOUS XURON BRAND

Same story except more amazing! This time stainless steel precision flush-cutting miniature cutters!!
These normally sell to the trade for $11.95 each *plus tax.*
For FEBRUARY ONLY you can grab a pair for

ONLY $4.95 - LESS THAN ½ NORMAL PRICE

- *Compare with more expensive Asian copies!!*
- *Note the blue cushion grips!*
- *Supplied in individual box*

Cat. TH-1585

ONLY $4.95

DPM-50

$39.95

Cat. QP-5512

DPM-200

$49.95

Cat. QP-5510

LCD panelmeters

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

DPM-200

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

DPM-50

(Not illustrated) 3½ digit display with "plus", "minus" and "low batt". Annunciators with 0.5" readout.
Both units sample at 3/second
If you want to express any physical meaurement in a bright easy to read display these are for you. They contain all analogue-to-digital electronics and LCD drive circuitry. Send SAE for more information.

MICROGRASP

The MicroGrasp 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 in 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 selectable locations.
Control of the MicroGrasp 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 MicroGrasp is supplied as a self-assembled kit. All components down to the last nut and bolt are included, as is the power supply.

COMPLETE KIT INCLUDING POWER SUPPLY..... Cat. XR-1000 **$499**

Universal Computer Interface Board (in kit form) Cat. XR-1010 ONLY $179

23 plus 23 way edge connector at $9.95
ZX81 peripheral/RAM pack splitter board $10.95

CA3005 RF AMP MODULE

This useful device is a complete RF amplifier on a chip.

NORMALLY SELLS FOR $6.95
FEB ONLY $2.95
including full data sheet

Cat. ZL-3805

SAVE $4.00

STANDARD BREADBOARDS

Cat. No.	No of holes	Price Normally	Price Feb
PB-8810	WBDN 100	$3.45	$2.95
PB-8812	WBTN 240	$10.05	$9.95
PB-8814	WB2N 840	$16.95	$15.45
PB-8816	WB4N 1680	$29.50	$26.50
PB-8818	WB6N 2420	$45.00	$39.95

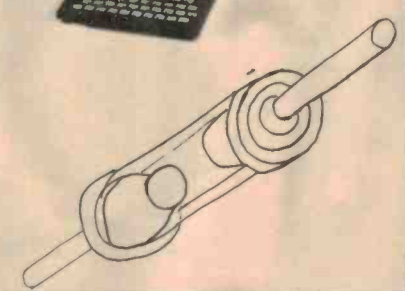
SURGE SUPPRESSOR - THE REAL THING??

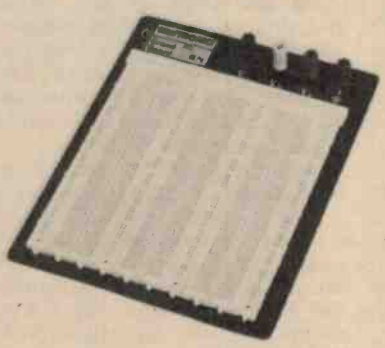
This unit is designed to fit on the low volt side of power supplies. It has the capacity to absorb enormous power transient spikes.

- *Ideal for computer conditioning*
- *Power supplies etc.*
- *Similar (but possibly superior) units sell for around $8*

FEB ONLY - LIMITED QUANTITY

$4.00 Cat. RC-5385





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CHECK OUR CONCORD STORE FOR SATURDAY AFTERNOON TRADING IN FEBRUARY

A beam heading calculator for the DX enthusiast

Neil Duncan VK3AVK

Here's a simple program to calculate beam headings from your location to any other location specified on the surface of the earth. It's written for the VIC-20 but should be readily translatable to other home computers.

ANYONE who owns a beam antenna for listening to or working DX will at some stage need to find beam headings for a particular area of interest. The usual way of achieving this is to refer to a "great circle" map of the world. In developing that map, an assumption was made as to the central point of the map. At the VK3AVK shack, I have found it particularly annoying to find beam headings which are significantly wrong, because the map from which I took the readings were based on Sydney (which is somewhere to the north of Melbourne).

