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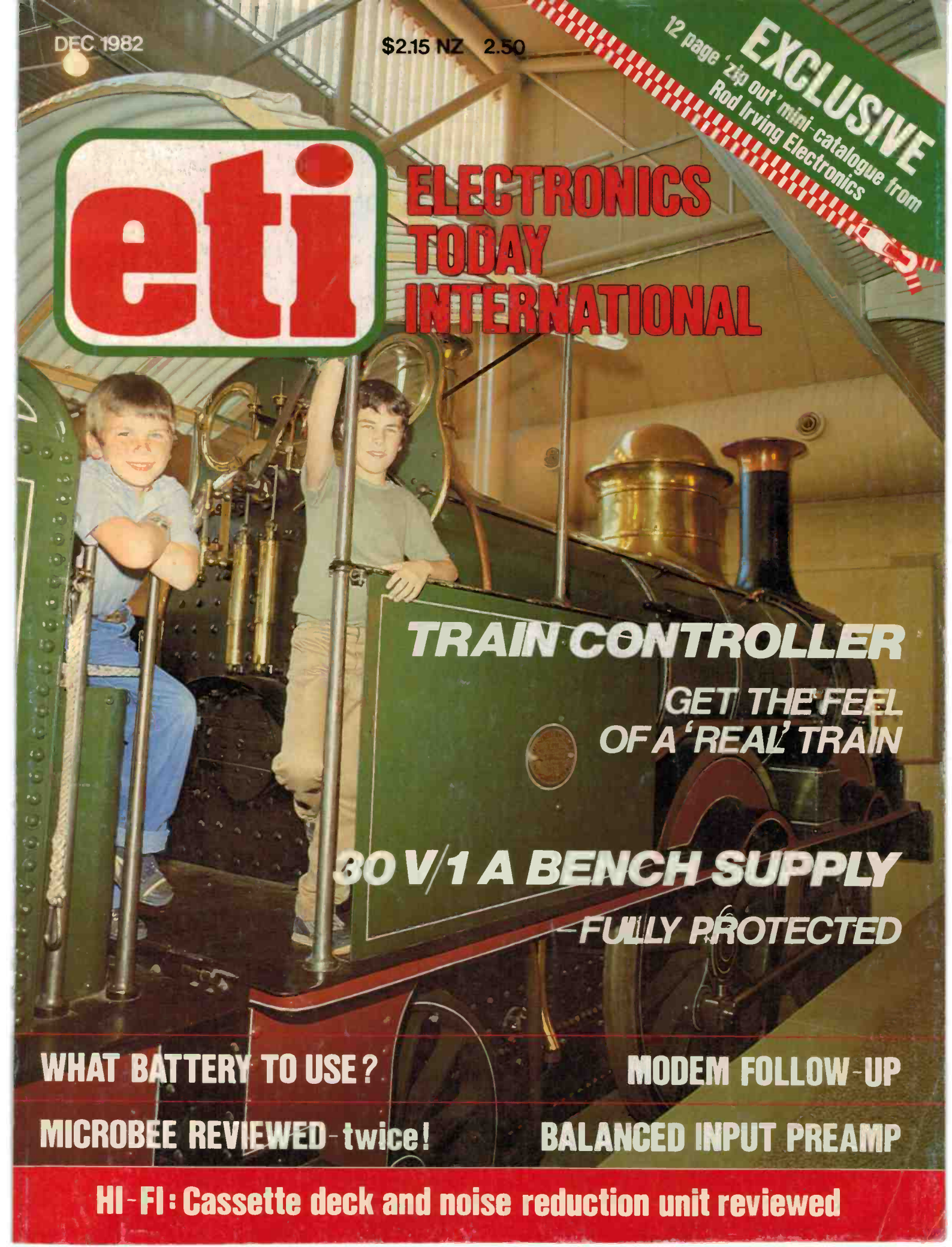
ELECTRONICS TODAY INTERNATIONAL



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WHAT BATTERY TO USE?

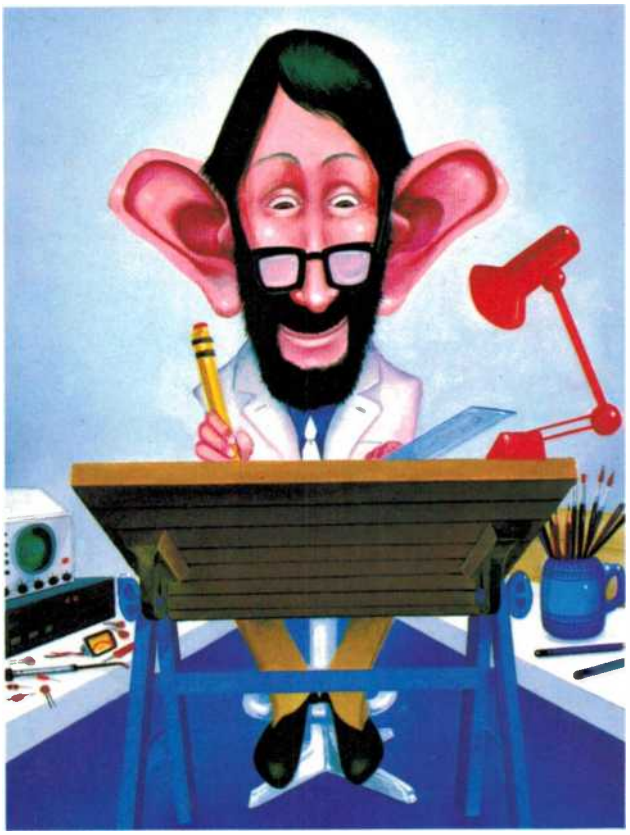
MODEM FOLLOW-UP

MICROBEE REVIEWED-twice!

BALANCED INPUT PREAMP

HI-FI: Cassette deck and noise reduction unit reviewed

The average hi-fi designer versus the human ear.



The human ear forms part of a sound receiving system that outperforms the best audio equipment known to science.

Capable of interpreting a dynamic range of 120db or 10 octaves, it has double the capability of any man made electronic equipment.

The ear can discern direction, coloration and musical within a complex detail rendition of a 50 piece orchestra in a manner no electronic equip ment is able to do.

It is, in short, a sophisticated piece of equipment that should represent the most stimulating challenge to any designer of audio equipment.

Unfortunately it's a challenge that's largely ignored. Which is why in most stereo

systems handling power and volume are substituted for subtlety and frequency response. Vector Research however is one of the few exceptions. Developed by a team of highly experienced audio engineers who were tired of comprom ise, Vector Research represents a new standard in high fidelity excellence.

Discussing the Vector VRX 9000, *Stereo Review* states "The receiver surpassed virtually every one of its performance specific ations... it sounds as good as it looks, which is saying a lot..."

High Fidelity states "a receiver with such sophisticated per formance and functions demands attention." *Popular Electronics* on the Vector VCX 600 cassette deck, "Lower Flutter readings than those of the VCX 600 are hard to find... while not cheap, it affords excellent value." *Hi-Fi Buyer's Review* sums up.

"Vector Research is a newcomer to the audio scene, but if the VCX 600 is any guide, this company should be very successful."

If then you are an audiophile whose interest goes beyond famous names and shiny knobs then you owe it to yourself to learn more about Vector Research.

Dear V.R., In my book, beauty is in the ear of the beholder. Send me the test reports and the name of my nearest stockist.

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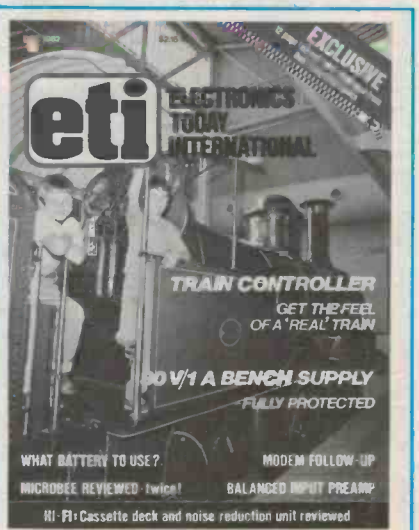

It's a 'real' train! Engine No. 1, now residing in Sydney's Power House Museum was almost Australia's first passenger train loco (it got pipped at the post by a Melbourne outfit). Jamye and Corey Harrison are still deciding whether they prefer the real thing to playing with models. We are indebted to the staff of the Power House Museum for permission to photograph Engine No. 1. Photography by John Knight.

Cover design: Githa Pilbrow

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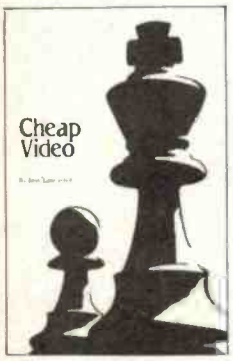

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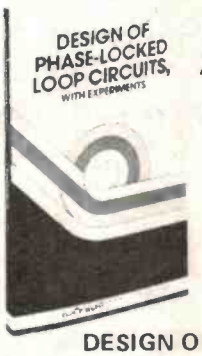

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An excellent introduction to the theory, design, and implementation of Phase-Locked Loop circuits using various TTL and CMOS devices. Useful self study course for the experimenter and for inclusion in college courses on control systems or linear ICs. Includes manufacturers' data sheets and describes the use of breadboarding aids in the wide range of laboratory type experiments. 256 pages 5½x8½, soft.
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As reviewed In Sept. EA page 107

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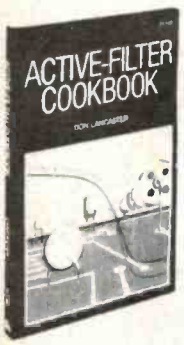

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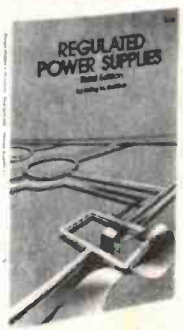

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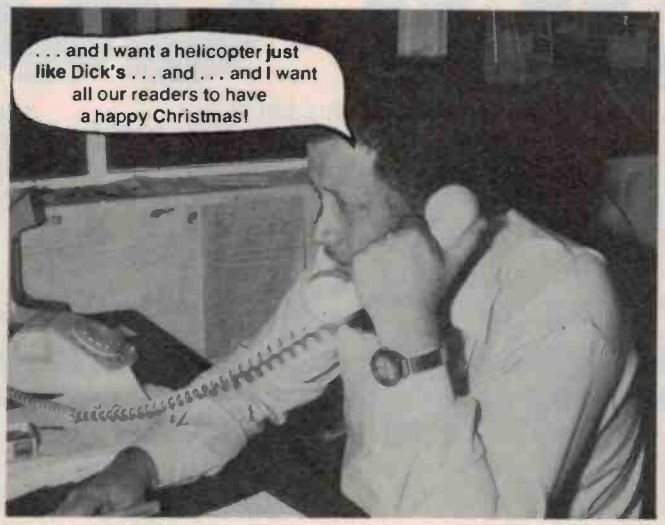

Roger Harrison
Editor

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next month

POLYPHONIC TOUCH ORGAN PROJECT

Held over from December, awaiting parts supply. This project features a 'touch' sensor keyboard on the pc board, full polyphonic capability (you can play chords) and 25-note range. It has loudspeaker output and can be operated from a battery or plugpack. Circuity has been designed to eliminate moisture on keyboard problems.

60 W AMP MODULE WITH TWO N.D.F.Ls

This project is the practical culmination of Professor Cherry's recent two-part series in ETI on Audio Amplifiers Using Nested Differentiating Feedback Loops. This amp has 60 W output and extremely low distortion. Components are inexpensive and readily available.

'AUTO TESTER'

Bamboozled by automotive electrics? This project was developed to make fault-finding in vehicle electrics just that much easier. Simple LED indicators give 'ballpark' readings of voltage and resistance. Simple to build and inexpensive.

MODEL RAILWAY POINTS CONTROLLER

Following up December's train controller, this project operates model railway points solenoids and provides an indication of which way the points are set. Power is only applied to the points solenoid for as long as it takes to close them, using a capacitor discharge system. Solenoid burn-outs are thus avoided.

MICROBEE COLUMN

Starting a regular column for the MicroBee. A not-to-be-missed feature for MicroBee owners. Don't wait, contributions are welcome!

CIRCUIT FILE: ANALOGUE DELAY LINES

Ray Marston goes into the subject of analogue delay lines in depth and follows up with some practical circuits using the TDA-1022 and SAD512. Start hunting up suppliers now.

MORE CHIP 8 PROGRAMMING HINTS AND SOFTWARE

Hints for CHIP 8 Programmers continues in January with some more interesting utility routines plus some you-beaut software.

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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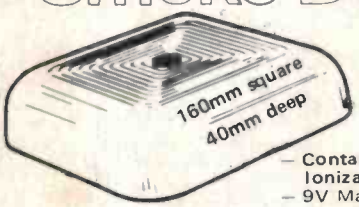

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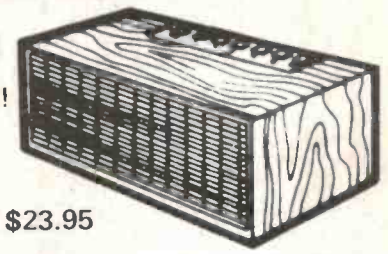

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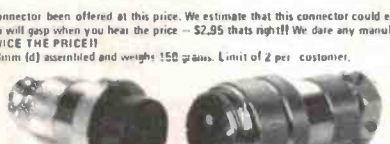
The applications for such a high quality device are endless, but a few. 12V linear amps. Power supplies, Marine connectors or anywhere where you want to disconnect high current, high voltage or both. Even if you have no need for one right at this moment someday you will.
Never before has such a high quality connector been offered at this price. We estimate that this connector could easily fetch $20 if specified by the military. So you will gasp when you hear the price – $2.95 thats right!!! We dare any manufacturer to make this connector in 1000 lots for TWICE THE PRICE!!
Each connector measures 92mm (l) x 28mm (d) assembled and weighs 150 grams. Limit of 2 per customer.



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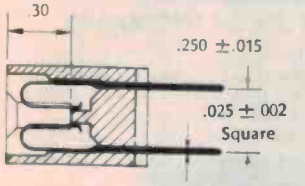

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AS REVIEWED SEPT EA Page 45
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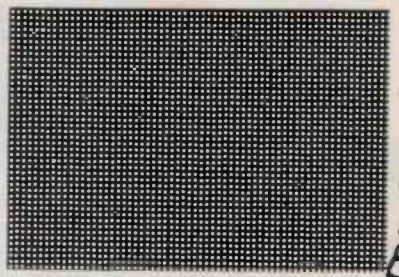
Source: Brisbane river.

$ 2.95



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Model KSN 1038A
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Model KSN 1039A
50 WATT HI-FI
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We have secured a smallish quantity of 5 pin DIN to 4 RCA audio leads that are the wrong side of the Q. C. inspection. Shame though. Because the DIN plug is ALL METAL and GOLD plated. So are the RCA plugs. Problem is that the gold plating is bubbling on the gold DIN plug. (As far as we can see the 4 gold RCA's are PERFECT.) An ordinary NICKEL PLATED lead set like this costs around $4.75. The gold versions normally are around $9.95 You can have one of these for $2.95 and that's better than Nickel any day! Worth it for the 4 RCA's alone!

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AUDAX

The Compact 200 as featured in EA, Sept 82

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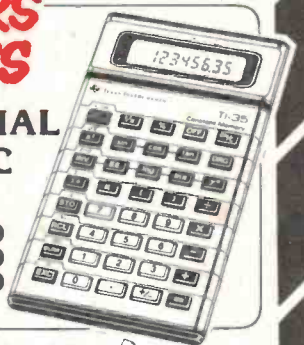

TI-35 Student math kit	$27.00
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4028B	55c	*74LS90	42c	LM555	25c
*4066B	44c	74LS161	53c	LM741N DIP	23c
*4511B	69c	81LS95	87c	LM741 DIP	36c
4520B	74c	81LS98	88c	*74C02	20c
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7414	33c	LM308 DIP	49c	*74C107	30c
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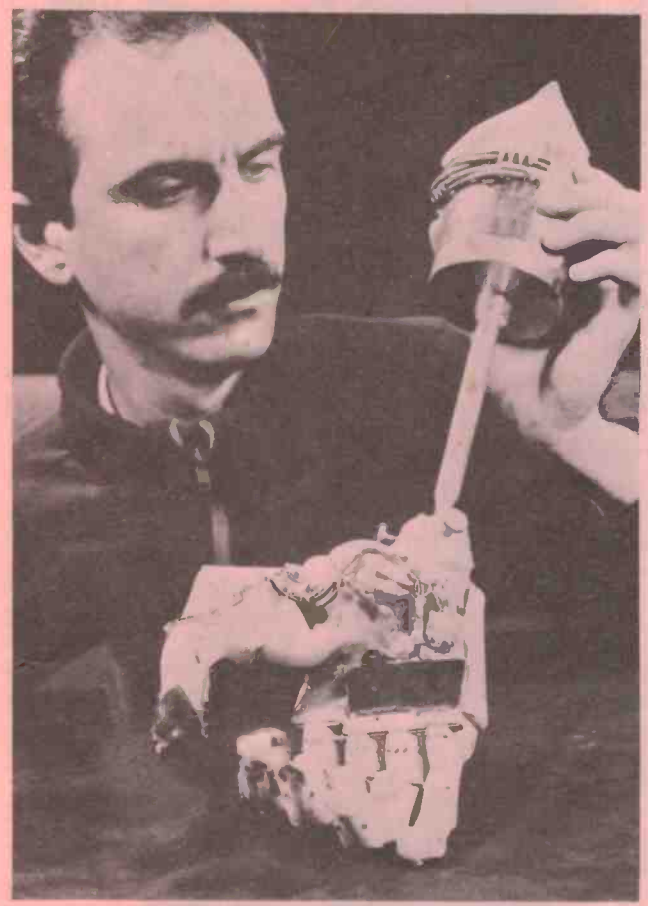
ETI-7

SUPER XMAS BARGAINS AT MAGRATHS

NEWS digest

Take yourself in hand



With the possibility of using your friendly robot as a surrogate human (see 'Dregs' in this issue) it's obvious that its bedside manner could be made more stimulating with the help of some artificial manipulation. Rather handy, don't you think?

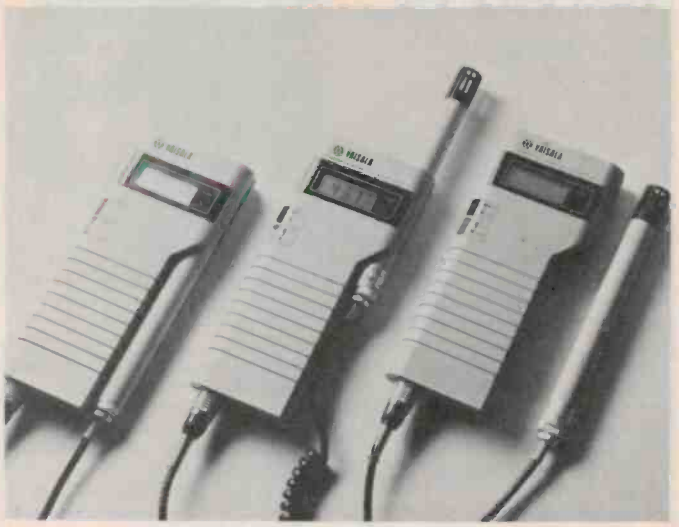
But I'm sure the team at Southampton University in southern England who developed this artificial manipulating hand envisaged it being used in a more orthodox manner. Microelectronics is now within easy reach for people who have had one or both hands amputated. The hand can differentiate between a ball of wool and a steel block and is so sensitive that it can even pick up a cigarette.

Controlled by a small computer worn on a belt and powered by a rechargeable battery, the moulded plastic fingers and thumb can all be moved individually and the hand can be formed into 14 different shapes from first grips to precision grips. For the first time, amputees will be able to handle assembly work, such as screwing a nut onto a bolt.

Inside the palm are four tiny motors, complete with tiny gearboxes and brakes, that drive the fingers and thumb. Sensors on the hand send signals to the electronic control box, which in turn makes the decision as to what shape to form the hand and what force to apply.

Weighing only 540 gm, the hand operates very naturally. The sequence in which the fingers curl is correct, as is the way certain fingers stay out of the way when not in use — for example, when picking up a teacup with forefinger and thumb.

The result of 12 years work at the University's electrical engineering department, the hand will shortly be passed to a limb manufacturer in the grounds of Queen Mary Hospital, Roehampton, one of the major limb-fitting centres in Britain, where it will be put into production. This handy device is not yet in commercial production.



Digital humidity meter

A new hand-held meter from Vaisala provides fast measurement and display of humidity from 0 to 100% RH and of temperature from −40 to +115°C.

The indicator, designated HM1 31, has a 3½ digit LCD display to show the parameter selected with a push button on the side of the meter.

Humidity is measured by a HUMICAP sensor which is based on capacitance change in a polymer thin film capacitor. Temperature is measured by a Pt 100 element.

Both sensors are mounted in the tip of the HMP 31 UT probe producing a millivolt output which is linear from 0 to 100 mV corresponding to 0 to 100% RH. The indicator is powered from a standard 9 V dry cell battery.

Vaisala is represented in Australia by Paton Electrical Pty Ltd, 90 Victoria Street, Ashfield NSW 2131.

Professional series of audio input transformers

Designed and manufactured in Australia by Selectronics, the TAI range of audio input transformers is suitable for input levels of −30, −10 or +18 dBm.

Series TAI 261, 262 and 263 (−10 or −30 dBm) have an output impedance of 600R, 15k and 30k respectively and an input impedance of 600R CT. Frequency response is ±1 dB from 20 Hz to 20 kHz and THD is less than 0.4% at 30 Hz and −10 dBm. They are packaged in a Mumetal can with single bush mounting, flying leads and electrostatic shield.

TAI 541 and 542 (+18 dBm) have an output impedance of 600R and 15k respectively and an input impedance of 600R. Frequency response is ±0.5 dB from 20 Hz to 20 kHz. THD is less than 0.35% at 30 Hz and 18 dBm. This series has an electrostatic shield, open clamp mounting and flying leads.

For further information contact Selectronic Components Pty Ltd, 25 Holloway Drive, Bayswater Vic. 3153. (03) 762-4822.

New Faces at ETI

Geoff Nicholls, Project Engineer

Geoff is an Orangeman (i.e: born in Orange, NSW). He commenced a distinguished academic career in Orange then moved on to other learned institutions in Tibooburra, Darwin and Adelaide. An early interest in chemistry (uh, oh . . . another one) led to many explosions, finally culminating in third degree burns to his hand! Exit chemistry. A wise occupational therapist pressed a soldering iron into his hand, scattered a few brightly coloured capacitors and resistors on the floor in front of him and said, "Play with those!" On completion of his first superheterodyne passive-state wideband tuner and mixmaster he decided an engineering degree would be the thing to do.

Settling eventually in Sydney, Geoff entered Sydney University. They tried to stop him but he burst through by putting money in their hand. Or maybe it was just that he enrolled in chemistry and they put him in electrical engineering for their own good.

Following a string of good grades in his early university years (continuing that distinguished academic career), Geoff managed to convince a few mates (delete 'vince' and you'll be closer to the truth, his mates say) to do the extra year's work and obtain a science degree as well. Caught up in the rush, they all breezed through the science year, majoring in Physics, Mechanics of Collisions of Elastic Objects (i.e: pool) and Fluid Mechanics (using beer as the main test medium).

Back in engineering, Geoff and cohorts found those lectures following fluid mechanics prac. sessions were much more easily digested, following the student trend since Shakespeare was a lad (i.e: four out of five took an extra year).

About this time Geoff shifted to living in the fast lane and indulged a voyeuristic interest in the mechanics of objects accelerating through a fluid, known to the cognescenti as 'drag boat racing'.

As a budding engineer (he's having hormone treatment for this problem) he couldn't resist measuring things so built up a set of timing equipment using modulated lasers to shoot across rivers to measure and display terminal velocities of the boats. The system was used in the recent World Water Ski Speed Record run by Grant Torrens on the Hawkesbury River at Windsor, NSW. That effort made it into the Guinness Book of Records, but Geoff didn't.

Geoff completed his B.Sc./B.E. in 1981 and intended to further his interests in fluid mechanics for six months or so. But, fate took a hand when a friend pointed out a job advertisement from ETI in the paper. Being quite unable to resist the opportunity to practise his hobby and be paid for it, Geoff presented his credentials. Despite that, he got the job and the fruits of his labours can be seen in ETI.

Star sign: Virgo (the water carrier, hence the consuming interest in fluid mechanics).

Beliefs: Hard science (things you can measure).

Likes: Tooheys Old, Sydney Draught, Guinness, Coopers ales and stouts, . . . etc, hot beef curries (from Sydney's famous Sri Lanka Room), cooking Chinese, digital electronics and hot Toranas.

Dislikes: Audio fanatics who argue ad nauseum about capacitors in the signal path, most Japanese cars (they get in the way of Toranas) and 'para' science.

Quote: "Whose shout is it?"

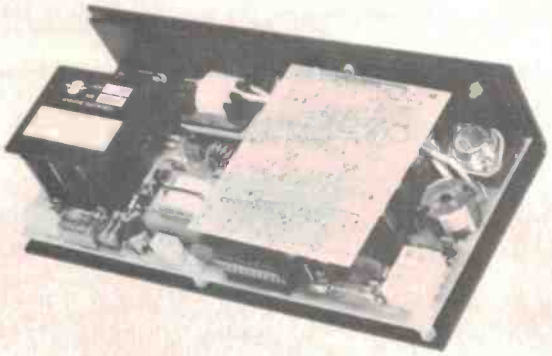
Rifa distribute Spectrum Control products

Component distributor Rifa recently announced the availability of the Spectrum Control range of EMI/RFI filters and shielding materials.

Products in the Spectrum Control range include hermetic seal filters and capacitors, resin seal filters and capacitors, connector contact filters, multi circuit filters, knitted wire shielding gaskets, EMI-proof ventilator panels, variable capacitors and many other products designed to solve electro-magnetic interference problems.

Applications for the Spectrum Control product range include communications, data processing, medical and scientific instrumentation and military.

For further information contact Mr. W. Scott, Rifa Pty Ltd, 202 Bell Street, Preston Vic. 3072.(03)480-1300.



Four rail switch mode supply

Australian power supply designer and manufacturer, Scientific Electronics, have released the latest model in their switch mode series of high efficiency power supplies.

Designated SM130AD2, this new, low cost power supply has four output rails from which a total of 115 watts can be drawn. There are two standard models and a 'custom' model which allows the OEM or microprocessor designer to specify his own output rails.

The standard output rails are +5.2 V at 10 A, +12 V at 1 A, −12 V at 1 A and 24 V at 2 A floating rail. The second standard model has a 20 V at 2 A floating rail.

All outputs are short circuit protected and the +5 V and +12 V outputs have overvoltage protection. A DCLO signal is available to warn logic of an impending supply rail failure making this supply ideally suited to microprocessor based systems.

The SM130AD2 carries a five year guarantee. For further information contact Mr. Peter Lloyd, Scientific Electronics, 6 Holloway Drive, Bayswater Vic. 3153. (03)762-5777.

Setting up a graphic equaliser?

Technics late this year released a graphic equaliser test generator/meter which they dubbed an 'Audio Frequency Analizer', model SH-8000.

The unit incorporates a special 31 channel 'warble' (narrow sweep) tone generator covering the 20 Hz to 20 kHz range and a calibrated microphone and meter.

The generator covers one-third octave channels in one-third octave steps, sweeping across each channel to provide a signal that can be integrated across the whole channel. A switch is provided to protect tweeters when using the generator above 10 kHz.

In use, the generator is coupled to the system input and the microphone set at a suitable position in the listening room. The generator is then switched through each channel and the graphic equaliser controls adjusted to produce the same reading on each channel.

A fast/slow meter response switch is provided and the meter level range can be set to 50, 60, 70, 80 and 90 dB.

The instrument is battery operated. Further details from Technics, 95-99 Epping Rd, North Ryde NSW 2113.

Tandy Electronics releases new catalogue for 1983

Tandy Electronics will give away half a million copies of its new 1983 catalogue. It is available at no charge from over 320 Tandy stores, computer centres and participating dealers throughout Australia.

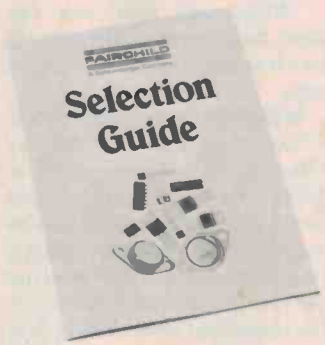
Inside the 166 page catalogue Tandy has included a comprehensive product index, store and dealer address list, details on quantity prices, charts for adaptors, styli and batteries, plus a mail order form for shop-at-home convenience.

Tandy has packed nearly 2500 products and brands such as Realistic, Radio Shack, TRS-80, Archer, Micronta and Science Fair into each store. Each Tandy store is filled with microcomputers and accessories, home stereos, car sound equipment, calculators, clocks and radios. They also stock a diverse range of electronic games, kits and toys, intercoms, CB, public address and security systems, telecommunication products and TV antennas, plus tools, hardware, electronic parts and accessories.

Fairchild selection guide

A short form selection guide, from Fairchild Australia, is available 'free of charge' from their distributors.

The 28 page guide covers a majority of Fairchild products including TTL, MOS, CMOS, voltage regulators, linear microcomputers, diodes, transistors, optoelectronics, liquid crystal displays and fibre optics. Also in the list are the ECL and CCD families.



Your free copy is available from George Brown and Co. in Camperdown and Newcastle NSW, Fyshwick ACT and Collingwood Vic; Protronics in Adelaide SA and Vic. Park WA; Ellistronics in Melbourne Vic; RIFA in Preston Vic, Hurstville NSW and Brisbane Qld; Reserve Electronics in Perth WA; ECQ Electronics in Jindalee Qld; David Reid in Birkenhead NZ.

Magraths move to new premises

After 43 years at 208 Little Lonsdale St, Melbourne, J.H. Magrath, supplier of electronic components and products, is moving to bigger and brighter premises at 55 A'Beckett St, Melbourne. This change is effective from November 1, 1982.

In 1939 Mr. Jim Magrath brought the company from C.P. Embolten & Co. In 1962 Jim Magrath sold his interest to John Gunn and John Watson and in March this year Rifa took over control at J.H. Magraths.

The shift to 55 A'Beckett Street, with the introduction of new products and new floor layouts will make it easier for the customer to do business with Magraths.

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NEWS digest

Sun sets on position of Government Astronomer

It's the end of an era for those on Observatory Hill. William Robertson, who has held the post of Government Astronomer for the last eight years, retired in October. He was the last Government Astronomer as the work has now been taken over by the Museum of Applied Arts and Sciences.

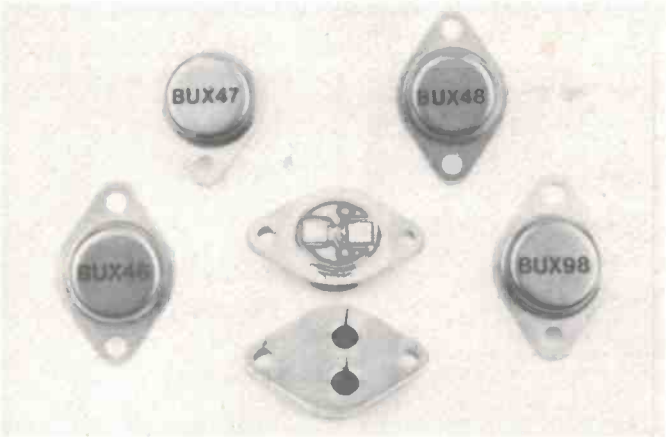
"While they take over our work, their records will really only be of museum value," Robertson says.

William Robertson first went to Observatory Hill as Assistant Government Astronomer in 1942. "My biggest regret is that work at the Observatory will be scaled down," he said, "Our job here is to provide information on the rising and setting of the sun, the moon and other planets. This information is published in newspapers and put in our records. Sometimes we have to supply solicitors and insurance companies with details on the time of sunset — they use this information to build up a more accurate picture of what really happened in a particular traffic accident."

In 1975, Robertson, a science graduate from the University of Sydney, ended his 33-year apprenticeship when the then Government Astronomer, Dr. Harley Wood, retired. During his term in office, Mr. Robertson and his staff gave lectures on astronomy at the Observatory to high school and tertiary students. Lectures were also open to the general public.

Observatory Hill has been a busy point of observation since it opened in 1858. Since 1890, night-time photographs of the sky above Sydney have recorded the position and movement of planets and stars. "We send the results to other observatories around the world. It helps us build up a better picture of outer space," Robertson said.

Long before the Harbour Bridge was built, Observatory Hill was used as an aid to maritime navigation. "In the old days ships were usually at sea for up to four months, and when they reached Port Jackson they had to check their chronometers," Robertson explained. "As soon as they rounded Bradley's Head they could see our time ball and correct their longitudinal readings. Of course, they don't do this any more, but we still operate the time ball for historical reasons."

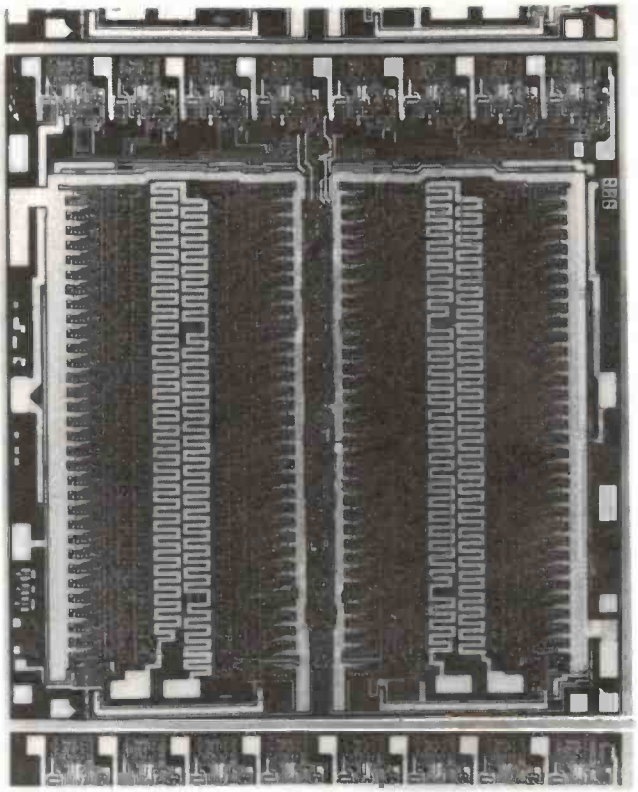


Silicon-diffused transistors

The BUX46, 47, 48 and 98 high-voltage, high-speed transistors, now available from Philips, can be used as converters, inverters, switching regulators and motor control systems.

These transistors have a peak collector current rating of 5 to 60 A, and a maximum power dissipation of 85 to 250 W. The maximum collector-emitter voltage is 850 V. 'A' versions of the transistors (with maximum collector-emitter voltages of 1000 V) are also available.

The transistors are glass passivated, and are supplied in a TO-3 envelope. For further information contact Elcoma, 67 Mars Road, Lane Cove NSW 2066. (02)427-0888.



Japanese semiconductor data manuals

Data manuals for Japanese semiconductor devices are now available from Imark Pty Ltd, 167 Roden Street, West Melbourne. 3003. (03) 329-5433.

The 1982 manuals are:

'The Transistor Manual' lists all 2SA, 2SB, 2SC and 2SD devices and their characteristics.

'The Transistor Substitution Manual' lists equivalent Japanese transistors for 2SA, 2SB, 2SC and 2SD transistors.

'The Diode Manual' provides specifications and package details for Japanese diodes.

'The FET Manual' details specifications and package details for Japanese FETs (2SK, 3SK and others).

'The Op Amp Manual' (Parts 1 and 2) provides detailed specifications and package information.

'The Linear IC Manual' provides technical specifications, and package details.

'The TTL IC Manual' provides technical specifications, package details and lists worldwide manufacturers of the particular device. The manual includes details for 7400 series/74SL series/74S series.

'The CMOS IC Manual' provides technical specifications, package details and world-wide manufacturers for 4000B series, 4500 series, TC5000BP series, TC5000P series, MSM500 series, and TC40H000P series devices.

'The Memory IC Manual' provides technical and package details and has tables of similar devices. Devices covered include Static RAMs, Clocked RAMs, Dynamic RAMs, PROMs, UV-EPROMs, and EAROMs.

Each manual is priced at $9.95 (plus $1.50 post/pack) and the complete set of ten manuals is $89.50 (plus $5.00 post/pack).

Flash converter

Motorola has introduced a monolithic high speed 7-bit parallel flash A/D converter designed to serve the needs of the video, radar, communications and high speed instrumentation markets.

The flash converter, part numbers MC10315L and MC10317L, is claimed to be capable of encoding video speed signals without a sample and hold at conversion rates to 15 MHz. MECL 10K compatability, along with an over-range bit, enables simple interconnection of two devices for expansion to an A/D function with 8-bits of resolution and accuracy.

The MC10315L and MC10317L perform identically in all aspects except for data output coding during over-range.

When an MC10315L is driven into over-range, all data bits remain high, but when the same condition occurs on an MC10317L, the data bits go low. This feature permits direct wire ORing of additional A/D converters to the MC10317L for expansion to greater than 7-bits.

Versatility of the input comparator structure and reference resistor ladder allows analogue input options of unipolar positive, unipolar negative (below ground), or bipolar with accuracy maintained at full-scale analogue signals as low as 1.0 volt peak-to-peak.

Low capacitance loading of only 70 pF at the analogue input reduces the demand on the driving amplifier at high frequencies. In addition, differential phase and gain are low.

Power supplies required are +5 Vdc and −5.2 Vdc with a total power consumption of one watt.

The MC10315L and MC10317L are specified over a 0°C to +70°C temperature range and can be obtained from Motorola Semi Conductor Products, 250 Pacific Hwy, Crows Nest NSW 2065. (02)438-1955.

electronic lay-out made easy

LINEX shows you how

Is electronics your hobby? You will soon find out that you cannot use the prints shown in foreign magazines; in particular because you cannot find components of the design imagined by the maker of the print.

This means that you will have to re-do the drawing and this is highly facilitated by using a P.C.B. Design Template.

First, draw in pencil a sketch layout, showing the positions of the components, the terminals, and the conducting paths — using the 1241S. Then redraw your layout, using ink, on a tracing foil.