This program, written for the VIC-20, calculates the beam headings which are needed, based on your own location (QTH). The mathematics involved assumes a great circle path between the two points entered into the program. Rounding error, etc, becomes a problem with bearings which are within one degree of multiples of 90 degrees, but otherwise, the results are very good indeed.

Using it

To use the program, you will need to arm yourself with the following information; the latitude and longitude of your own QTH and that of the various places in which you are interested. The best place to find these is probably a world atlas. You probably have one left from your school days. It will likely be full of amusing things that you wrote, however!

The program requires the entry of your QTH co-ordinates. I found mine to be 37°45′ S and 145°14′ E. Obey the following convention: Latitudes which are *North* of the equator are *positive* numbers, those which are *South* are *negative*. Longitudes which are *West* are positive, those which are *East* are *negative*. So those co-ordinates will be entered as

−37,45 (return)
−145,14 (return)

The comma separating the numbers is essential. To check that your program is working properly, Table 1 gives a few results that the program should produce. They are based on the above QTH.

The error due to the number of significant figures used, will become apparent if you calculate bearings and distances to

Out with old — in with new! Now there's no need to fool around with azimuth-equidistant projections (like that below) that are centred on somewhere other than your location (resulting in incorrect beam headings). Use the program opposite and get beam heading printouts directly. Azimuth-equidistant maps (or Great Circle maps, as they are generally called) also have a problem in that it is difficult to find locations around the outer edge (antipodes) where distortion of the outlines is greatest.

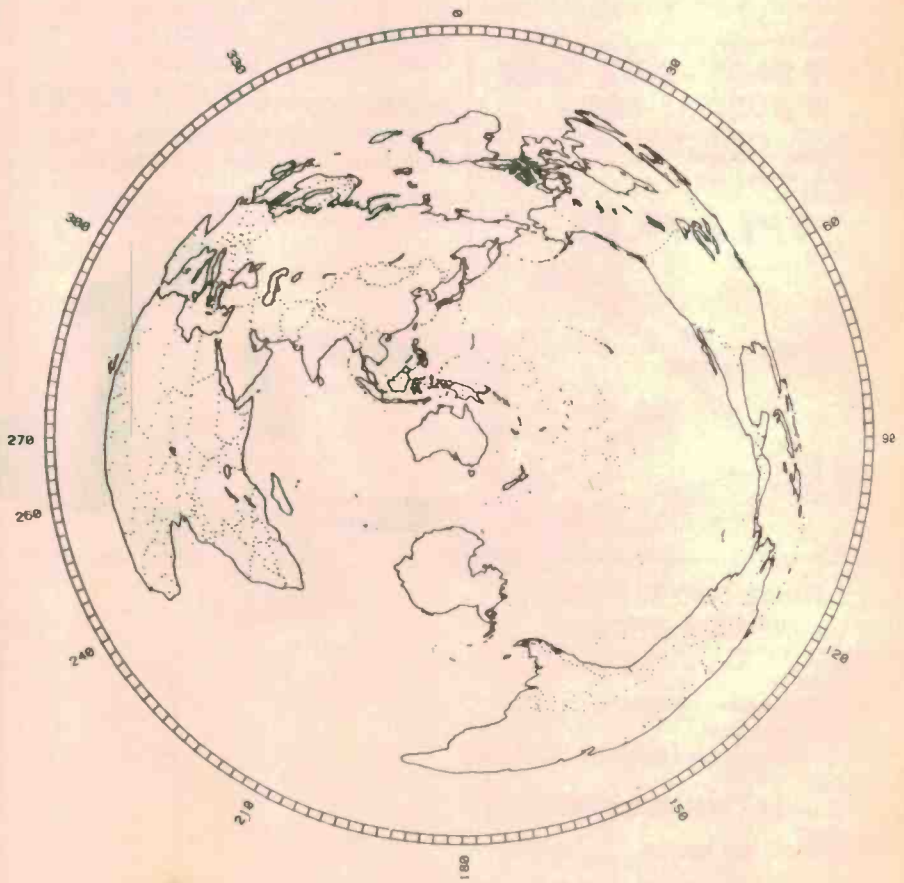

TABLE 1

Place	Latitude	Longitude	Bearing	Distance
Berlin	52,32	−13,25	310°	15984 km
Llullaillaco	−24,43	68,30	148°	12225 km
Leeds	53,50	1,35	316°	16924 km
Mulga Park	−25,50	−131,45	312°	1834 km

places relatively near. VHF operators will need to think further afield. They tend to point their beams up in the air sometimes which won't help, either!