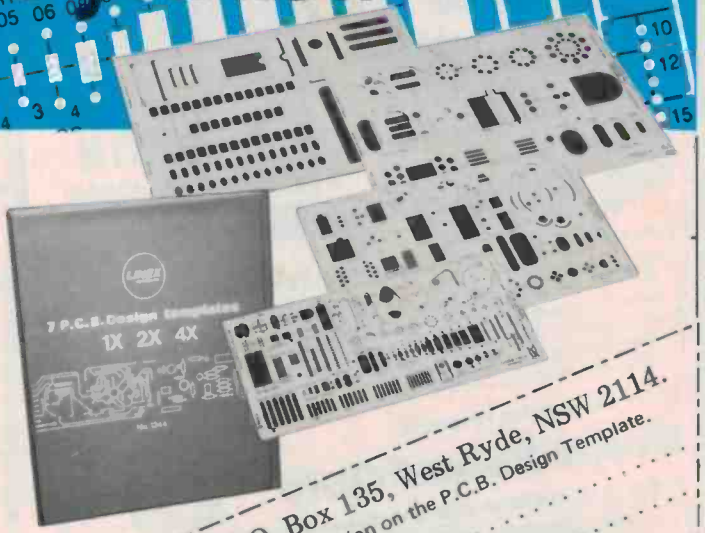
The P.C.B. Design Template is provided with ink bosses, which prevent the ink from blurring the lines below the template during the tracing.

The drawing, thus completed, can be used directly for copying on a photo-print-plate. Place the side with the inked lines against the emulsion-side of the print, and use UV-lamp for copying.

This procedure prevents the inked lines from "burning out" during the exposure.

For development, etc., use the specified developers, etc.

Electronic templates are available from Jaycar



JASCO PTY. LTD., P.O. Box 135, West Ryde, NSW 2114.

Please send me further information on the P.C.B. Design Template.

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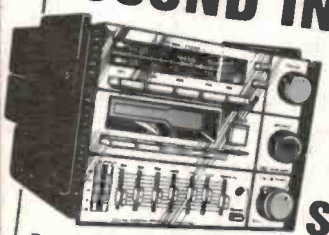

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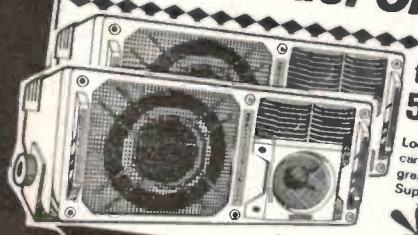

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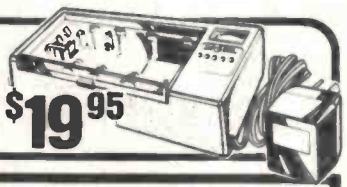

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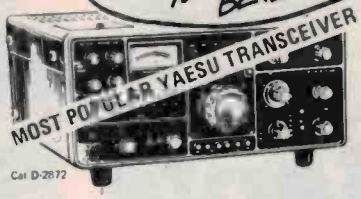

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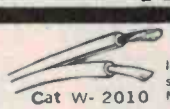

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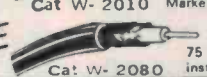

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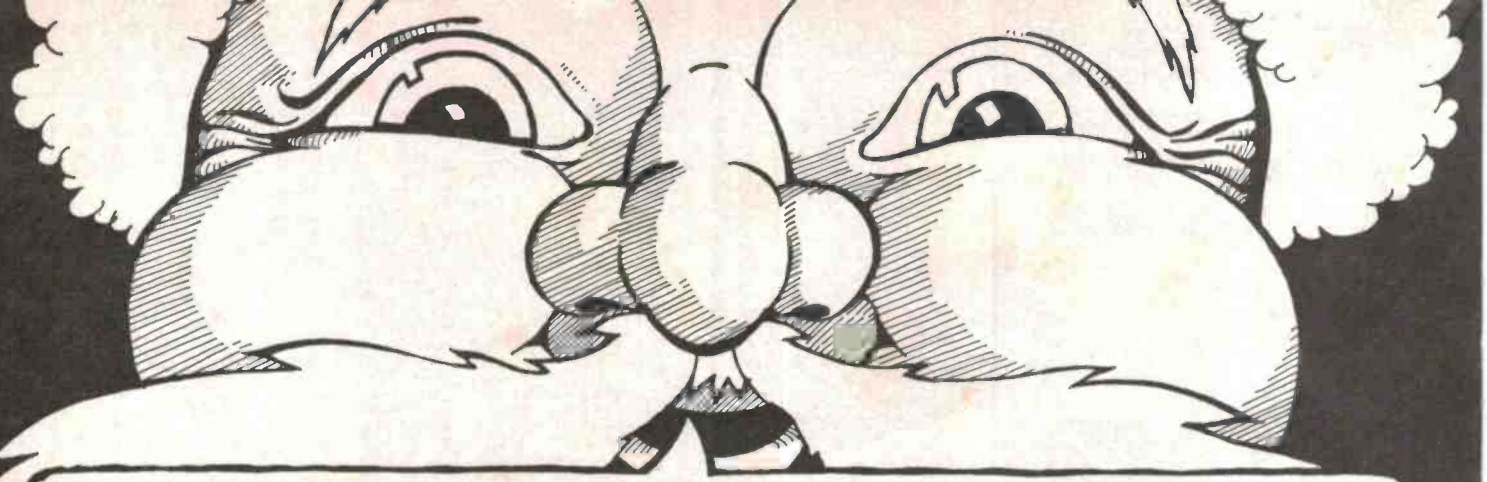

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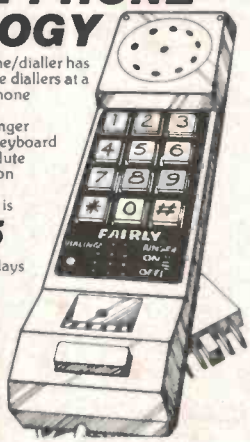

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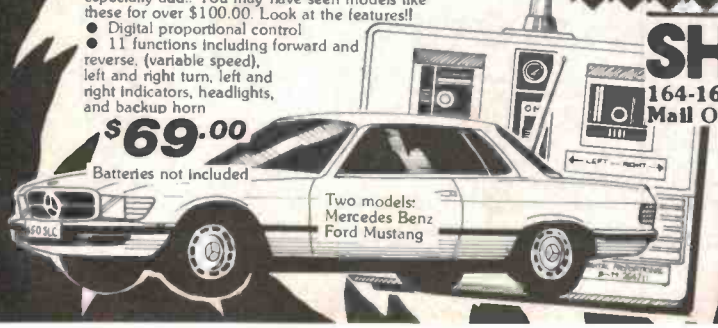

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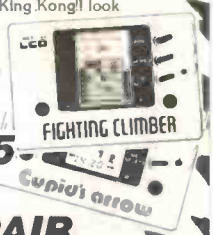

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Which battery to use?

The advent of microcircuits leading to miniaturisation of equipment and to decreased power demands has resulted in a resurgence of battery operated devices. Advances in technology have led to some remarkable developments in batteries today. But there you have a problem. Which battery to use?

Philip Clark

MANY PEOPLE have a tendency to replace conventional 'dry' cells with the rechargeable nickel-cadmium type simply to avoid replacement costs, but this practice may not be cost effective and can even lead to reduced equipment performance and greater cost. In order to make some form of meaningful comparison between types, it was necessary to select one common size of cell and look at the performance under similar load conditions. Also, because the performance of carbon-zinc cells is more dependent on usage than alkaline or NiCad cells, a definite statement as to which is best cannot readily be made.

The purpose of this article is to try to present a guide to the selection of cell type best suited for an application, bearing in mind equipment performance, duty cycle, current demand, weight and cost. The information presented here has been obtained from the data sheets of many manufacturers and should not be regarded as typical of any particular make. Because of the variation in performance of carbon-zinc cells with differing loads, the presentation has been optimised to give a reasonable overall guide to performance without being too optimistic.

Cells tested

The basic cells compared are the nickel-cadmium rechargeable type, the ordinary carbon-zinc dry cell, both normal and heavy duty (leclanche type) and the manganese dioxide-alkaline type. The size of the cells selected for comparison are the 'AA' or UM-3, SAA designation R6. In the case of the NiCad this is a 450 mA hour capacity cell. The load characteristic selected was a current drain of 30 mA for four hours per day. This is typical of much portable equipment such as walkie-talkies, portable radios, calculators, etc. This was also the load which was easiest to compare on a range of data for various cells.

Result of comparisons

Generally, the comparison here shows alkaline cells to have a performance about twice that of ordinary carbon-zinc cells, however they can be many times better, depending on usage. Alkaline cells have higher efficiency when used for continuous or heavy load (high current) applications where the conventional carbon-zinc cell is less effective. The rechargeable NiCad is good for heavy current applications, provided the correct supply voltage can be achieved. Unfortunately, carbon-zinc and alkaline cells are not directly interchangeable with NiCad cells due to ▶

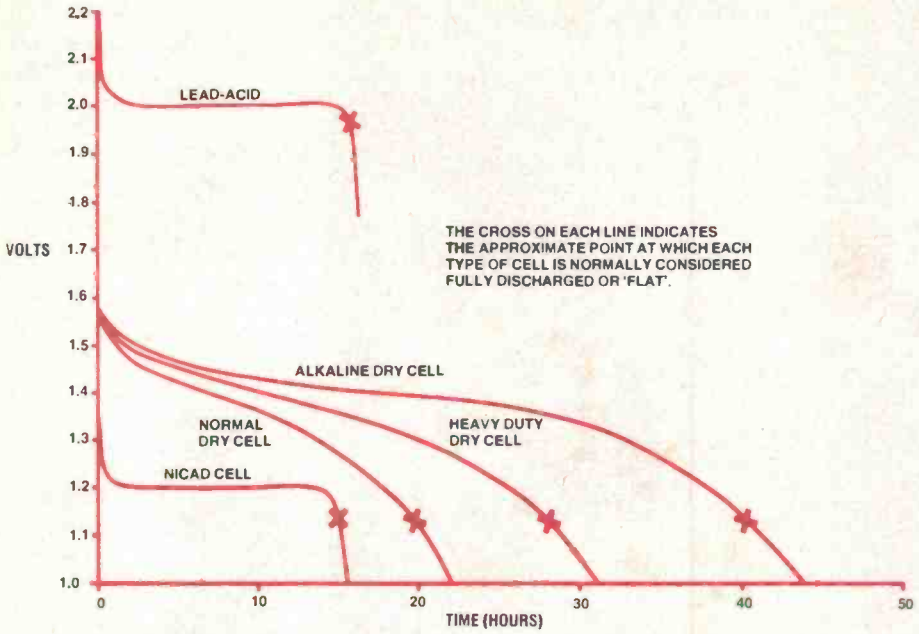

Figure 1. The discharge performance of various cells. The discharge characteristics of a lead-acid cell are shown for comparison. Note that terminal voltage cannot be used to indicate the state of charge of NiCad cells.

differing terminal voltages. This is caused by the different types of materials and construction used for these cells. The result is that while carbon-zinc and alkaline cells have a terminal voltage of 1.5 V, the NiCad cell has a voltage of only 1.2 V.

Figure 1 shows the performance of the various cells and that of a similar capacity lead-acid cell for comparison. It is important to note that the terminal voltage cannot be used to indicate the state of charge of the NiCad cell but can be used as an approximate indicator for 'dry' cells. NiCad cells are about 25% to 30% heavier than 'dry' cells and because more of them may be required for the same voltage, this could mean a substantial weight penalty in portable equipment.

Batteries at work

The place where these various cells must work is in the equipment, and this is where many factors become important. The points to be considered are: *duty cycle* — is the load to be continuous or intermittent high current, or is it to be low current, continuous or intermittent? *Operating environment* — will the power be required at extremes of temperature? What is the design voltage of the equipment and can sufficient cells be accommodated to provide this? *Replacement or recharging* — in a particular situation one option may be preferable to the other, and which option is cost effective? *Operational life* — how long will the selected cell operate before recharge or replacement is necessary? *Shelf or storage life* — how good is a particular cell after a period of no use?

Duty cycle

This will have a major effect on the performance of a cell in any situation. Conventional carbon-zinc cells perform best at a relatively light load when operated intermittently. This allows a degree of recovery between periods of use. The service life of alkaline cells is relatively constant regardless of whether use is continuous or intermittent. This type of cell then shows its advantage mainly when continuous use is required. It can have a service life of three to ten times that of carbon-zinc cells in ideal circumstances.

Another advantage of the alkaline cell is its ability to supply considerably higher currents than the carbon-zinc type. In fact, the current available from alkaline cells can approach that from NiCad rechargeable cells in some circumstances. For high current loads, intermittent or continuous, the NiCad cell may be preferred, either because other cell types cannot supply the required current or because discharge is so rapid that continual replacement would be necessary. Substitution of carbon-zinc or alkaline cells with NiCads should only be undertaken after consideration of all the factors involved, including operating environment, equipment voltage requirements and storage life.

Operating environment

Carbon-zinc cells deteriorate quickly at temperatures above about 50°C and become rapidly unable to deliver useful current below −18°C. Alkaline cells show better operating characteristics at extremes of temperature. Although it is difficult to determine the upper temperature limit of these cells, it is considerably better than carbon-zinc cells. Alkaline cells perform reasonably well down to temperatures of −40°C.

NiCad rechargeable cells have an operating temperature range of about −20°C to +45°C but should not be exposed to temperatures below 0°C while charging. Generally, their operating temperatures are about the same as for carbon-zinc cells. There may be some temperature rise in NiCad cells during charging or heavy discharge, and this factor should be considered if these cells are used as a replacement for 'dry' cells in sensitive or critical equipment.

Design voltage of equipment

This is an important factor when consideration is being given to replacing carbon-zinc or alkaline cells with rechargeable NiCad types or replacing NiCads with 'dry' cells. In equipment such as portable transceivers, satisfactory operation depends greatly on the available supply voltage. Some of this equipment is designed to operate from NiCad cells while other is intended to use 'dry' cells. Most such equipment has a specified operating range of voltages and attempted use outside of this range will result in severely degraded performance, no operation at all, or possible damage to the equipment. Typical ranges for nominal 12 V equipment are 11 V to 14 V or 10 V to 15 V. There is a temptation to replace carbon-zinc or alkaline cells with an equal number of rechargeable NiCad cells but because of the difference in terminal voltage (1.5 V as compared to 1.2 V), a fully charged NiCad battery may not meet the minimum voltage requirements of equipment.

Figure 2 shows the performance of various battery types in a piece of 12 V rated equipment such as a portable transceiver. Note that if provision is only made for eight cells, then replacement with lower voltage types can result in insufficient supply for the correct operation of the equipment. Often, the mere fact that the equipment operates at all under these conditions is more a tribute to the designer than the performance of the power source! On the other hand, replacement of NiCad cells with 'dry' cells could allow the equipment voltage specification to be exceeded.

Replacement or recharging

Which is best here will depend very much on the user requirement. For example, a transceiver used by emergency

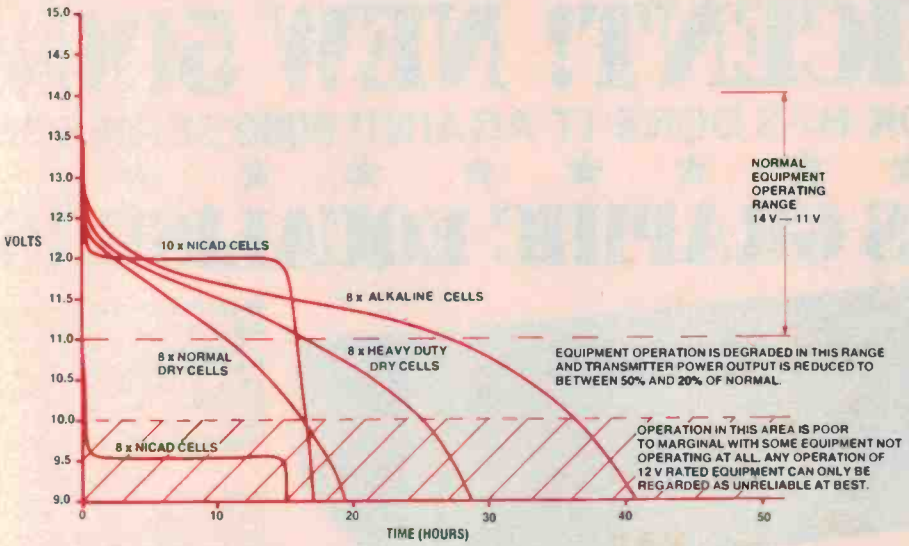

Figure 2. **The performance of various battery types in a 12 V operated handheld transceiver. Note that you cannot expect to replace eight dry cells with eight NiCads.**

services might be more quickly restored to service by replacement of batteries than by recharging. For personal use, where failure due to battery discharge is not so critical, recharging may be acceptable. If the equipment is in heavy or continuous use then recharging may be a viable alternative to replacement.

The cost of any option will depend on how often replacement is required, the higher initial cost of rechargeable cells, (and you may need more of them), the cost of a charger and the cost of an additional battery pack if operation is needed while recharging is in progress. Another important factor, especially in an emergency environment, is the availability of power for recharging. If such a source is not readily accessible, a user may be ill-advised to use rechargeable batteries at all.

Operational life

The effective operational life of a battery may become very important if access to replacement or recharged cells is difficult. As can be seen from Figure 2, the NiCad cells under this load will supply power for about 15 hours of operation. This is conditional on the battery being fully charged and in good condition. Ordinary carbon-zinc cells will provide about the same service life and heavy duty ones about twice this. Alkaline cells can be expected to have a greater operating life, about three times or better, than either NiCads or carbon-zinc as compared here.

There is a further factor which should be considered where the use of NiCad cells is contemplated. It has become recognised that NiCad cells tend to develop a 'memory' of their usage pattern. What appears to happen is that if a cell is used to say only 50% of capacity and then recharged, after a few cycles of this pattern the cell then becomes only capable of delivering 50% of rated capacity before going 'flat'. This condition can be reversed by correctly cycling the cell through several discharge and charge cycles, but unless this condition is recognised as developing, it may seriously degrade the operational life of the equipment in which it is used.

Shelf life or self discharge

All cells will discharge by themselves when not in use, to a greater or lesser degree. This self discharge will determine the length of time for which a cell can be left unused and still be able to deliver a reasonable proportion of its original charge. The major factors which influence the rate of self discharge are storage temperature, amount of charge at storage, and the condition of the cell.

The definition of shelf life is somewhat variable, but for carbon-zinc and alkaline cells appears to be the time taken to decrease to 90% of initial capacity. Accepting this definition then gives the following approximate storage lifetimes for cells in good condition.

Carbon-zinc cell — 8 to 9 months
Alkaline cell — Over 2 years.
NiCad cell — 3 days to 4 weeks.

These storage times are based on a constant temperature of about 20°C to 25°C. Storage life may be improved by storing the cells at 5-10°C. Generally, higher temperatures cause more rapid degradation. Storage life is also shown in graphical form in Figure 3. An approximation for a lead-acid car battery type cell is shown for comparison. NiCad cells appear to show up poorly in this regard and some manufacturers now claim to have substantially improved this characteristic. The self discharge of NiCad cells depends on the type of cell, whether it is intended for high or normal current discharge. The condition of the cell is also important, whether it has been cycled correctly, the age (number of cycles), the environment in which it has been used and the state of charge at storage.