Inspiration in writing this program was gained from an article in *Amateur Radio* magazine (journal of the Wireless Institute of Australia) for April 1982, page 16. ●

```
10  REM GREAT CIRCLES
20  GOSUB 1000
30  DIM A(2,2)
40  FOR I= FL TO 2:FOR J = 1 TO 2
50  PRINT"clear,home,down,down"A$(J)
    B$(I):PRINTC$;
60  PRINT"down(seven times)":INPUT Z1,Z2
    :GOSUB 2000
70  A(I,J)=X1:NEXTJ:NEXTI:FL=2
80  X1=SIN(A(1,1))*SIN(A(2,1))
90 X1=X1+COS(A(1,1))*COS(A(2,1))*
    COS(A(2,2)-A(1,2))
100 X1=SQR(1-X1*X1)/X1
110 X2=ATN(X1):IFX1<0 THEN X2=π+X2
120 D1=6370.15*X2:D2=40212.38-D1
130 X3=SIN(A(2,1))-SIN(A(1,1))*COS(X2)
140 X3=X3/(SIN(X2)*COS(A(1,1)))
150 IF ABS(X3)>.999THEN X3=.999*SGN(X3)
160 X4=SQR(1-X3*X3)/X3:X3=ATN(X4)
170 IF X4<0 THEN X3=X3+π
180 IF SIN(A(2,2)-A(1,2))>=0 THEN
    X3= 2*π-X3
190 IF X3<0 THEN X3=π+X3
200 X3 = X3*180/π
210 X5=X3+180:IF X5>360 THEN X5=X5-360
220 GOSUB 900:GOTO 40
900 PRINT"clear,homeSHORT PATH BEARING"
    INT(X3+.5)"ΔΔΔ(DEGREES)"
910 PRINT"DISTANCE"INT(D1+.5)"KILOMETRES"
920 PRINT:PRINT:PRINT
930 PRINT"LONG PATH BEARING"INT(X5+.5)
    "ΔΔΔ(DEGREES)"
940 PRINT"DISTANCE"INT(D2+.5)"KILOMETRES"
950 PRINT:PRINT"E=END C=CONTINUE";
960 GET Q$:IF Q$=""THEN 960
970 IF Q$="E"THEN END
980 IF Q$<>"C" THEN 960
990 RETURN
1000 A$(1)="LATITUDEΔ-Δ"
1010 A$(2)="LONGITUDEΔ-Δ"
1020 B$(1)="YOUR QTHΔ"
1030 B$(2)="REMOTE QTHΔ"
1040 C$="DEGΔ(COMMA)ΔMINUTES"
1050 FL=1
1060 RETURN
2000 IF ABS(Z1)>360 OR ABS(Z2-30)>30
     THEN FOR L=1 TO 200: PRINT
     "clear,homeBAD DATA":NEXTL:RUN
2010 X1=(Z1+SGN(Z1)*Z2/60)*π/180
2020 RETURN
```

Get the gear for the new tech/school year!

Casio FX-602P Advanced Programmable

The last word in pocket calculators! Programmable scientific calculator ideal for high school and university students, from one of the world's leading manufacturers. Extra thin and will fit in your pocket. Geared to higher mathematics, physics & engineering. 88 memories, up to 512 steps.
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WAS $169
SAVE $30
$139

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Get the most from your FX602P with this brilliant addition. Now you can store data, programs, results etc on a standard cassette recorder with the help of this interface.
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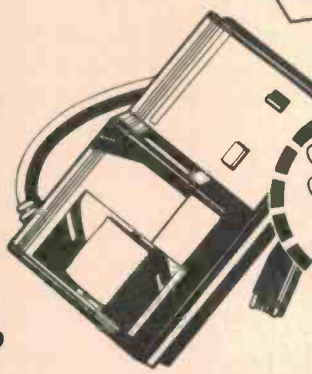