Consideration of the information provided here may be able to assist you to make a better informed decision as to the best power source for your battery operated equipment. It is not practical to cover all the eventualities and applications in a short article, but at least this should provide some guide to the cost effectiveness and practicability of the battery that you select. Most manufacturers will provide design and engineering data on request should you need to make a more detailed analysis of your particular needs. ●

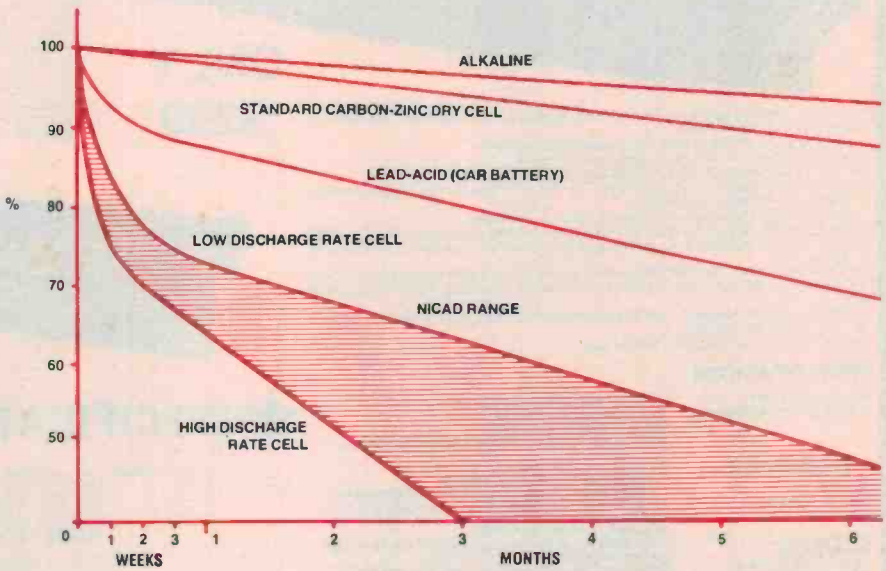

Figure 3. **All secondary cells self-discharge, which gives them a certain 'shelf life'. Here, the self-discharge characteristics of the various cells are shown. A lead-acid cell is included for comparison.**

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1/3 octave equalisers have been used by professional engineers in Recording Studios and live concerts for over a decade now. It is no accident that the advent of the 1/3 octave equaliser and studio quality live sound have gone hand-in-hand. BUT THERE'S A CATCH. One of these equalisers is not enough. You will have to buy 2 (for stereo). Quite a lot of money – but worth it if you want the best.

For those whose budget does not extend to $389, may we suggest the 2010MkIIA octave (10 band) equaliser. This unit is rack mounted and in the same format as the 5000 series equaliser. It is stereo (in one 3½" cabinet) with one slider per octave. Basically an upgrade of the ETI 485 graphic, it represents outstanding value for money at only $139.00.

The Jaycar kit includes a fully prepunched plated chassis, prepunched heavy gauge front panel with silkscreened front panel to match the other 5000 components. It is absolutely original. You can purchase the kits one at a time for $199 ea. or, for two, $389 – a $10 saving. If you are one of the hundreds of happy 5000 users we are convinced that you will be just as delighted with this unit.

BUY 2 AND SAVE $10 – ONLY $389

☆ only ☆
$199

"BLACK MONOLITH"

ONLY $299

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

IF YOU THINK THAT YOU CAN SAVE MONEY ON THESE KITS ASK YOUR SUPPLIER IF HE WILL GIVE YOU ALL OF THESE FEATURES AT THE PRICE. MAKE SURE THAT YOU GET IT IN WRITING!!
A PRICE RISE ON BOTH KITS (i.e. SALES TAX AND METALWORK ETC.) IS EXPECTED SOON! BUY THE BEST FOR NO MORE.
Write in (SAE) for a new glossy leaflet on both amps.

SPECIFICATIONS

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

"BLUEPRINT"

5000 PREAMPLIFIER

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

Several of our competitors are imitating our "Blueprint" preamp by adding a few bits and pieces, notably gold plated RCA sockets to their standard kits. Unfortunately they have missed the point. We supply gold plated sockets in our "Blueprint" preamp but only where it makes sense to do this, i.e. on the inputs – NOT the outputs. 16 gold sockets are provided by us. This, however, does not make a "Blueprint". THIS DOES:
- Low capacitance screened cable – 12 metres of it. NOT Taiwanese cable as supplied in other kits. Our cable costs us NEARLY 5 TIMES MORE than the Taiwanese stuff.
- Original ETI designed front panel. Not an "ADAPTION". Our front panel is by far the nicest.
- Factory pre-tinned PCB's to reduce chances of dry or noisy solder joints.
- Quality LEDs, polished finish, multicoloured display.
- IC sockets on line amp board.
- Special rear panel.
- Special low noise selection LM394H NOT CH device in M.C. preamp.
- Thermalloy (U.S. made) heatsink on 7805 regulator.
- English Lorlin selector switches.
- Apart from the 16 gold RCA's we throw in a pair of gold plated line RCA plugs – worth $5.
- Special Nylon rear panel grommets.

So don't "Swallow" the facts before they are properly digested!!
You can't make a silk purse out of a sow's ear. Send SAE for full specs.

BLUEPRINT $275

★ SPECIFICATIONS

Frequency Response	High level input (5Hz–130kHz, +0, –1dB Low-level input—conforms to RIAA equalisation +0.2dB (see detail on Phono specs.)	ETI-478MM Moving Magnet input stage Gain	½, 1kHz
Distortion	1kHz 0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation)	Frequency Response	Conforms to RIAA Equalisation +0.2dB
S/N noise	High level input, master full, with respect to 300mV input signal at full output (1.2V) 92dB flat 100dB A-weighted	Total Harmonic Disorder Headroom	0.001%, 1kHz, 10mV RMS input 20dB with respect to 5mV RMS input signal. Lo. 135mV RMS
	MM input, master full, with respect to full output (1.2V) at 5mV input, 500 ohm source resistance connected 86dB flat 92dB A-weighted	Noise	Total equivalent input noise, 122nV 'A' input shorted, 216nV flat, input shorted 1mV 5mV 10mV Flat 73dB 87dB 93dB A-weighted 78dB 92dB 98dB
	MC input, master full, with respect to full output (1.2V) and 290uV input signal 71dB flat 75dB A-weighted	S/N ratio	
		ETI-478MC Moving coil input stage Gain	24
		Frequency Response	7Hz–135kHz +0, –1dB
		Total Harmonic Disorder	0.003%, 1kHz, 30mV input
		Noise	Total equivalent input noise 83nV flat, input shorted 42nV 'A', input shorted 56nV flat, after RIAA Eq, input shorted 34nV 'A', after RIAA Eq, input shorted

SERIES COMPONENT

OCTAVE GRAPHIC EQUALISER – BRILLIANT!!

FROM $495

8 CHANNEL MIXER KIT

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

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

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

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

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

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Just check the features. We are sure that you will calculate that the "Voyager" represents outstanding value!

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

IDEAL RALLY COMPUTER!

only $199 Complete

FEATURES

- INSTANT FUEL CONSUMPTION IN LITRES/100KM AND MPG!! (MOST OTHERS HAVE ONLY ONE OF THE ABOVE) JUST SWITCH FROM ONE TO THE OTHER AS YOU DRIVE ALONG.
- INSTANT SPEED, TIME AND OTHER FUEL DATA.
- VISUAL AND AUDIBLE EXCESS SPEED ALARM.

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The "Voyager" comes complete with an unbelievable array of mounting configurations, on dash, under dash or stalk mount. ALL installation hardware is supplied (even a roll of insulation tape!) as well, of course, as the speed and fuel sensors. A lavishly illustrated installation manual is provided as well as a comprehensive operators manual.

A typically competent EA/ETI reader would be able to install this unit in 3-4 hours.

'super siren'

Incredible CMOS circuit drives a Motorola piezo horn (KSN 1038A) to achieve extremely high sound pressure levels. Makes a great alarm and only draws – would you believe – 5mA average?

Runs for ages on a 9V battery. You can get the electronics including the PCB for only $5.00. KSN1038A only $17 extra.

Ref: EA 11/82

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Using the 4007UB 'FETset' IC

The 4007UB comprises two pairs of complementary MOSFETs and a simple MOSFET inverter stage, all independently accessible, which makes this simple IC a very versatile chip indeed.

Ray Marston

THE 4007UB is the simplest chip in the entire CMOS range. It contains little more than two pairs of complementary MOSFETs, plus a simple CMOS inverter stage. All of these elements are, however, independently accessible, enabling them to be configured in a wide variety of ways, thereby making the IC the most versatile in the entire CMOS range.

The 4007UB is an ideal device for demonstrating CMOS principles to students, technicians and engineers. It is sometimes known as the 'design-it-yourself' CMOS chip, and can readily be configured to act as a multiple digital inverter, NAND or NOR gate, transmission gate, or as a uniquely versatile 'micropower' linear amplifier, oscillator or multivibrator. We'll look at some practical examples of these applications later. In the meantime, let's look at 4007UB basics.

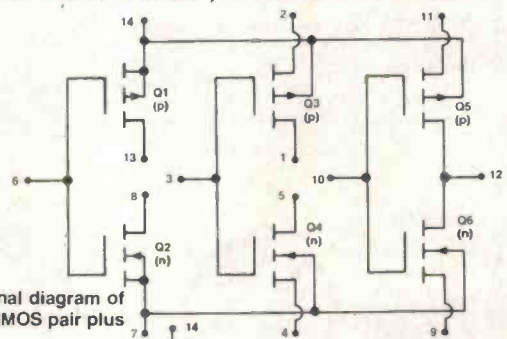

Figure 1a. Functional diagram of the 4007UB dual CMOS pair plus inverter.

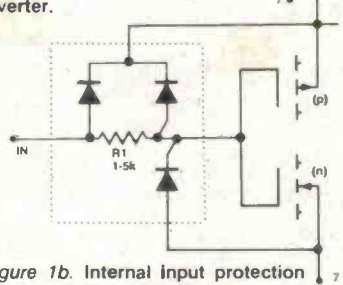

Figure 1b. Internal input protection network (within dotted lines) on each input of the 4007UB.

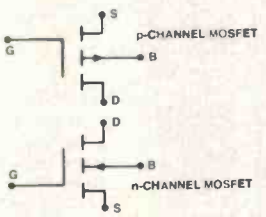

Figure 1c. MOSFET terminal notations. G = Gate. D = Drain. S = Source. B = Bulk substrate.

Basics: digital operation

Figure 1a shows the functional diagram and pin numbering of the 4007UB. Each of the three independent input terminals of the IC is internally connected to the standard CMOS protection network shown in Figure 1b. All MOSFETs in the 4007UB are enhancement-mode devices; Q1, Q3 and Q5 are p-channel MOSFETs, and Q2, Q4 and Q6 are n-channel MOSFETs. Figure 1c shows the terminal notations of the two MOSFET types; note that the B terminal represents the bulk substrate.

The term 'CMOS' actually stands for 'Complementary Metal Oxide Silicon field-effect transistors' and it is fair to say that all CMOS ICs are designed around the basic elements shown in Figure 1. It is thus worth getting a good basic understanding of these elements. Let's look first at the digital characteristics of the basic MOSFETs.

The input (gate) terminal of a MOSFET presents a near-infinite impedance, and the magnitude of an external voltage applied to the gate controls the magnitude of source-to-drain current flow. Basic characteristics of the enhancement-mode n-channel MOSFET are that the source-to-drain path is open circuit when the gate is at the same potential as the source, but becomes a near short-circuit (a low resistance) when the gate is heavily biased positive with respect to the source. Thus the

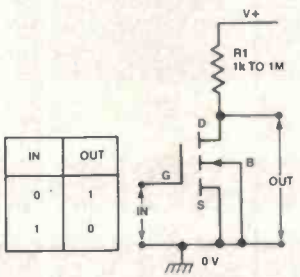

Figure 2. Digital inverter made from n-channel MOSFET.

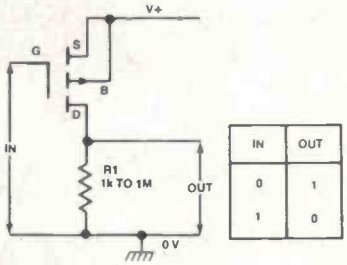

Figure 3. Digital inverter made from p-channel MOSFET.

n-channel MOSFET can be used as a digital inverter by wiring it as shown in Figure 2. With a logic 0 (zero volts) input the MOSFET is cut off and the output is at logic 1 (positive rail voltage), but with a logic 1 input the output is at logic 0.

Basic characteristics of the p-channel enhancement-mode MOSFET are that the source-to-drain path is open when the gate is at the same potential as the source, but becomes a near-short when the gate is heavily biased *negative* to the source. The p-channel MOSFET can thus be used as a digital inverter by wiring it as shown in Figure 3.

Note in the Figures 2 and 3 inverter circuits that the *on* currents of the MOSFETs are determined by the value of R1 and that these circuits draw a finite quiescent current when they are in one of their logic states. This snag can be overcome by connecting a complementary pair of MOSFETs in the standard CMOS inverter configuration shown in Figure 4a.

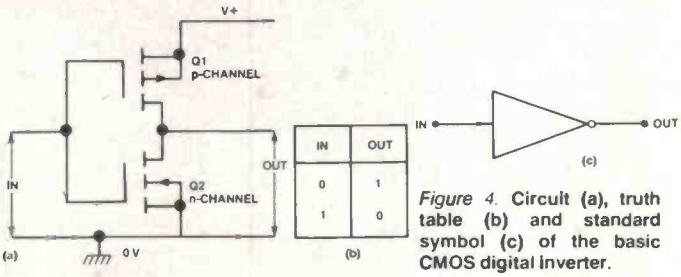

Figure 4. Circuit (a), truth table (b) and standard symbol (c) of the basic CMOS digital inverter.

Here, with a logic 0 input applied, Q1 is shorted, so the output is firmly tied to the logic 1 (positive rail) state, but Q2 is open and the inverter thus passes zero quiescent current via this transistor. With a logic 1 input applied, Q2 is shorted and the output is firmly tied to the logic 0 (zero volt) state, but Q1 is open and the circuit again passes zero quiescent current. This

'zero quiescent current' characteristic of the complementary MOSFET inverter is one of the most important features of the CMOS range of digital ICs, and the Figure 4a circuit forms the basis of almost the entire CMOS family. Figure 4c shows the standard symbol used to represent a CMOS inverter stage. Q5 and Q6 of the 4007UB are fixed-wired in this inverter configuration.

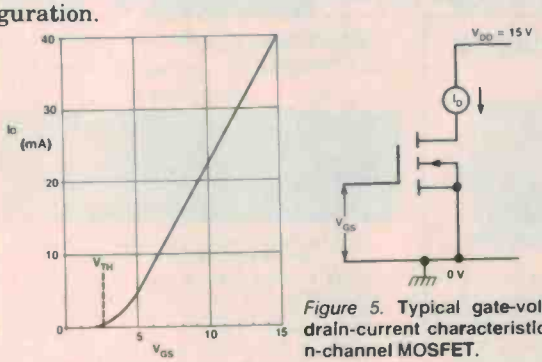

Figure 5. Typical gate-voltage to drain-current characteristics of an n-channel MOSFET.

Basics: linear operation

To truly understand the operation and vaguaries of CMOS circuitry, it is essential to understand the linear characteristics of basic MOSFETs. Figure 5 shows the typical gate-voltage to drain-current graph of an n-channel enhancement mode MOSFET. Note that negligible drain current flows until the gate voltage rises to a 'threshold' value of about 1.5 to 2.5 volts, but that the drain current then increases almost linearly with further increases in the gate voltage.

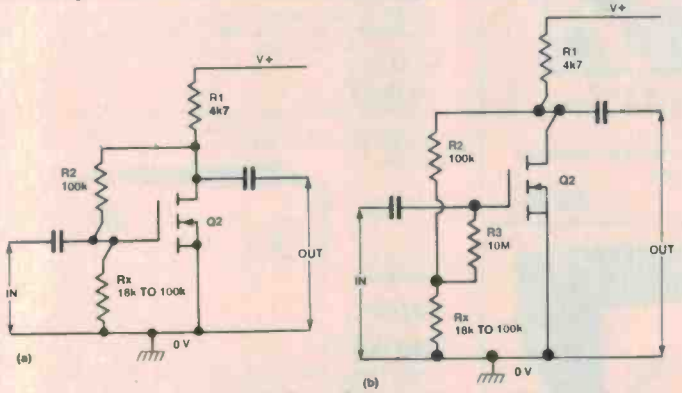

Figure 6. Methods of biasing an n-channel 4007UB MOSFET for use as a linear inverting amplifier.

Figure 6 shows how to connect an n-channel 4007UB MOSFET as a linear inverting amplifier. R1 serves as the drain load of Q2 and R2-Rx bias the gate so that the device operates in the linear mode. The Rx value must be selected to give the desired quiescent drain voltage; the Rx value is normally in the range 18k to 100k. If you want the amplifier to give a very high input impedance, wire a 10M isolating resistor between the R2-Rx junction and the gate of Q2, as shown in Figure 6b.

Figure 7 shows the typical I_D to V_{DS} characteristics of an n-channel MOSFET at various fixed values of gate-to-source voltage. Imagine here that, for each set of curves, V_{GS} is fixed at the V_{DD} voltage, but that the V_{DS} output voltage can be varied by altering the value of drain load R_L. The graph can be divided into two characteristic regions, as indicated by the dotted line, these being the triode region and the saturated region.

When the MOSFET is in the saturated region (with V_{DS} at some value in the nominal range 50% to 100% of V_{GS}) the drain acts like a constant current source, with it's current value controlled by V_{GS}. A low V_{GS} value gives a low constant-current value, and a high V_{GS} value gives a high constant-current value. These saturated 'constant-current' characteristics provide CMOS with its short-circuit proof feature and also determine it's operating speed limits at different supply voltage values.

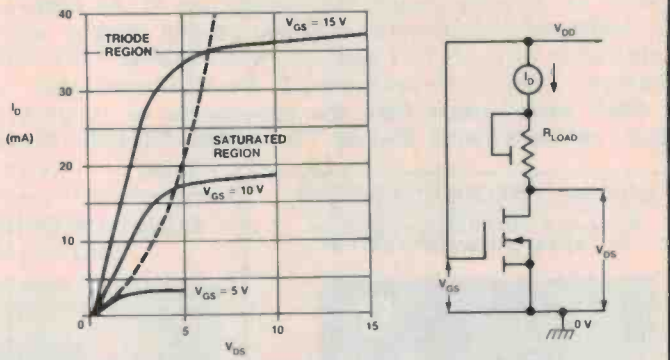

Figure 7. Typical I_D to V_{DS} characteristics of the n-channel MOSFET at various fixed values of V_{GS}.

When the MOSFET is in the triode region (with V_{DS} at some value in the nominal range 1% to 50% of V_{GS}) the drain acts like a voltage-controlled resistance, with the resistance value increasing approximately as the square of the V_{GS} value.

The p-channel MOSFET has an I_D to V_{DS} characteristics graph that is complementary to that of Figure 7. Consequently, the action of the standard CMOS inverter of Figure 4 (which uses a complementary pair of MOSFETs) is such that it's current-drive capability into an external load, and also it's operating speed limits, increases in proportion to the supply rail voltage.

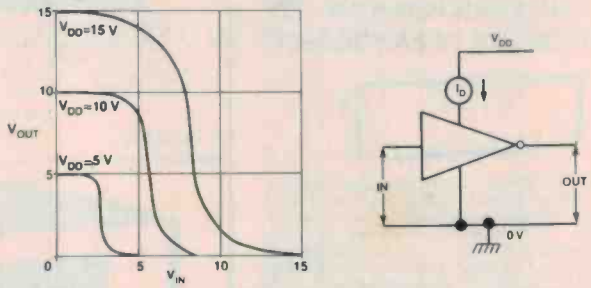

Figure 8. Typical voltage transfer characteristics of the 4007UB simple CMOS inverter.

Figure 8 shows the typical voltage-transfer characteristics of the standard CMOS inverter at different supply voltage values. Note (on the 15 V V_{DD} line, for example) that the output voltage changes by only a small amount when the input voltage is shifted around the V_{DD} and 0 V levels, but that when V_{in} is biased at roughly half-supply volts a small change of input voltage causes a large change of output voltage.

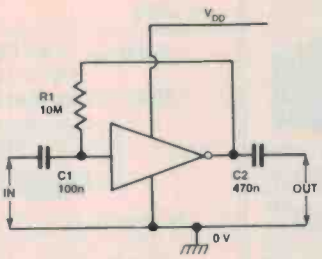

Figure 9. Method of biasing the simple CMOS inverter for linear operation. Typical gain and bandwidth performance figures are 30 dB and 2.5 MHz at 15 V supply, 40 dB and 710 kHz at 5 V.

Typically, the inverter gives a voltage gain of about 30 dB when used with a 15 V supply, or 40 dB at 5 V. Figure 9 shows how to connect the CMOS inverter for use as a linear amplifier; the circuit has a typical bandwidth of 700 kHz at 5 V supply, or 2.5 MHz at 15 V. ▶

I'M BUILDING have built THE FIRST TWO

– what am I raving about? Well, having one of the World's finest home stereo systems (the brilliant ETI 5000 series amp and preamp together with my beloved B & W DM II loudspeakers of course!), I couldn't resist building ETI's 5000 series 1/3 octave Graphic Equalizers. I have been pestering ETI for well over a year – and at last the many 1000's of 5000 series owners have the opportunity *to complete their system with another* classic, no compromise DAVID TILBROOK DESIGN. *Details are on the other page of this ad.* Cheers Jack O'Donnell

DIGITAL FREQUENCY METER

See Electronics Aust. Mag. Dec. 81-Feb. '82
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Project 82 AR12 — See December EA

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See EA April, 1982

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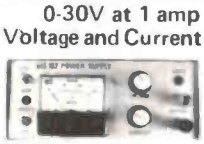

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See June '82

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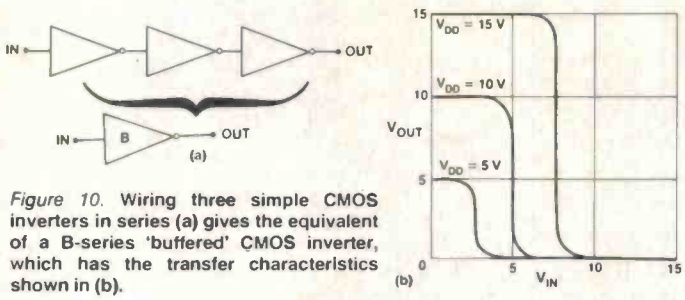


Figure 10. Wiring three simple CMOS inverters in series (a) gives the equivalent of a B-series 'buffered' CMOS inverter, which has the transfer characteristics shown in (b).

Wiring three simple CMOS inverter stages in series (Figure 10a) gives the direct equivalent of a modern B-series 'buffered' inverter stage, which has the overall voltage transfer graph shown in Figure 10b. The B-series inverter, typically gives about 70 dB of linear voltage gain, but tends to be grossly unstable when used in the linear mode.

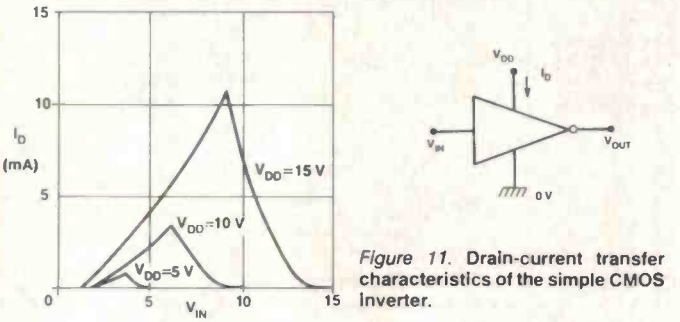


Figure 11. Drain-current transfer characteristics of the simple CMOS inverter.

Finally, Figure 11 shows the drain-current transfer characteristics of the simple CMOS inverter. Note that the drain current is zero when the input is at zero or full supply volts, but rises to a maximum value (typically 0.5 mA at 5 V supply, or 10.5 mA at 15 V supply) when the input is at approximately half-supply volts, under which condition both MOSFETs of the inverter are biased on. In the 4007UB, these *on* currents can be reduced by wiring extra resistance in series with the source of each MOSFET of the CMOS inverter; we use this technique in the 'micropower' circuits shown later in this article.

Using the 4007UB

The usage rules of the 4007UB are quite simple. In any specific application, all unused elements of the device must be disabled. Complementary pairs of MOSFETs can be disabled by connecting them as standard CMOS inverters and tying their inputs to ground, as shown in Figure 12. Individual MOSFETs can be disabled by tying their source to their substrate (B) and leaving the drain open circuit.

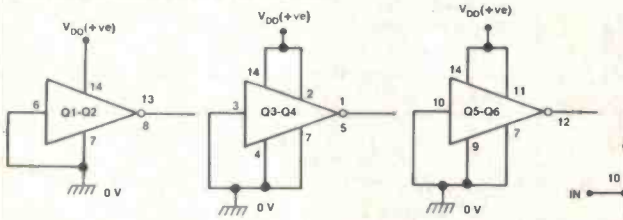


Figure 12. Individual 4007UB complementary MOSFET pairs can be disabled by connecting them as CMOS inverters and grounding their inputs.

In use, the input terminals must not be allowed to rise above V_{DD} (the supply voltage) or below V_{SS} (zero volts). To use an n-channel MOSFET, the source must be tied to V_{SS}, either directly or via a current-limiting resistor. To use a p-channel MOSFET, the source must be tied to V_{DD}, either directly or via a current-limiting resistor.

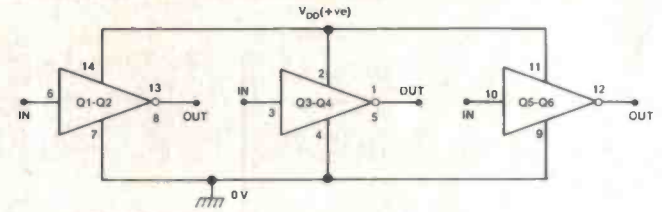


Figure 13. 4007UB triple inverter.

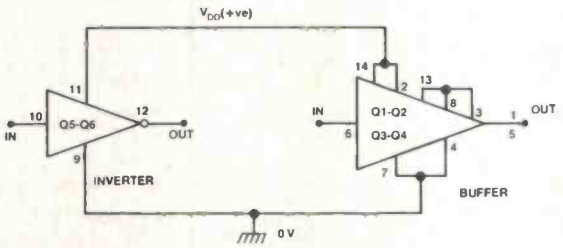


Figure 14. 4007UB inverter plus non-inverting buffer.

Practical 4007UB circuits: digital

The 4007UB elements can be configured to act as any of a variety of standard digital circuits. Figure 13 shows how to wire it as a triple inverter, using all three sets of complementary MOSFET pairs. Figure 14 shows the connections for making an inverter plus non-inverting buffer; here, the Q1-Q2 and Q3-Q4 inverter stages are simply wired directly in series, to give an overall non-inverting action.

The maximum source (load-driving) and sink (load-absorbing) output currents of a simple CMOS inverter stage self-limit at 10-20 mA as one or other of the output MOSFETs turns fully on. Higher sink currents can be obtained by simply wiring n-channel MOSFETs in parallel in the output stage.

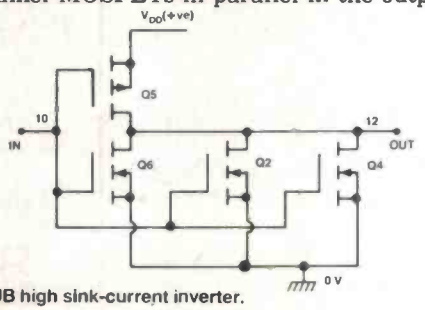


Figure 15. 4007UB high sink-current inverter.

Figure 15 shows how to wire the 4007UB so that it acts as a high sink-current inverter that will absorb triple the current of a normal inverter. Similarly, Figure 16 shows how to wire the IC to act as a high source-current inverter, and Figure 17 shows the connections for making a single inverter that will sink or source three times more current than a standard inverter stage.

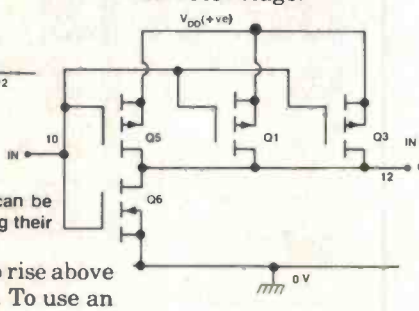


Figure 16. 4007UB high source-current inverter.

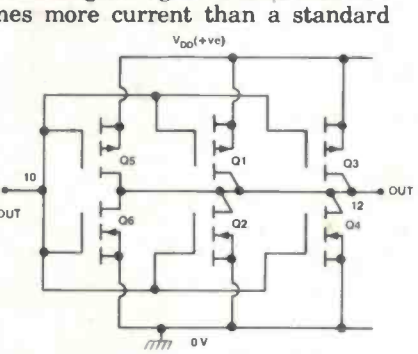
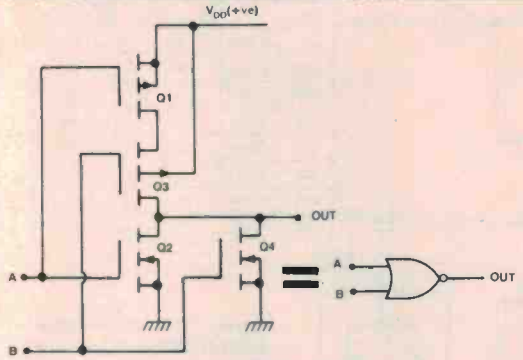


Figure 17. 4007UB high-power inverter, with triple the sink- and source-current capability of a standard inverter.



A	B	OUT
0	0	1
0	1	0
1	0	0
1	1	0

Figure 18. 4007UB two-input NOR gate.

The 4007UB is a perfect device for demonstrating the basic principles of CMOS logic gates. Figure 18 shows the basic connections for making a two-input NOR gate. Note that the two n-channel MOSFETs are wired in parallel so that either can pull the output to ground from a logic 1 input, and the two p-channel MOSFETs are wired in series so that both must turn on to pull the output high from a logic 0 input. The truth table shows the logic of the circuit. A three-input NOR gate can be made by simply wiring three p-channel MOSFETs in series and three n-channel MOSFETs in parallel, as shown in Figure 19.

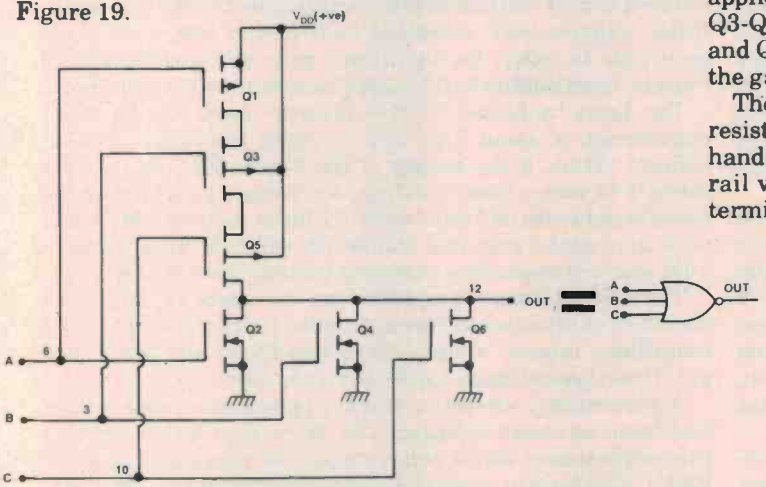
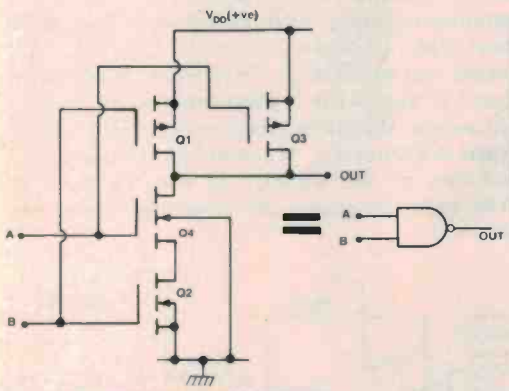


Figure 19. 4007UB three-input NOR gate.



A	B	OUT
0	0	1
0	1	1
1	0	1
1	1	0

Figure 20. 4007UB two-input NAND gate.

Figure 20 shows how to wire the 4007UB as a two-input NAND gate. In this case the two p-channel MOSFETs are wired in parallel and the two n-channel MOSFETs are wired in series. A three-input NAND gate can be made by similarly wiring three p-channel MOSFETs in parallel and three n-channel MOSFETs in series.

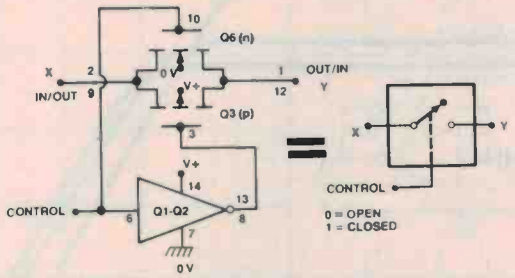


Figure 21. 4007UB transmission gate or bilateral switch.

Figure 21 shows the basic circuit for using the 4007UB to make another important CMOS element, the so-called transmission gate or bilateral switch. This device acts like a near-perfect switch that can conduct signals in either direction and can be turned on (closed) by applying a logic 1 to the control terminal or turned off (open) via a logic 0 control signal. Here, an n-channel and a p-channel MOSFET are wired in parallel (source-to-source, drain-to-drain), but their gate signals are applied in anti-phase via the Q1-Q2 inverter. To turn the Q3-Q6 transmission gate on (closed), Q6 gate is taken to logic 1 and Q3 gate to logic 0 via the inverter. To turn the switch off, the gate polarities are simply reversed.

The 4007UB transmission gate has a near-infinite OFF resistance and an ON resistance of about 600 ohms. It can handle all signals between zero volts and the positive supply rail value. Note that, since the gate is bilateral, either of its terminals can function as input or output.

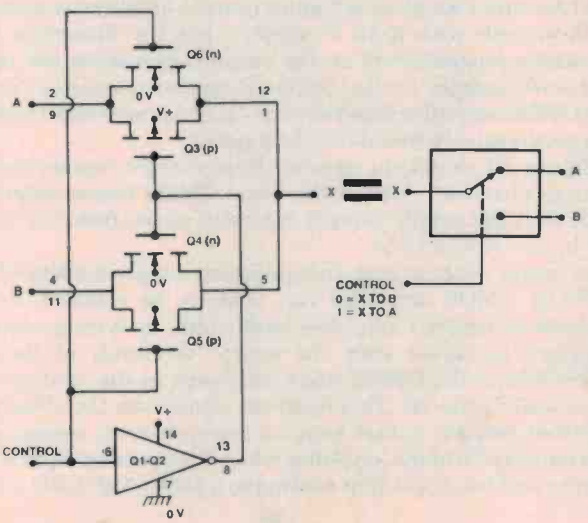


Figure 22. 4007UB two-way transmission gate.

Finally, Figure 22 shows how the 4007UB can be wired as a dual transmission gate that functions like a single-pole double-throw (SPDT) switch. In this case the circuit uses two transmission elements, but their control voltages are applied in antiphase, so that one switch opens when the other closes, and vice versa; the 'X' sides of the two gates are shorted together, to give the desired SPDT action. ▶

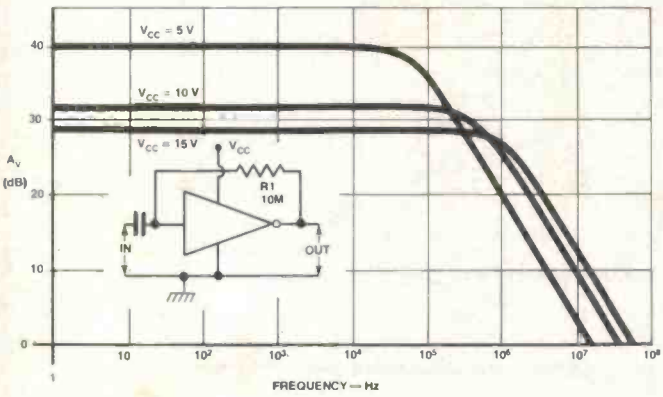
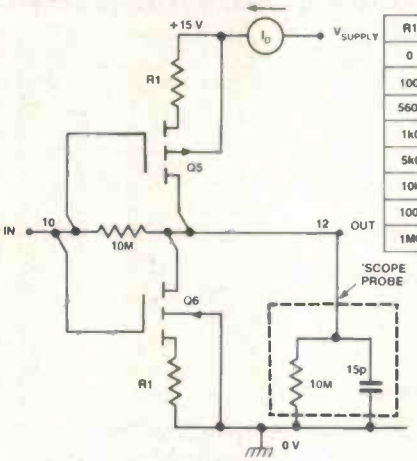


Figure 23. Typical A_V and frequency characteristics of the linear-mode basic CMOS amplifier.



R1	I_D	A_V (V_{OUT}/V_{IN})	UPPER 3 dB BANDWIDTH
0	12.5 mA	20	2.7 MHz
100R	8.2 mA	20	1.5 MHz
560R	3.9 mA	25	300 kHz
1k0	2.5 mA	30	150 kHz
5k6	600 uA	40	25 kHz
10k	370 uA	40	15 kHz
100k	40 uA	30	2 kHz
1M0	4 uA	10	1 kHz

Figure 25. 'Micropower' 4007UB CMOS linear amplifier, showing method of reducing I_D, with measured performance details.

Practical 4007UB circuits: linear

We've already seen in Figures 6 and 9 that the basic 4007UB MOSFETs and the CMOS inverter can be used as linear amplifiers. Figure 23 shows the typical voltage gain and frequency characteristics of the linear CMOS inverter when operated from three alternative supply rail values. This graph assumes that the amplifier output is feeding into the high impedance of a 10M/15 pF 'scope probe. The output impedance of the open-loop amplifier typically varies from 3k at 15 V, to 5k at 10 V, to 22k at 5 V, and it is the product of the output impedance and output load capacitance that determines the bandwidth of the circuit, increasing the load capacitance or output impedance reduces the bandwidth.

As you would expect from the voltage transfer graph of Figure 8, the distortion characteristics of the CMOS linear amplifier are not particularly wonderful. Linearity is quite good for small-amplitude signals (output amplitudes up to 3 V peak-to-peak with a 15 V supply), but the distortion then increases progressively as the output approaches the upper and lower supply limits. Unlike a bipolar transistor circuit, the CMOS amplifier does not 'clip' excessive sine wave signals, but progressively rounds off their peaks.

Figure 24 shows the typical drain-current versus supply-voltage characteristics of the basic CMOS linear amplifier. Note that the supply current typically varies from 0.5 mA at 5 V to 12.5 mA at 15 V.

In many applications, the quiescent supply current of the 4007UB CMOS amplifier can usefully be reduced, at the expense of reduced amplifier bandwidth, by wiring external resistors in series with the source terminals of the two MOSFETs of the CMOS stage, as shown in the 'micropower' circuit of Figure 25. This diagram also shows the effect that different resistor values have on drain current, voltage gain and bandwidth of the amplifier when it is operated from a 15 V supply and has it's output feeding to a 10M/15 pF CRO probe.