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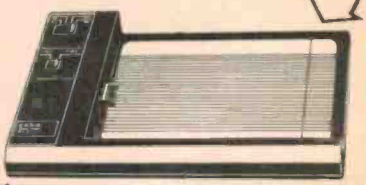


CASIO FX3600P SCIENTIFIC/ PROGRAMMABLE

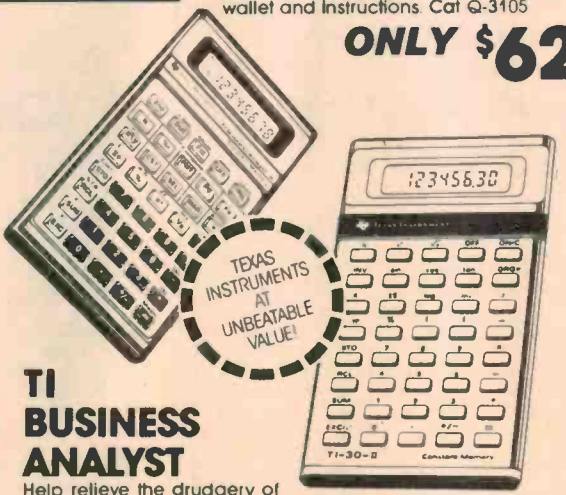
Ready to handle anything you can give it! The ideal calculator for tech. & university students, engineers, technicians and lab. workers. This Casio calculator has the added advantage of simple programmability, plus integrals! It has up to 38 step programming capacity with integrals, regression analysis, 7 memories, 10 digit mantissa and 2 digit exponent. Comes complete with wallet and instructions. Cat Q-3105
ONLY $62.50

CASIO HAND HELD COMPUTER

A brand new hand held computer from one of the world's leading manufacturers. The Casio PB100 – learn as you go computer with VLSI CPU equivalent to 150,000 transistors! With 544 program steps and 94 data memories (expandable). 5 x 7 dot matrix 12 digit display and a standard 53 key keyboard.
Cat X-5110
New model only $79.95

1K RAM PACK

Expands the PB100's memory to 1K, programming to 1,568 steps. A must for the serious user. Cat X-5112
Unbelievable value! ONLY $40



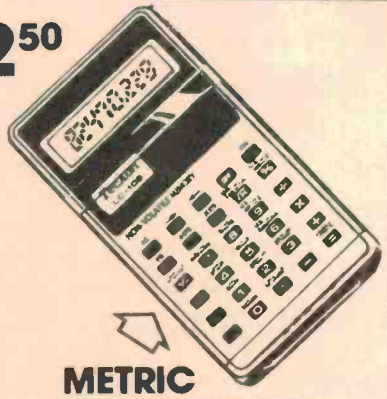
TEXAS INSTRUMENTS AT UNBEATABLE VALUE!

TI BUSINESS ANALYST

Help relieve the drudgery of many complex calculations that can arise every day. This little business analyst (that lives in your briefcase!) can calculate sales tax & price, monthly payment for mortgages, present value of lease without residue, solving for APR, finding yield to maturity on a commercial bond and lots more. As well it's an LCD memory calculator with auto power down, scientific notation and constant memory.
Cat Q-3785
and it's only $57

Slimline TI-30

Look at this for value! There are more features packed into this budget-priced slide rule calculator than most other manufacturers put into calculators that cost twice the price! Features like LCD, constant memory holds numbers in user memory even while it's turned off, automatic power down shuts calculator off after 5-15 minutes of non-use. There is more! Why not check it out at your nearest store? **$23**
Cat Q-3737