It is very important to appreciate in the Figure 25 circuit that these additional resistors add to the output impedance of the amplifier (the output impedance is roughly equal to the R1-Av product) and this impedance and the external load resistance/capacitance has a great effect on the overall gain and bandwidth of the circuit. When using 10k values for R1, for example, if the load capacitance is increased to 50 pF the bandwidth falls to about 4 kHz, but if the capacitance is reduced to 5 pF the bandwidth increases to 45 kHz. Similarly, if the resistive load is reduced from 10M to 10k, the voltage gain falls to unity; for significant gain, the load resistance must be large relative to the output impedance of the amplifier.

The basic (unbiased) CMOS inverter stage has an input capacitance of about 5 pF and an input resistance of near-infinity. Thus, if the output of the Figure 25 circuit is fed directly to such a load, it will show a voltage gain of about 30 and a bandwidth of 3 kHz when R1 has a value of 1M; it will even give useful gain and bandwidth when R1 has a value of 10M and will consume a quiescent current of only 0.4 uA!

The CMOS linear amplifier can be used, in either its standard or micropower forms, to make a variety of fixed-gain amplifiers, mixers, integrators, active filters and oscillators, etc. Three typical basic applications are shown in Figure 26.

A particularly attractive linear application is as a crystal oscillator, as shown in Figure 27a. Here, the CMOS amplifier is linearly biased via R1 and provides 180° phase shift, and the Rx-C1-XTAL-C2 pi-type crystal network provides an additional 180° of phase shift at the crystal resonant frequency, thereby causing the circuit to oscillate. If you simply want the crystal to provide a frequency accuracy within 0.1% or so, Rx can be replaced by a short and C1-C2 can be omitted. For ultra-high accuracy, the correct values of Rx-C1-C2 must be individually determined (Figure 27 shows the typical range of values). In micropower applications, Rx can be incorporated in the CMOS amplifier, as shown in Figure 27b. If desired, the output of the crystal oscillator can be fed directly to the input of an additional CMOS inverter stage, for improved waveform shape/amplitude.

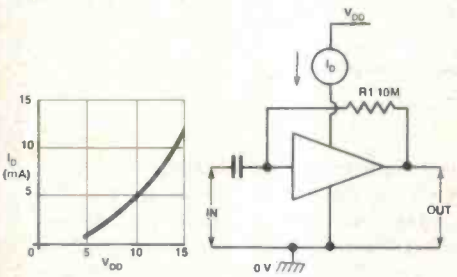


Figure 24. Typical I_D/V_{DD} characteristics of the linear-mode CMOS amplifier.

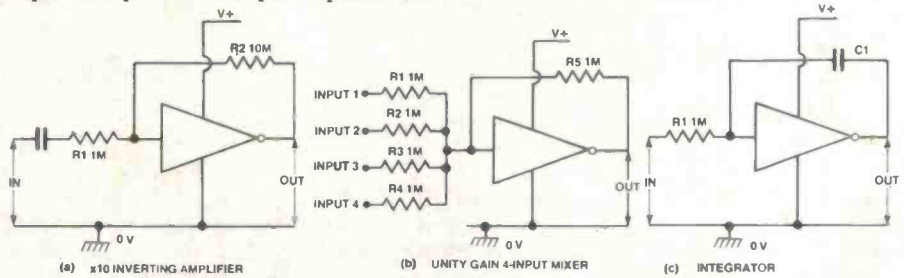


Figure 26. The CMOS amplifier can be used in a variety of linear inverting amplifier applications. Three typical examples are shown here.

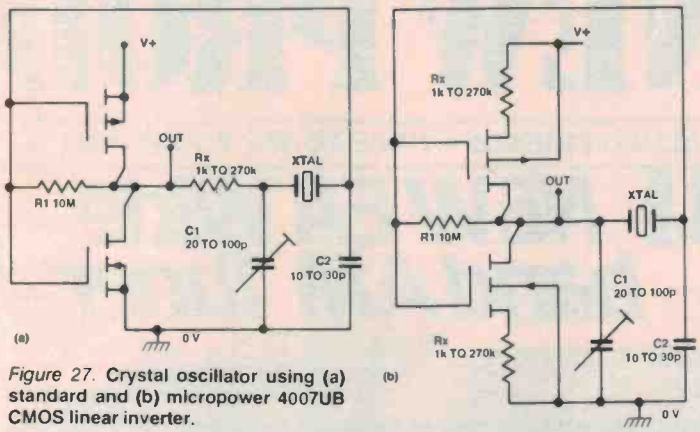


Figure 27. Crystal oscillator using (a) standard and (b) micropower 4007UB CMOS linear inverter.

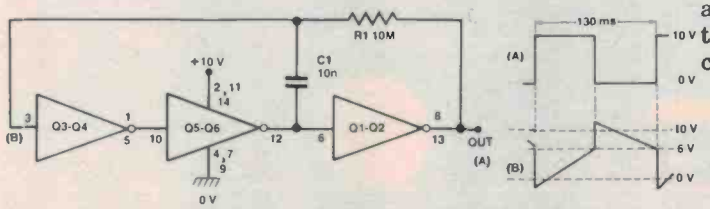


Figure 28. This 4007UB ring-of-three astable consumes 280 uA at 6 V, 1.6 mA at 10 V.

Practical 4007UB circuits: astables

One of the most useful applications of the 4007UB is as a ring-of-three astable multivibrator. Figure 28 shows the basic configuration of the circuit. Waveform timing is controlled by the values of R1 and C1, and the output waveform (A) is approximately symmetrical. Note that for most of the waveform period the front-end (waveform B) part of the circuit operates in the linear mode, so the circuit consumes a significant running current.

In practice, the running current of the Figure 28 astable circuit is far higher than that of an identically configured B-series 'buffered' CMOS chip such as the 4001B, the comparative figures being 280 uA at 6 V and 1.6 mA at 10 V for the 4007UB against 12 uA at 6 V and 75 uA at 10 V for the 4001B. The 4007UB circuit, however, has far lower propagation delays than the 4001B and typically has a maximum astable operating speed that is three times higher than that of the 4001B.

The running current of the 4007UB astable can be greatly reduced by operating it's first two stages in the 'micropower' mode, as shown in Figure 29. This technique is of particular value in low frequency operation, and the Figure 29 circuit in fact consumes a mere 1.5 uA at 6 V or 8 uA at 10 V, these figures being far lower than those obtainable from any other IC in the CMOS range. The frequency stability of the

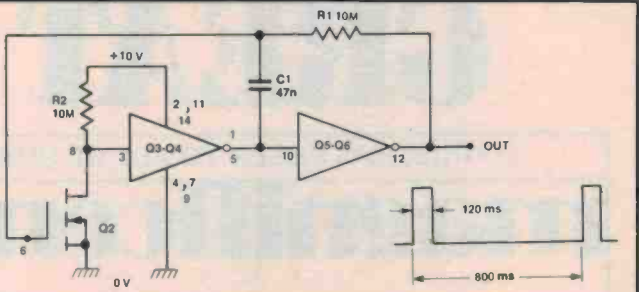


Figure 30. This 4007UB asymmetrical ring-of-three astable consumes 2 uA at 6 V, 5 uA at 10 V.

Figure 29 circuit is not, however, very good, the period varying from 200 ms at 6 V to 80 ms at 10 V.

Figure 30 shows how the 4007UB can be configured as an asymmetrical ring-of-three astable. In this case the 'input' of the circuit is applied to n-channel MOSFET, Q2. The circuit consumes 2 uA at 6 V or 5 uA at 10 V.

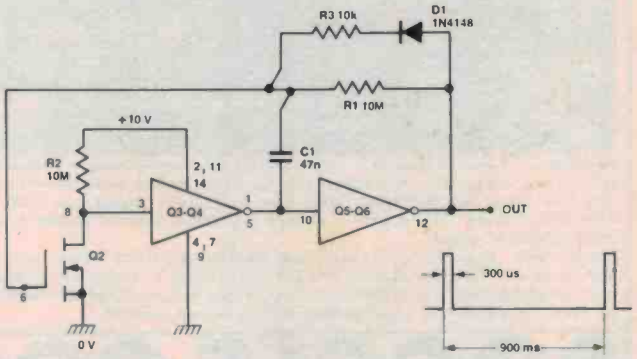


Figure 31. This dual time constant version of the 4007UB astable generates a very narrow output pulse.

Figure 31 shows how the symmetry of the above circuit can be varied by shunting R1 with the D1-R3 network, so that the charge and discharge times of C1 are independently controlled. With the component values shown, the circuit produces a 300 us pulse once every 900 ms and consumes a mere 2 uA at 6 V or 4.5 uA at 10 V. Note that these characteristics are similar to those of the ideal 'sample-pulse generator' circuit that was mentioned at the end of the last Circuit File, on Voltage and Window Comparators (ETI, November '82, pp 48-51).

Finally, to round off this edition of Circuit File, Figure 32 shows how the current consumption of the above circuit can be even further reduced, by operating the Q3-Q4 CMOS inverter in the micropower mode. The table gives details of circuit performance with alternative C1 and R3 values. This circuit will give years of continuous operation from a single battery supply. ●

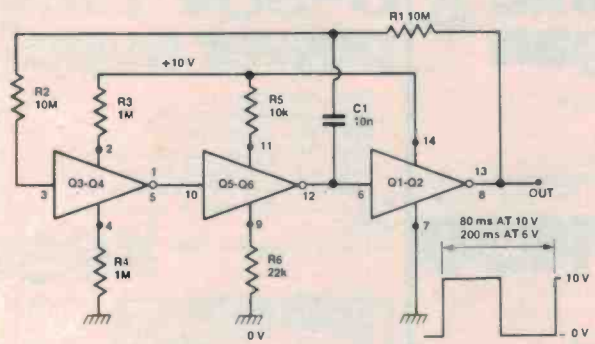
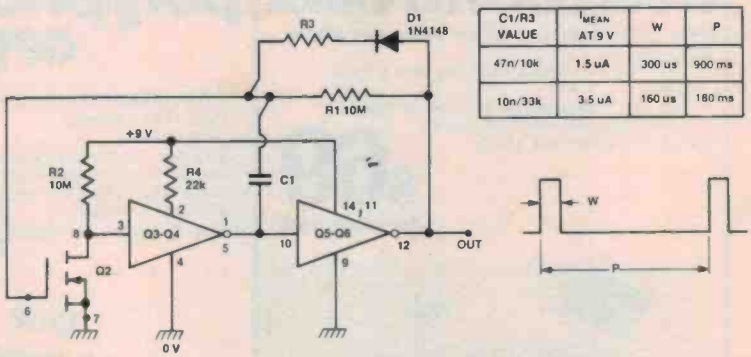


Figure 29. This micropower ring-of-three symmetrical 4007UB astable consumes 1.5 uA at 6 V, or 8 uA at 10 V.



C1/R3 VALUE	I_{MEAN} AT 9 V	W	P
47n/10k	1.5 uA	300 us	900 ms
10n/33k	3.5 uA	160 us	180 ms

Figure 32. This micropower version of the 4007UB dual time constant astable consumes absolutely minimal currents.

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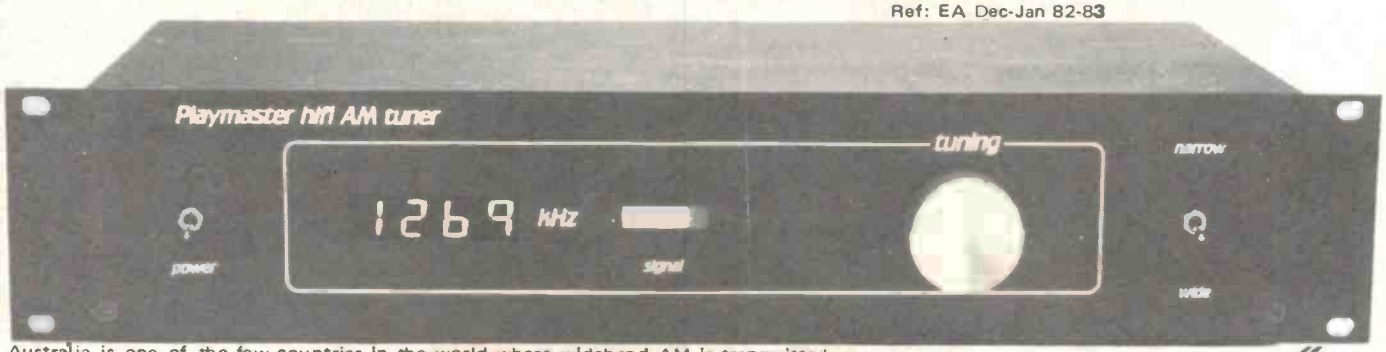

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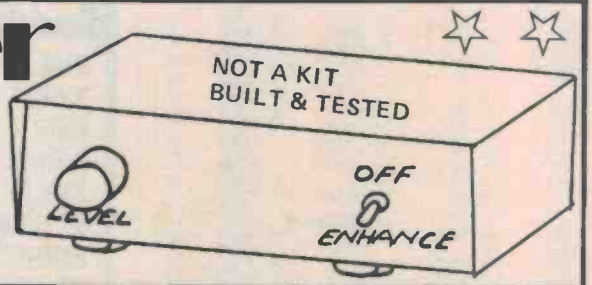

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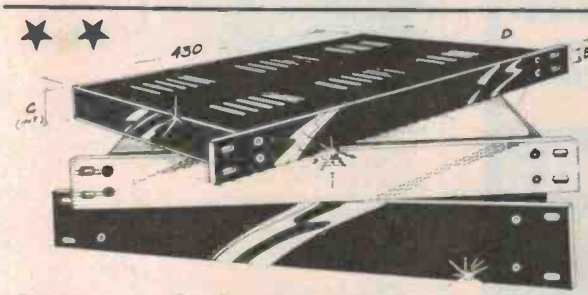

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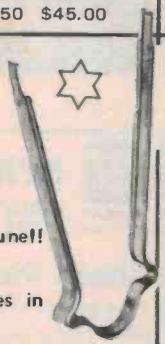

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Model train controller simulates 'real' train controls

This model train, or better, railway, controller has controls that operate like 'real' train controls. In addition, it signals open circuit or short circuit conditions on the track and you can make emergency stops.

Jonathan Scott

MODEL RAILWAY controllers are one of those perennial projects which recur every year or so in some magazine or other, because they are almost ideal as a project: lots of people have model electric train sets (what other sort *is* there? Yeh, yeh — steam, but this isn't Steam Train International Today magazine! — Ed.), lots of commercial controllers are either crude or relatively expensive and there are plenty of 'angles' to explore, both electronic and philosophical.

Some controller designs are *cheap*. And that's as it should be, a hobbyist has to start somewhere. Some are designed to employ recently-released innovations. Some use microprocessors and digital tone-encoding techniques to be really comprehensive. Others are designed to make driving the train 'easy' by compensating for loads of hill-climbing or many carriages, etc. It is our belief that these are rather artificial aims, so let's see what *we* think is *really* necessary.

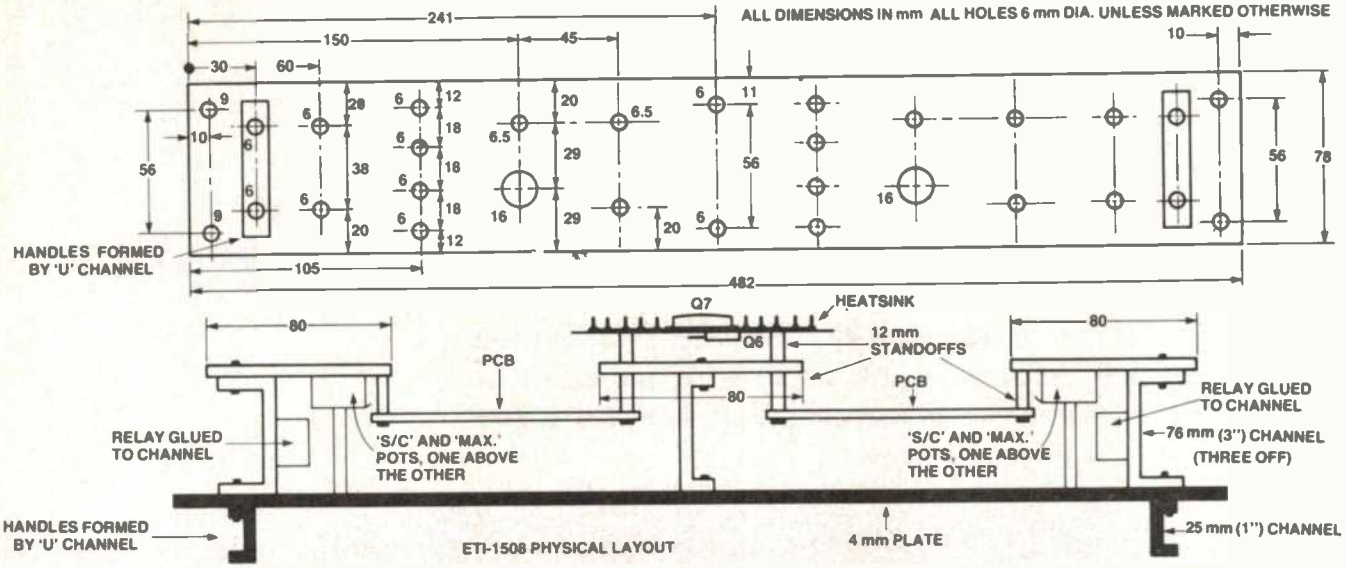
The model railway enthusiast does not just like to see it go, he likes to *drive* the train. So, a controller should pass on to the user as many of the 'inputs' as a real train would encounter, but hide from him unreal inputs which only a model exhibits. In other words, he wants to feel the effect of inertia, but not of bad contacts, feel the engine and brake work separately and to feel the effort of climbing or carrying extra load, but not feel some loss of power when junior gets his train going too, or the butler turns on the mixmaster. In addition, a controller should be able to run everything from a micro-gauge small locomotive to twin O-gauge engines. Finally, it wants to be as inexpensive to build as is possible without sacrificing anything. (After all, if you've got a butler, there's not going to be too much spare cash left to spend on luxuries like model railways!) This is precisely the philosophy adopted for this project. Our new controller has been built in rack panel form with two separate control systems running from one mains step-down transformer. Needless to say, if you want to build 1-to-21 such units in wooden consoles all run from two car batteries, then you can please yourself — our design can be used as a guide for those who want to follow that course. From our experience, hobbyists like to customise their housings.

The front panel of our controller is rather unconventional for a *model* train controller, but somewhat closer to the controls of a real train. One switch selects the thrust applied ("accelerate"), no thrust, or in the momentary (spring-loaded return) position, normal brake. This is the main control, and indeed the only one required for commuter trains such as London's Tube or Le Metro in Paris. Once the throttle knob has been set to define maximum torque, throwing the main lever to ACCELERATE causes a small jerk in the wheels, corresponding to the take-up of slack etc, followed by normal acceleration toward the top speed. Moving the main level to the centre or 'idle' position causes the train to start coasting to a final halt. Pressing it to BRAKE hastens the stop. In metropolitan trains the driver aligns the train correctly in the station by judicious pressing and releasing of the main lever, finally stopping with precision, in spite of the train's great inertia, of a few inches. This you will discover, requires *some skill*.

The throttle knob we have already mentioned. On brief runs, you never reach full speed, so the setting of this control is not critical. It sets final engine torque, and hence speed, after the acceleration is over. This is important on long runs. This control can be internally preset to match the size of model train you have; on the prototype the MAX. SET is a screwdriver preset accessible from the front, but provision has been made for it to be a preset on the pc board if you so desire.