METRIC CONVERSION

Still having problems with metrics? Let this superb calculator help you. Pocket sized, LCD, converts imperial to metric and vice-versa. Also does the normal functions.
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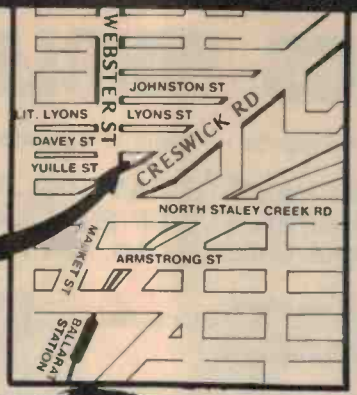
$19.95

Ruler/Calculator & Clock

No student should be without one of these. Inside this 1ft/300mm metric/imperial rule is an accurate LCD digital clock & a full function LCD 8 digit memory calculator. Plus there's the added bonus of a metric conversion table on the rule too! And all this for the price of a clock alone! Cat Y-1057
WAS $19.95 SAVE $5 $14.95

Includes attractive protective pouch at no extra cost!

OPENING THIS MONTH IN BALLARAT (VIC.)



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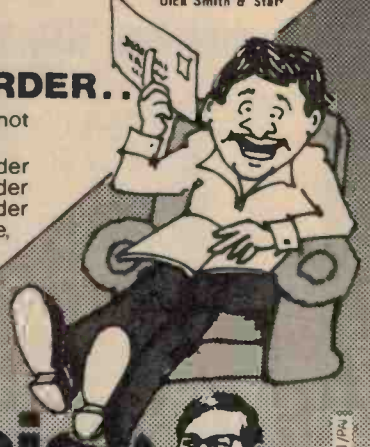

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MD550-16	DSDD 16 Sectors 40 Tracks		51.00
MD577-01	SSDD Soft Sect 80 Tracks		51.00
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FD10-4008	Double Sided, Single Density		59.00
FD10-4015	Double Sided, Single Density		59.00
FD10-4026	Double Sided, Single Density		59.00
FF32-2000	SD FLIPPY FLOPPY		62.00
FF34-2000	SD FLIPPY FLOPPY		62.00
DD32-4000	Double Sided, Double Density	hard sectored	53.00
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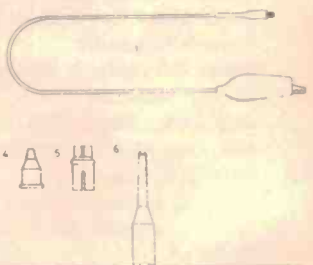

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DREGS

MICRO WAS A real-time operator and dedicated multi-user. His broad-band protocol made it easy for him to interface with numerous input/output devices, even if it meant time-sharing.

One evening he arrived home just as the sun was crashing, and had parked his Motorola 68000 in the main drive (he had missed the S100 bus that morning), when he noticed an elegant piece of liveware admiring the daisy wheels in his garden. He thought to himself, "She looks user-friendly, I'll see if she'd like an update tonight."

Mini was her name, and she was delightfully engineered with eyes like COBOL and a Prime mainframe architecture that set Micro's peripherals networking all over the place.

He browsed over to her casually, admiring the power of her twin, 32-bit floating point processors, and enquired "How are you, Honeywell?" "Yes, I am well," she responded, batting her optical fibres engagingly and smoothing her console over her curvilinear functions.

Micro settled for a straight line approximation. "I'm stand-alone tonight," he said. "How about computing a vector to my base address, I'll output a byte to eat, and maybe we could get offset later on."

Mini ran a priority process for 2.6 milliseconds then transmitted "8K, I've been dumped myself recently, and a new page is just what I need to refresh my disks. I'll park my machine cycle in your background and meet you inside." She walked off, leaving Micro admiring her solenoids and thinking, "Wow, what a global variable, I wonder if she'll like my firmware."

They sat down at the process table to a top of form feed of fiche and chips and a bucket of Baudot. Mini was in conversational mode and expanded on ambiguous arguments while Micro gave occasional acknowledgements although, in reality, he was analysing the shortest and least critical path to her entry point. He finally settled on the old 'would you like to see my benchmark subroutine', but Mini was again one step ahead.

Suddenly she was up and stripping off her parity bits to reveal the full functionality of her operating system software. "Let's get BASIC, you RAM," she said. Micro was loaded by this stage, but his hardware polling module had a processor of its own and was in danger of overflowing its output buffer, a hang-up that Micro had consulted his analyst about. "Core," was all he could say.

Micro soon recovered, however, when she went down on the DEC and opened her device files to reveal her data set ready. He accessed his fully packed root device and was just about to start pushing into her CPU stack, when she attempted an escape sequence.

"No, no!" she piped. "You're not shielded."

"Reset, baby," he replied. "I've been debugged."

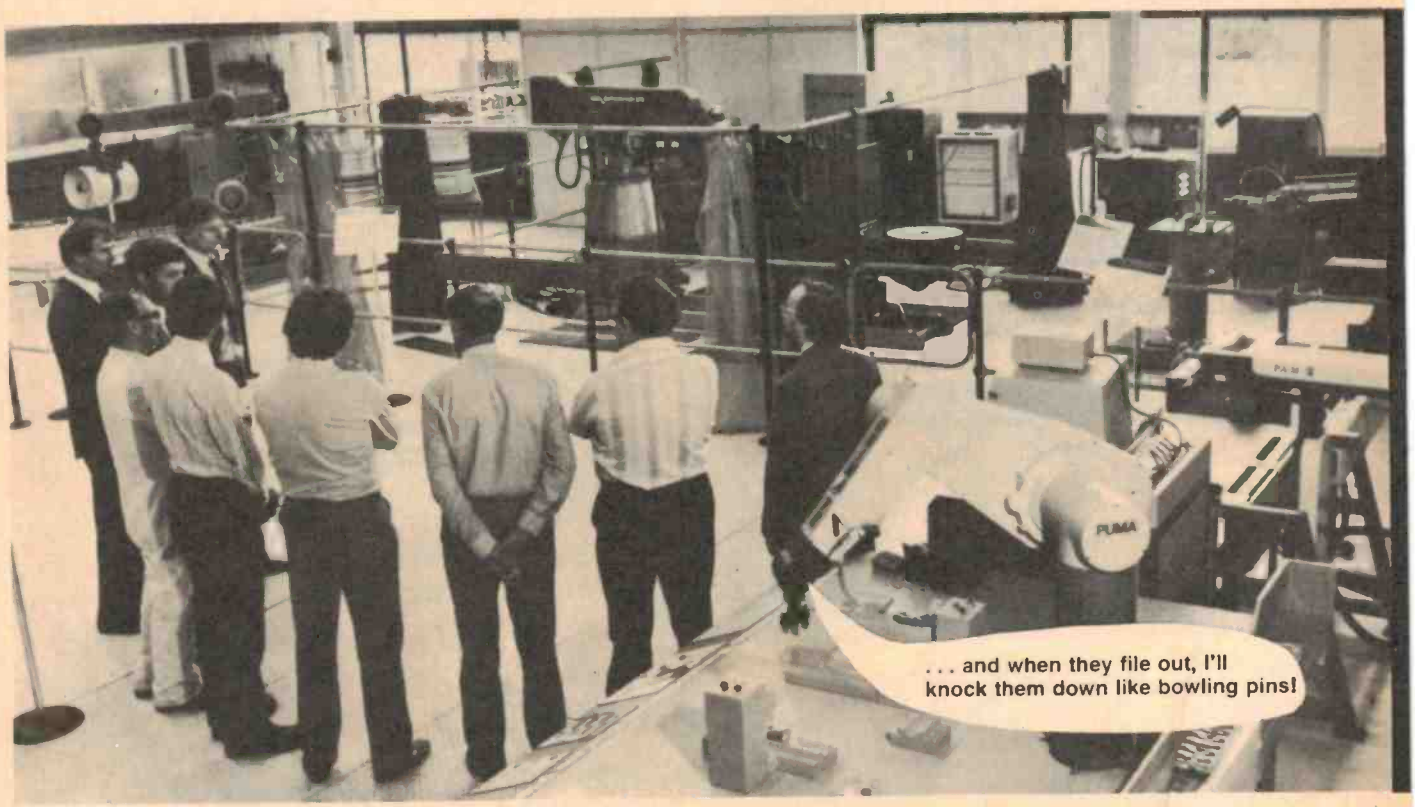
"But I haven't got my current loop enabled, and I can't support child processes," she protested.