The STOP button is the front panel control corresponding most closely to the 'communications cord' on a real train. It is the one concession to necessity over realism. When pressed it quickly shuts down the controller output, halting the train as rapidly as possible. There are two possible ways of wiring it — one which restarts the train when the button is released and another which requires the mains to be removed before it can be restored. This latter option discourages frivolous use of the STOP button (people don't *believe* it when you put a notice on it saying "Fine — $40 for unwarranted use") and provides some failsafe against accident. It is the option we recommend. This will be further discussed in the construction section.

The forward-reverse switch is the fourth and final driving control. In many normal controllers we have seen, even some with inertia, immediate reverse is possible. This is not the case in real life and not the case on our controller. The switch is 'momentary' in its action. It will only have effect when the train is stationary. This further limits the model train driver to abide by the rules of 'realism'. You cannot spoil the▶



effect or cause physical mayhem with it.

Four indicator LEDs are provided. One is for the 'power up' condition and this illiminates when power is applied, extinguishing when the lock out condition exists, such as when the STOP button has been pressed. There are LEDs to warn of an open circuit or a short circuit. The open circuit indicator will also illuminate should the commanded current (according to the throttle setting) be impossible to achieve with the available supply voltage. The short circuit indicator warns when the load impedance drops below a value preset by the user. This value may be set from zero to five ohms. On our prototype this was again a screwdriver adjusted front panel control. There is also a LED indicating when reverse is engaged. In a normal railway system a line is 'one way' and reversing is only used (on any given power supply) for shunting. Thus the warning is given when this wrong-way condition exists.

Construction

As this project is aimed at the enthusiast with at least a basic mechanical and electrical/electronic ability we expect most constructors will tailor the physical construction to suit their own requirements. The following is an outline of the order in which to do things if you intend to more or less duplicate our prototype.

Our prototype fits conveniently behind a 78 mm high standard (19 inch — 482 mm) instrument rack panel. With the heatsink and transformer mounted separately, the whole dual controller is less than 75 mm deep and so will recess conveniently into a model baseboard. It requires a hole of about 455 mm by 75 mm for the panel.

The front panel can be made from a blank piece of aluminium sheet cut to the right size. Kit suppliers may supply predrilled and lettered panels, but if not, it's a relatively simple matter to make your own. First step is to carefully mark out the holes with a soft pencil. Centre punch the hole centres and then drill the holes according to the sizes marked on the accompanying drawings. Clear the holes of all burrs and clean the panel down with either steel wool or a weak caustic solution. You can then paint the panel and when the paint is thoroughly dry it can be carefully lettered. We used white Letraset on the black panel. A spray-on lacquer will protect the lettering. Once the panel is prepared, fit the switches and the handles. The latter were made from pieces of aluminium channel, also sprayed black. Handles aren't essential, but they can be handy.

Next, mark out and drill the three rear panel pieces. Short lengths of 75 mm (3") channel were used to secure these to the front panel. You can do a 'trial' assembly using the unassembled pc boards to mark their mounting hole positions. If you drill holes a little oversize then you have some latitude for adjustment later to allow for inaccurate marking or drilling. The mechanical assembly drawings should assist you here.

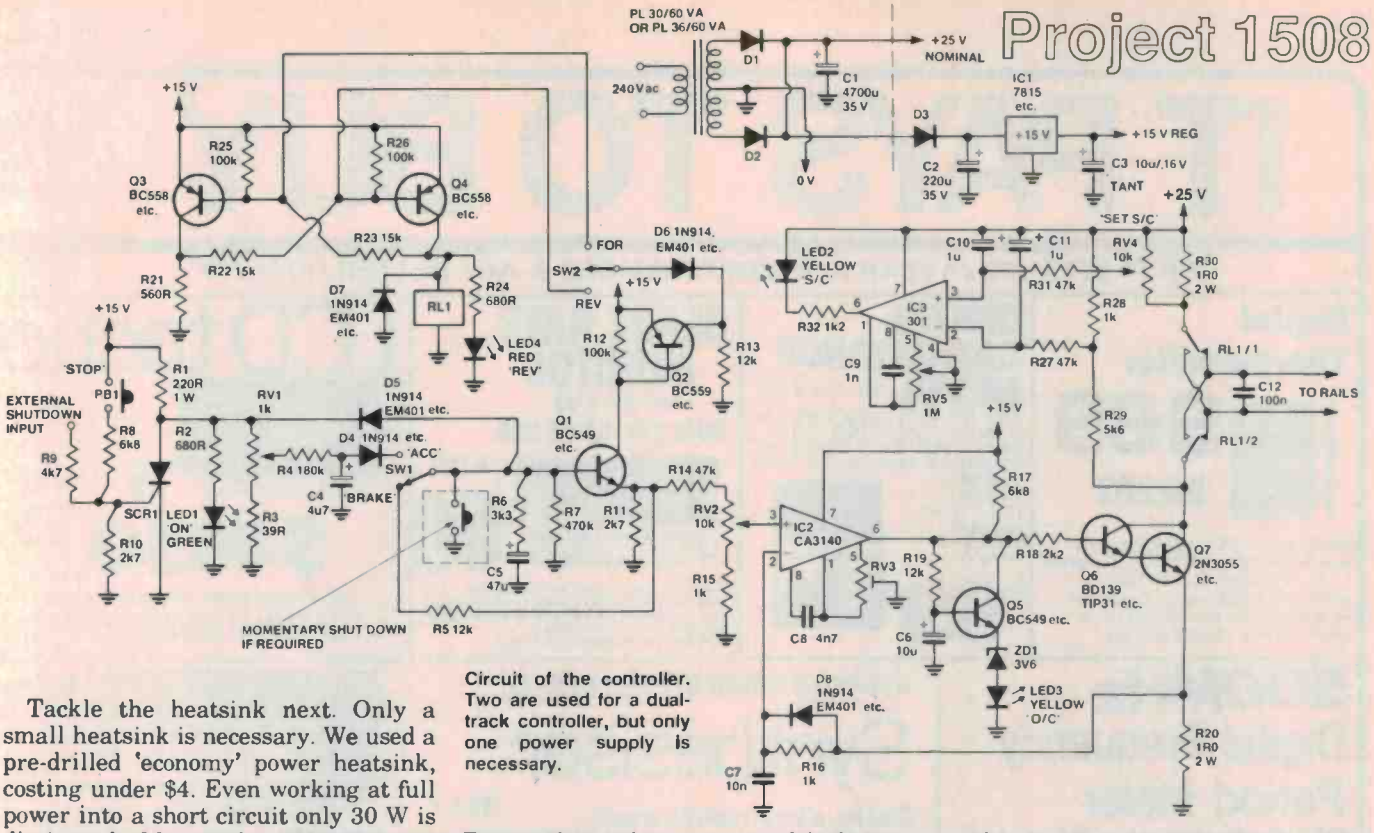
Having got the rear panel pieces sorted out, you can decide where to mount potentiometers RV2 and RV4 (the S/C and MAX. SET pots). You may elect to mount them directly on the front panel or glue them to the rear panel, as we did. We used Silastic to glue them in place. The shaft ends of the two pots were grooved with a hacksaw cut so that they could be adjusted with a screwdriver. Make sure the pot shafts line up with the panel holes. The two relays were secured to the channel pieces at either end of the panel using Silastic. You can mount all the switches and the throttle pots now. That's it for the moment with the mechanical assembly, now you can get on with the pc boards.

We have drawn up a component overlay and wiring diagram to assist assembling and wiring the pc board. Follow the component overlay for mounting the components to the pc board. Start by soldering the resistors and non-polarised capacitors (i.e: not the electrolytics) in place. Then follow with the polarised capacitors, making sure you get them in the right way round. A small '+' is on the overlay diagram where the positive lead is to be inserted. Identify the leads from the accompanying component pinout diagram. Solder all the semiconductors in place next, taking care you get all of them the right way round, too. You can identify which way they go from the overlay and pinout diagrams. Note that low power types for IC1 and SCR1 can be used, rather than the 'flatpack' higher power versions illustrated on the overlay. The low power versions come in transistor-type plastic packages with just three flying leads and no metal tab.

If you're using the flatpack types, we recommend that you bolt them to the pc board.

When you have fitted all the components to the pc board, make a careful check that all components are correct and those that need to be are correctly orientated. If all is well, you can now attach all the flying leads. Make sure each is of adequate length to reach from the pc board to their intended destination with some to spare.

Rear view of the controller.



Circuit of the controller. Two are used for a dual-track controller, but only one power supply is necessary.

Tackle the heatsink next. Only a small heatsink is necessary. We used a pre-drilled 'economy' power heatsink, costing under $4. Even working at full power into a short circuit only 30 W is dissipated. Mount the 2N3055s and BD139s to the heatsink taking care to insulate the 2N3055 with a mica washer. Ensure that no burrs on any of the holes can puncture the insulator. Smear the insulator both sides with thermal compound before mounting it. Check with an ohmmeter that none of the transistor leads is shorted to the heatsink. ▶

HOW IT WORKS — ETI-1508

The circuit of the train controller can be considered as five separate functional blocks: power supply, current control, current regulator, reversing control and short circuit detector.

The current control serves to interpret the driver's instructions and, taking inertia and energy into account, outputs a voltage proportional to the requisite engine torque. The current regulator forces the train to conduct this current and indicates the high resistance, or open circuit, condition, should it occur. The reversing control consists of a flip-flop driving a relay. This circuit will only toggle when the train is not being driven, preventing reversal during operation. Finally, the short circuit detector continuously searches for a low resistance condition in the load.

The power supply requirements are: a 15 V regulated rail for the electronics and an unregulated rail of between 18 and 35 volts. The circuit can tolerate severe ripple on the unregulated supply. Its only constraints are that the average voltage should lie between 18 and 30 volts with peak excursions no more than 35 volts and minimum excursions no lower than 10 volts. The supply must be able to deliver at least 1.5 amps per controller. We recommend a transformer such as the Ferguson PL36/60 VA or PL30/60 VA, which should be more than sufficient for two controllers. The +15 V rail is separately regulated for each controller, the regulator IC being mounted on the pc board (IC1). Diode D3 isolates C2 and IC1 from severe ripple on C1. IC1 may be a low power type (78L15) but provision for a 7815 was made on the pc board as these are more readily obtainable. Capacitor C3 bypasses the +15 V rail and prevents IC1 oscillating.

The current control comprises SCR1, SW1, RV1, Q1 and surrounding components (i.e: about the middle of the circuit!). If about 4 — 15 V appear on the 'EXTERNAL SHUTDOWN' input, or the 'STOP' button is pressed, SCR1 is triggered, removing drive from RV1 and discharging C5 via D5-R6. This condition is indicated by LED1 going out.

Normally, when SCR1 is not triggered, control is vested in SW1 ('ACCELERATE — BRAKE') and RV1 ('THROTTLE'). With SW1 in the mid (open) position, C5 remains discharged while C4 charges to the level set by RV1. When SW1 is moved to the ACCELERATE position, C4 discharges into C5 via R6. This causes C5 to charge to about 20% of the final voltage set by RV1. Also, a small voltage pulse appears on the base of Q1. Capacitor C5 then charges exponentially via R4 to the final level. If RV1 is reduced, D4 prevents C5 discharging through R4. Capacitor C5 discharges via R7, allowing a different rate of reduction of speed, as is the case in reality. (A train accelerates faster than it slows down if no braking is applied).

If SW1 is placed in the 'BRAKE' position, a constant current is drawn out of C5 via R6 and R5, because Q1 maintains its emitter voltage at about 0.65 V below its base. This action causes a linear reduction (rather than an exponential fall-off) of the voltage on C5. (A vehicle dissipates energy proportional to the square of speed. This linear braking effect causes the model to reflect this sharp-halt situation more realistically). Transistor Q1, acting as an emitter follower, copies this voltage on C5 out to RV2 via R14. Thus, the initial peak and the continuously varying voltage on C5 are output for the current regulator.

The current regulator consists of IC2 (a CA3140) and surrounding components. This is simply an op-amp wired to ensure that the emitter current of Q7 in amps equals the voltage on pin 3 (the non-inverting input). Trimpot RV3 is included so that a small offset voltage may be established to fix the emitter current of Q7 at a value of about 15 mA when the voltage on pin 3 of IC2 is at 0 V. This minimum current value allows the short circuit and open circuit detectors to work all the time, even when the train is stationary. This current is not sufficient to cause train movement. Resistor R16 and capacitor C7 remove hash caused by commutation and dirt on the tracks. Diode D8 is required to protect the circuit from overload when going from an open circuit condition to a short circuit condition. Transistor Q5 and surrounding components detect the open circuit condition. If the collectors of Q6-Q7 go open (i.e: no current supplied via the rails), they saturate, the voltage on R20 falls and the output of IC2 rises toward the +15 V rail. If this condition persists for more than quarter of a second or so, C6 charges up and Q5 turns on LED3 via ZD1. The delay prevents flickering due to momentary effects such as crossing isolators on the track or dirty engine pickup wheels.

Reversing is achieved by operating the relay, RL1. Transistors Q3 and Q4 form a flip-flop which drives RL1 on in one state and off in the other. When Q1 draws no current (i.e: there is no drive signals to IC2) Q2 is off, allowing SW2 to toggle the flip-flop by pulling the base of either Q3 or Q4 to ground via D6-R13. When running the train, Q2 remains turned on and SW2 has no effect because of D6. The 'REVERSE' indicator, LED4, lights when Q4 is on and the relay activated.

The short circuit detector is built around IC3. This acts as a comparator. Its output lights LED2 if the voltage across the relay contacts drops below a preset ratio of that voltage dropped across R30, the current sense resistor. Capacitors C10 and C11 prevent IC3 responding to hash. Trimpot RV5 is for nulling the op-amp offset. Capacitor C12 also helps reduce interference from getting into the high gain circuits on the pc board.

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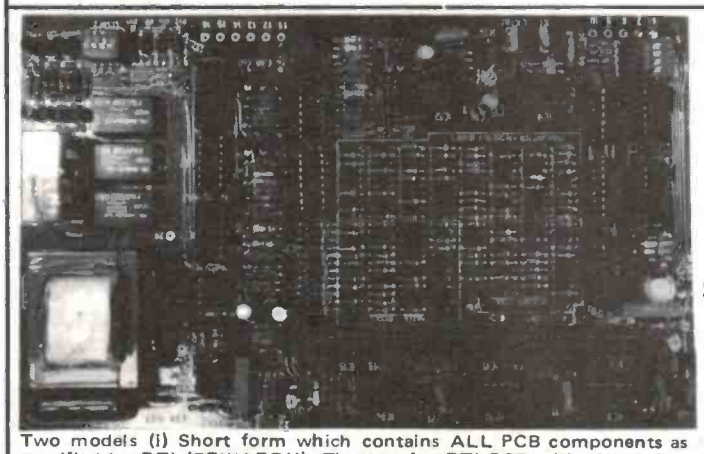

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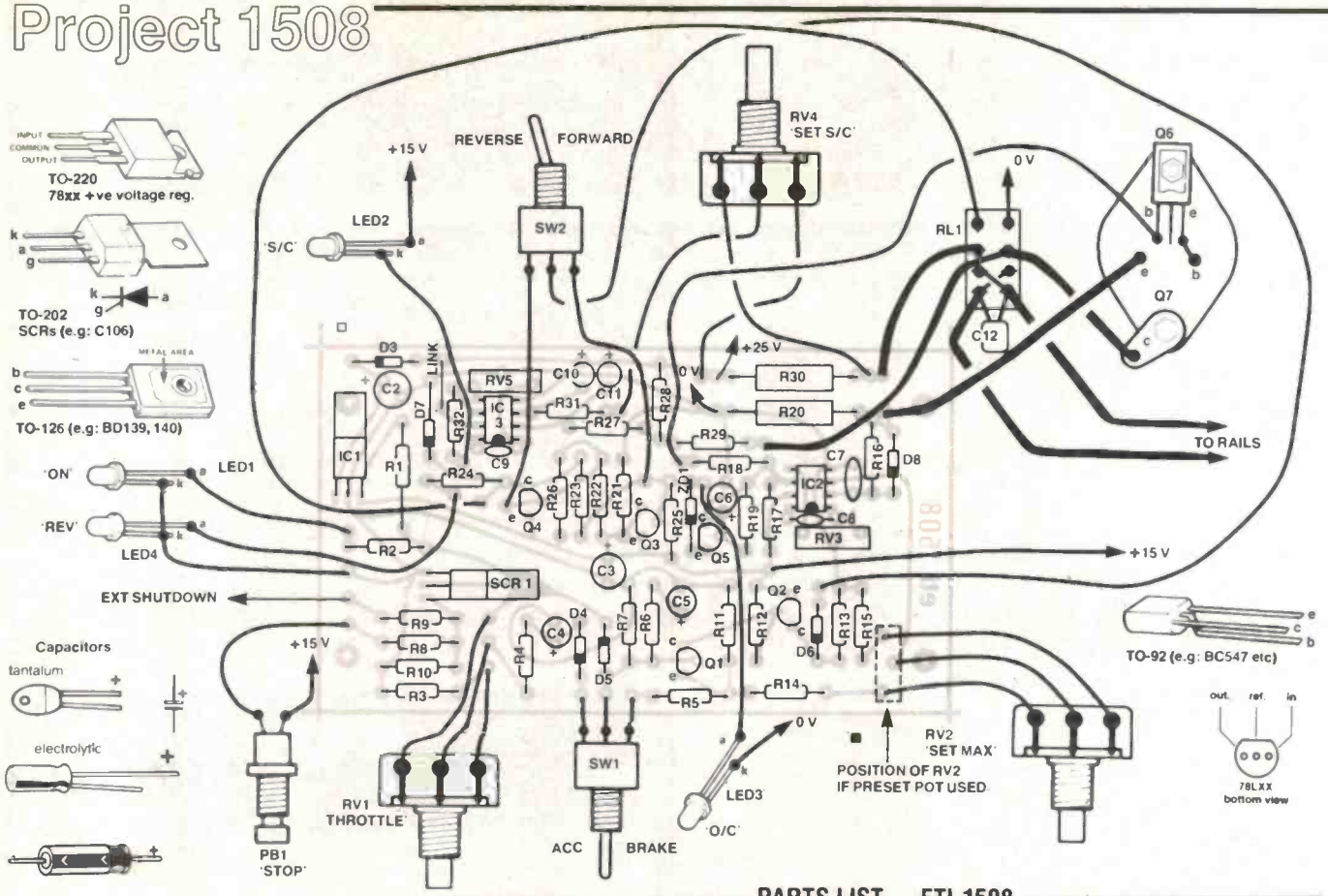


You can wire up the transistors and attach flying leads, referring to the wiring diagram, but don't connect the leads from the pc board yet.

Now you can return to the mechanical assembly. Mount the pc boards and wire up all the flying leads. Note that the +15 V and 0 V leads go to several locations each: for example, LEDs 1, 3 and 4 all have their cathodes (k) going to 0 V. Double check to see that no connections to off-board components are left unused. We used double-pole switches for SW1, SW2 and PB1. This was mainly because single-pole versions were not available at the time we constructed the prototype. The spare poles were unused.

Note that heavier gauge hookup wire should be used to connect the collector and emitter of Q7 to the rest of the circuit. Use 24 x 0.2 mm plastic insulated hookup wire at least.

Now check *everything*.

Finally, wire up the rectifier and filter capacitor as per the wiring diagram, unless you're using some other supply, and connect up the power transformer. Take care with the mains wiring. If you are using an existing transformer/rectifier, then only a filter capacitor is needed. Its value depends on the voltage: we recommend at least 3300 uF for a supply of 21 volts peak, which is the minimum unsmoothed supply recommended. Now you're ready for 'the big switch on!'.