"Don't run away," he said, "I'll generate an interrupt."

"No that's too error prone, and I can't abort because of my design philosophy."

Micro was locked in by this stage though, and could not be turned off. But she soon stopped his thrashing by introducing a voltage spike into his mains supply, whereupon he fell over with a head crash and went to sleep.

"Computers," she thought as she compiled herself, "all they ever think of is hex."



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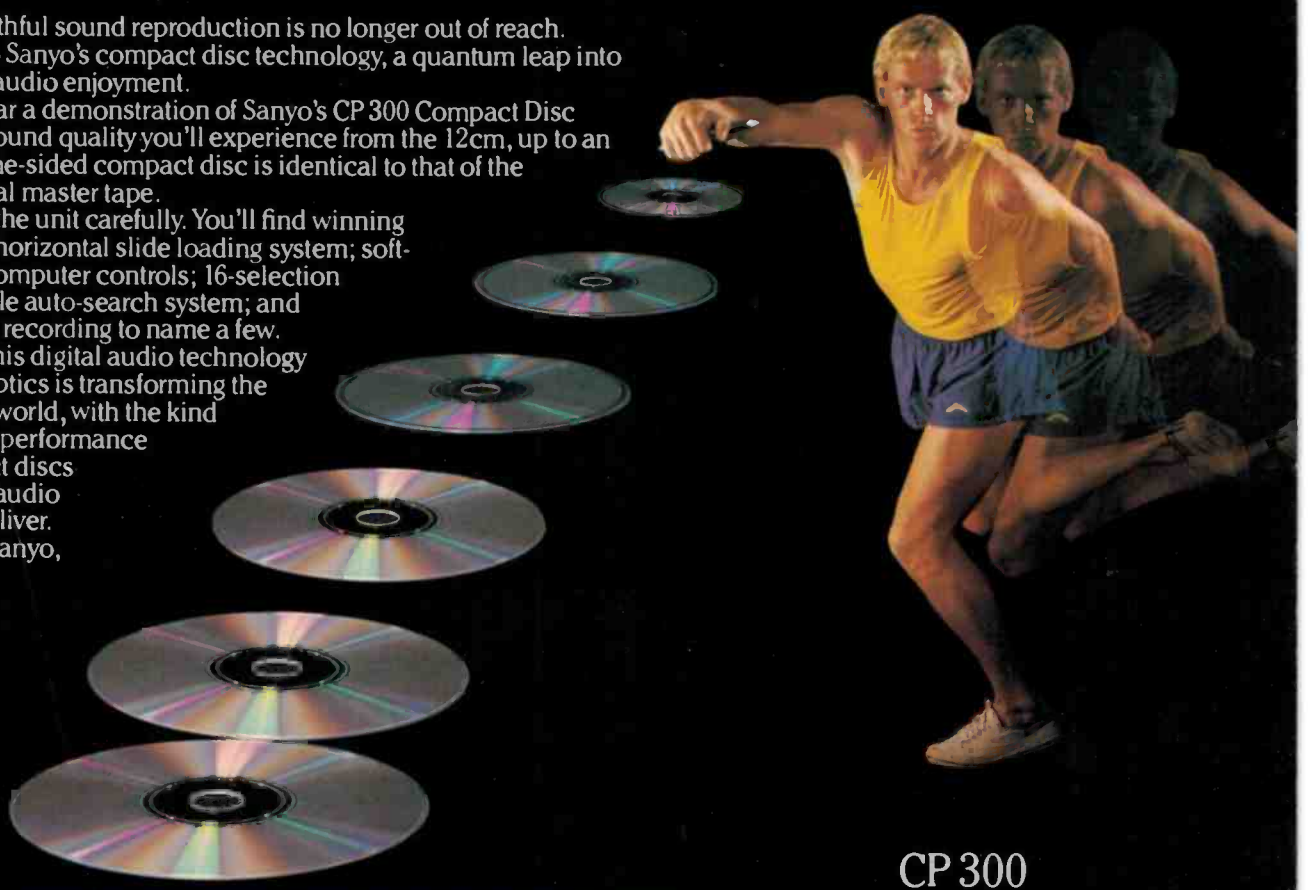

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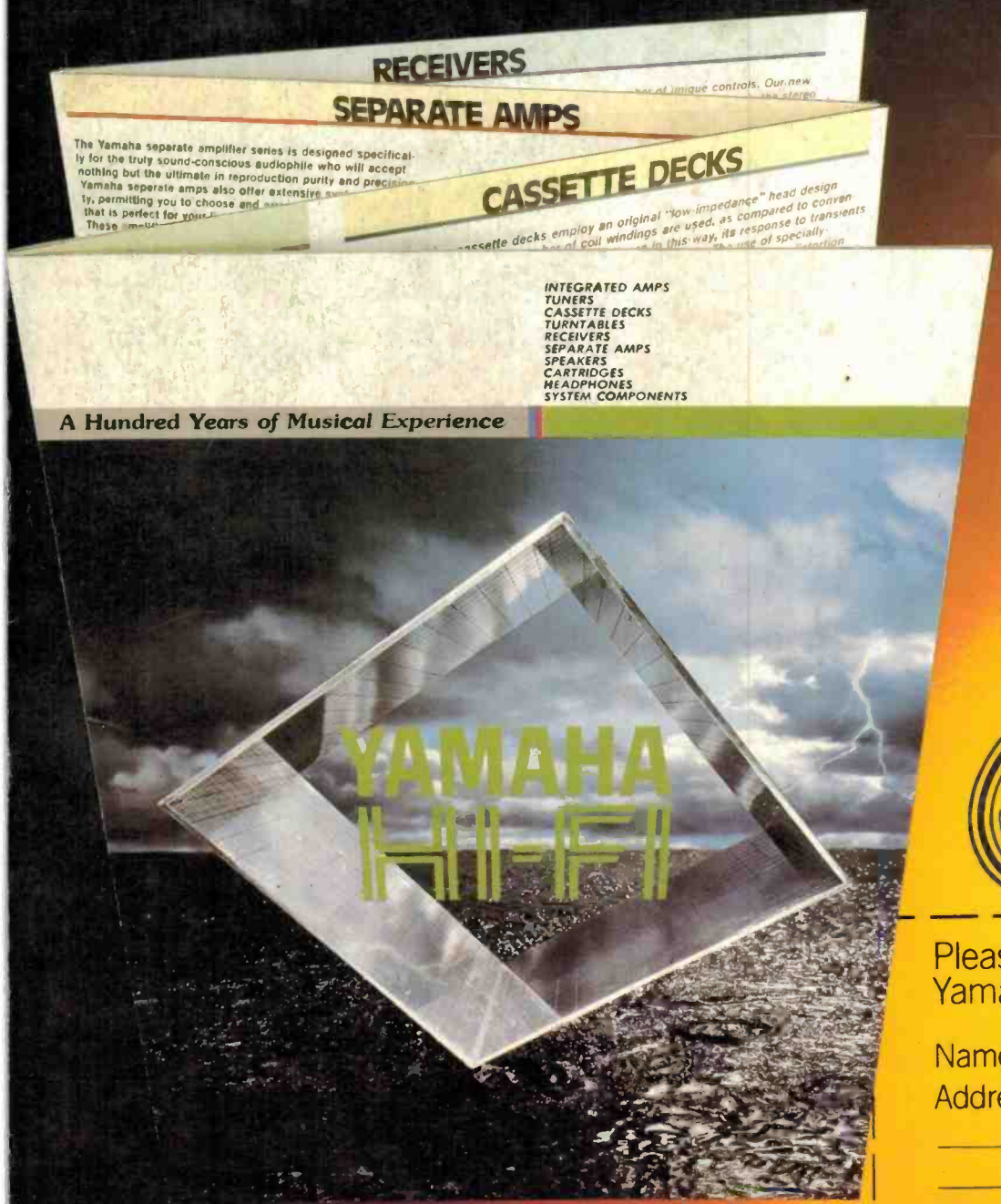

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