PARTS LIST — ETI-1508

Resistors — all ½ W, 5% unless noted

R1	220R, 1 W
R2, R24	680R
R3	39R
R4	180k
R5, 13, 19	12k
R6	3k3
R7	470k
R8, 17	6k8
R9	4k7
R10, 11	2k7
R12, 25, 26	100k
R14, 27, 31	47k
R15, 16, 28	1k
R18	2k2
R20, 30	1R, 2 W
R21	560R
R22, 23	15k
R29	5k6
R32	1k2
RV1	1k lin. pot.
RV2	10k trimpot or lin. pot
RV3	10k trimpot
RV4	10k pot.
RV5	1M trimpot

Capacitors

C1	4700u/35 V or 50 V axial electro.
C2	220u/35 V RB electro.
C3, 6	10u/16 V tant.
C4	4u7/16 V RB electro.
C5	47u/16 V RB electro.
C7	10n greencap
C8	4n7 greencap
C9	1n greencap
C10, 11	1u/16 V tant.
C12	100n greencap

Semiconductors

D1-D3	1N4001, EM401, 1N4002 etc.
D4-D8	1N914, 1N4148, 1N4001 etc.
IC1	7815, 78L15
IC2	CA3140
IC3	LM301, uA301
Q1, Q5	BC549
Q2	BC559
Q3, Q4	BC558
Q6	BD139, TIP31
Q7	2N3055
LED1	TIL220G green LED
LED2, 3	TIL220Y yellow LED
LED4	TIL220R red LED
SCR1	C106

Miscellaneous

RL1	12 V double-pole change-over relay with contacts rated at 2 A or more, coil 240 ohms or more.
SW1	SPDT toggle switch with spring return.
SW2	single-pole, three-position switch, centre-off, spring-loaded return one side.

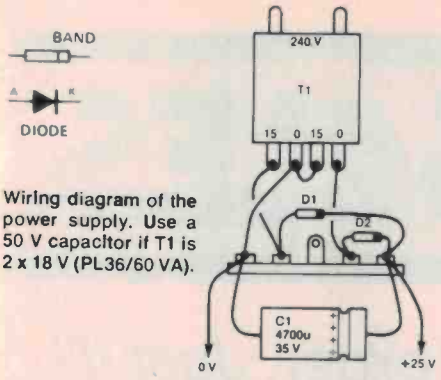
ETI-1508 pc board; PL30/60VA transformer or PL36/60VA, if needed; knobs to suit; panel metalwork, channels etc as per drawings; spacers; nuts, bolts etc; hookup wire.

Note: For a twin-track controller, two of everything except the mechanical hardware will be necessary.

Price estimate $105 — $115 (dual track unit)

Adjustments

Once the wiring up is complete some adjustment of preset pots must be made. As well, some adjustment of component values may be desirable in order to tailor the controller action, or 'feel', to your particular requirements. You may also wish to modify the action of the 'STOP' button.



Wiring diagram of the power supply. Use a 50 V capacitor if T1 is 2 x 18 V (PL36/60 VA).

TABLE 1

Possible component variations.

FUNCTION	COMPONENT TO CHANGE	RANGE OF VALUES
Acceleration	R	50k to 330k
Starting pulse magnitude	R6	100R to 10k
Slowing	R7	390k to 10M
Braking	R5	1k to 27k
	(Note: R4 affects this too!)	
% charge jump	C4	0 to 20 uF

*Do not forget to adjust R14 if necessary to limit maximum current to 1.5 A.

There are two preset potentiometers, the offset null pots for the two op-amps, which must be adjusted. These will probably never need readjustment once initially set. The 3140 (IC2) offset pot should be adjusted to give the required 15 mA minimum current in the output. Place a current meter across the track, and adjust this pot until 12 to 18 mA flows. Removing the meter, leaving an open circuit, should illuminate the O/C LED. Shorting the output will turn it off.

The 301 (IC3) offset pot should be adjusted with pins 2 and 3 shorted to pin 7. When you have temporarily made these connections, move the wiper to and fro, observing that one direction turns the S/C LED off, the other turns it on. Leave the wiper at the point of switching just so that the slightest movement in the appropriate direction will toggle the LED. Remove the temporary connection. Verify the correct connection and operation of the short circuit detector by following this procedure: place a locomotive on the track; adjust the 'SET S/C' pot, slowly, until the LED just goes out. If the track is now shorted, the LED should come on. This takes half a second or so. The SET pot can be adjusted to recognise any resistance from almost zero to 5 ohms at least, as the minimum acceptable value, before a short condition is indicated. This range will be adequate for all normal wiring up resistances, etc. The 'SET MAX' pot is adjusted simply to set the level which is the most current a locomotive or pair of locomotives will ever need. It can be adjusted either with a current meter if you know the value, or simply to give convenient feel to the throttle knob. If you find you are always at the beginning of the throttle range, adjust this pot down to reduce the maximum. If you always need full throttle to run a train, adjust it up.

Once you have familiarised yourself with the operation, you may wish to change certain time constants. The accompanying table shows what components affect what characteristics. Recommended values fit recent design HO scale models. If you wished to increase all the time constants because your layout is very large, you could increase C5, or vice versa. This will also affect the initial current jump, reducing it. If you need to restore this or even make it larger, increase C4 as well. If you change any of the resistors, you may need to change R14. This resistor does not directly affect the 'feel' of the controller, but limits the maximum current which may be requested, to the controller limit of 1.5 A so that prolonged short circuits at full current cannot harm the unit. It is likely that R4, C4 and C5 only will need changing, to tailor the controller for another scale, such as N-gauge, etc.

Finally, you may wish to change the STOP button action. We suggest wiring it as shown in the diagrams. It triggers the SCR when pressed. This locks out the controller until the SCR is isolated by turning off the supply. Two modifications may be implemented. Firstly, you may wish to have it stop the trian but allow it to start as soon as the button is released. This is achieved by wiring it from the top of R6 to ground. Alternately you may wire it across the SCR, anode to cathode. This has the advantage that it may be used to restore power by isolating the SCR if it is triggered by an external signal. The other option is to include a separate (possibly concealed) button across the SCR for restoring power. Whichever option you wish is open to you. We feel that the need to use the button should incur some inconvenience, so we opted for the turn-off-to-restore-power method.

The external SCR trigger input is provided for those who wish to include some logic in their layout. Position sensors, point and signal control systems, etc, may be wired to stop the train by means of applying a TTL-high (4 V or more) to this input, which has the effect of pressing the STOP button. ●

Some Notes on TRAIN DRIVING and Problems you may encounter

This controller, as we have said before, delivers constant current rather than constant voltage. Constant current produces constant motor torque. Thus, just as is the case in a car, the train will slow for hills, speed up for descents, etc. This will mean that you have to pay fairly constant attention or the train will end up derailing or throwing carriages due to speed or 'stalling' due to insufficient 'gas'. The author can barely manage to control two trains at once, so be warned that train driving is not as easy as it used to be! Braking is also not exponential, as is acceleration. This corresponds to an effect you may have noticed if you drive a car — hard braking at 25 kph causes fairly severe loss of speed, but hard braking at 125 kph causes an alarmingly mild reduction of speed; you dissipate energy proportional to speed, but the energy needed to be dissipated rises with the square of speed.

A problem which demands some discussion is that of 'starting torque'. Many model engines, particularly old ones (the author has several engines over twenty years of age) have a tendency to require an amount of current to start moving which is greatly in excess of that to keep moving. Thus they sit still until the 'starting torque' is achieved then take off at some speed. This is not due to bad contacts. To some degree this controller scheme can overcome the problem. Firstly, actual bad contact problems will be automatically resisted, and indication is given as soon as the fault becomes serious. Thus, these will be separated from other problems and can be remedied by cleaning, and so forth. Secondly, the controller gives a small 'jerk' at startup, corresponding to the takeup of coupling slack in a real train. If controls are adjusted suitably, the train will not quite stop after this jerk (which should easily exceed starting torque) and will pull away smoothly. Recall that the controller output jumps to some preset fraction of the initial throttle setting immediately after switching to the 'accelerate' position of the main control switch. Judicious adjustment of the throttle before startup can ensure a sizeable jerk and a large initial step level. If necessary, increasing the startup capacitor C4 will increase the initial step torque so that the engine does not come to rest even for a moment after startup. Reducing R6 will reduce the duration of the jerk, increased by increasing C4. Newer engines respond smoothly and may benefit purely from reduction of R6 to minimise the startup jerk. Our older engines used 15 uF for C4 successfully.

One further point arising is that the jerk may be reduced or eliminated where you wish by reducing the throttle to zero before going to accelerate mode, and bringing it up as soon as you start up, though this eliminates the initial torque step. Our prototype units delivered a typical jerk of about 30 degrees of wheel rotation on a model steam locomotive — most pleasing.

Another problem which is regretably unique to current type controllers such as this one is that they do not like the non-linear load of incandescent lamps in parallel with the engines. Two effects will be evident: when the train is stationary, the lamps are cold and look like a short circuit and so the S/C detector will respond. It will reset as soon as power is delivered however, and should be sensitive enough to be settable at the level where only a genuine short is registered. The second problem is that the cold lamps draw a lot of the current delivered in total until they heat up and begin to glow, whereupon they allow a much larger voltage across themselves while drawing the same current. This makes the train sluggish at first and likely to run away once the lamps are on. This effect is similar to and worsens the starting torque problem. In general, lamps should be avoided or at least have a few tens of ohms inserted in series to minimise the problem. Using lower voltage units and series resistances is less power economical but better. The author uses LEDs on locomotives, which are sufficient and do not affect performance.

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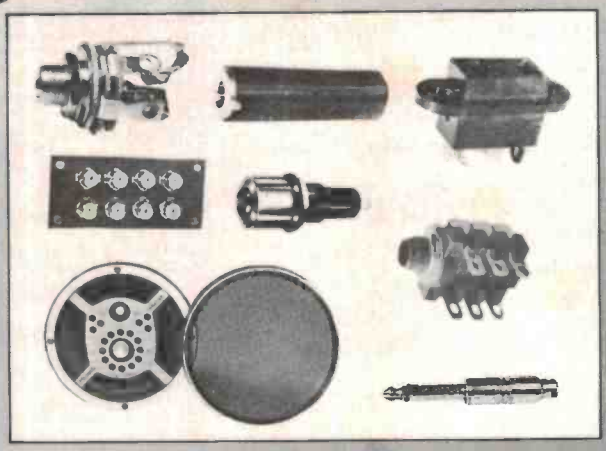

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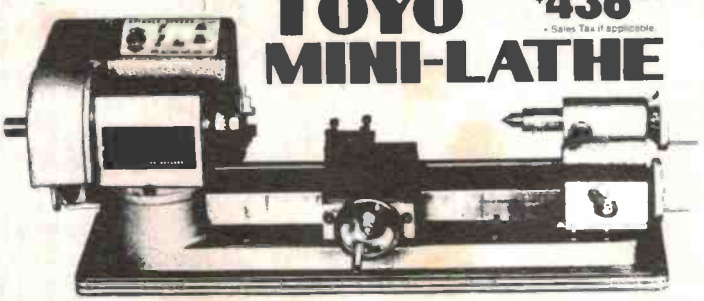

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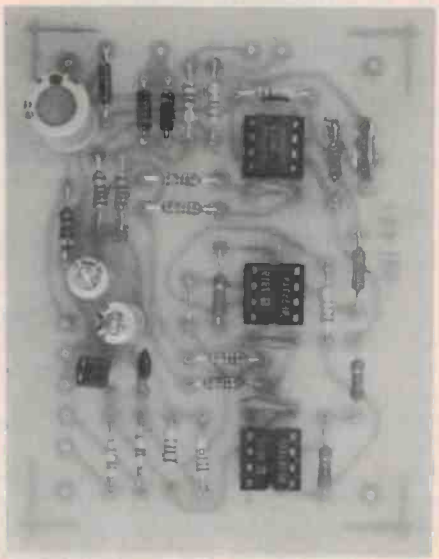
Project 461

Balanced input differential preamp

David Tilbrook



This versatile little preamp has a host of applications in the audio-and-beyond range, not the least of which would be as a balanced mic preamp.

MANY transducers require a balanced or differential preamplifier rather than the simpler single input unbalanced type. Balanced microphones, for example, require a balanced preamplifier to ensure minimal susceptibility to extraneous noise sources. The concept in the balanced approach is fairly simple. The microphone, for example, is connected to the balanced preamp using three wires instead of two. Two of these wires carry signal and the other is a ground connection. The balanced source, in this case a microphone, generates a signal voltage on the two signal wires such that one of the signals is 180 degrees out of phase with the other. The two active lines are twisted together, with the earth line, or a two-wire shielded cable is used to connect the mic to the preamplifier. In this way any external noise or hum source will affect both inputs equally, producing a signal that is in phase on both of the signal wires. Such a signal is called a *common mode* signal. The balanced preamplifier however, is configured in such a way as to amplify only a differential signal. The preamp produces an output signal that is proportional to the difference between its two inputs. Since the signal is generated out of phase, it is amplified. The noise source however is a common signal and is the same in both input wires. The difference between the noise signals on each of the input wires is therefore zero, and is not amplified (see Figure 1). With this technique small signals can be sent over long lines, an otherwise impossible task due to the susceptibility of these lines to mains hum in particular.

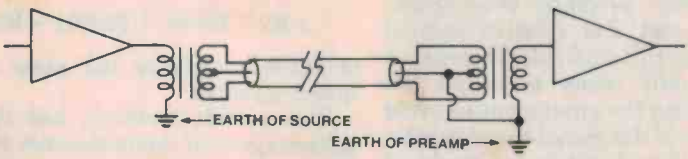


Figure 2. Balanced line with transformer coupling.

In audio the most common method employed to implement a balanced line is with transformers. The basic approach is shown in Figure 2. The source may be a microphone or a small preamplifier inside the microphone, or simply the output from a mixer or other electronic device. This is connected to the input of a balancing transformer that is wound to represent the correct load to the driving stage. The output of this transformer consists usually of a bifilar wound secondary connected as shown in Figure 2. A similar transformer is used at the other end of the line to convert the differential signal back into one that can be amplified by the single input preamp. This technique has the advantage that the signal earth of the source need not be connected to that of the preamplifier. This can be a *very* useful feature at times, particularly when large numbers of cables are connected together at a common point such as at a mixing console. The ability to isolate the input earths of the various inputs enables complete freedom from hum loops which otherwise can become almost impossible to remove.

Transformers have disadvantages however. Firstly, good ones are expensive as they must be carefully wound and shielded from external hum fields. Since the transformer is a coil of wire, wound specifically for good response over the complete audio ▶

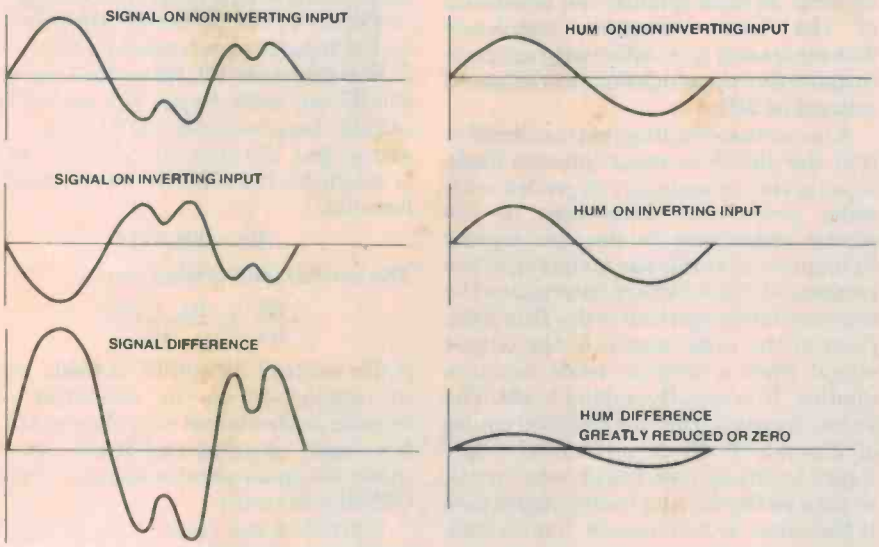


Figure 1. Differential signals on a balanced line are amplified while common-mode signals are reduced.

spectrum, they are particularly susceptible to magnetic fields produced by power transformers etc. The problems associated with isolating the transformers from power supply hum fields can be very real, if not impossible in some instances.

It is often said that a transformer's ability to reject a common mode signal is inferior to that of a balanced preamplifier such as the one to be described in this project. Although this is true it is largely irrelevant since the limit to common mode rejection is usually set by the shielded cable used to connect the input devices. Even the best quality cables seldom allow common mode rejections greatly in excess of 60 dB, a figure which is easily surpassed by most input transformers. The main advantage of differential preamps over transformers is cost and relative lack of susceptibility to hum fields. This makes it substantially easier to mount the preamp within the equipment to avoid degradation of the signal-to-noise ratio by hum pickup. Another advantage of the preamp over transformers is that even the best transformers generate significant amounts of harmonic distortion in comparision to distortion figures easily obtained with an op-amp based balanced design.

The differential input needed is easy to implement with the help of operational amplifiers, since these have inverting and non-inverting inputs already. The simplest circuit that could be used and one that is adequate with microphones is shown in Figure 3. This circuit is the standard differential op-amp circuit and offers good performance with most balanced sources. The resistor from the

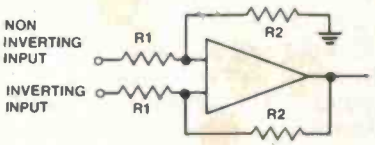


Figure 3. Preamp stage with a simply-balanced input.

non-inverting input to ground is made the same value as the feedback resistor. In this way the gain of the stage is identical for the two inputs. With the non-inverting input grounded, the gain of the stage is determined by the ratio of the resistors R2/R1. With the inverting input grounded, the gain of the op-amp is given by the standard formula

$$(R2 + R1)/R1.$$

In this case however, the input resistor in series with the non-inverting input and the resistor from this input to ground form a potential divider and attenuate the signal by an amount given by:

$$V_i = V\,(R2/(R1 + R2))$$

So the total gain of the stage at the non-inverting input is

$$((R2 + R1)/R1)\,(R2/(R1 + R2))$$

or R2/R1, which is the same as the inverting input.

This circuit however, has the disadvantage that the impedance to earth from each of the two inputs is very different. The impedance at the non-inverting input can usually be regarded as approximated by the series combination of the two resistors, i.e: R1 + R2. The impedance at the inverting input is simply that of the input resistor, since the inverting input is a virtual earth once feedback is applied in this way. This does not bother most balanced sources, since a true balanced source works independently of the ground connection.

The impedance seen by the balanced source is a result of that due to both input resistors and the internal impedance from base to base of the input differential pair within the op-amp. In most circuits the resistance of the input resistors completely dominates and it is sufficiently accurate to quote the input impedance to balanced sources as 2R1.

A major disadvantage of this circuit is that the ability to reject common mode signals can be seriously degraded with some sources by differences in the source impedance to the two inputs. Remember that it is the matching of the two sets of resistors that determines the common mode rejection ratio. This is the ratio of the input signal to the output signal when a common mode signal is applied. It is usually quoted in dB. The value quoted earlier for shielded cables of around 60 dB is a relatively easy figure to obtain with the op-amp circuit so long as the driving source impedance is the same for both inputs. A mismatch of only one per cent will degrade the common mode rejection ratio (CMRR) of an otherwise well designed preamp by around 20 dB, and result in a figure that could easily be unsatisfactory.

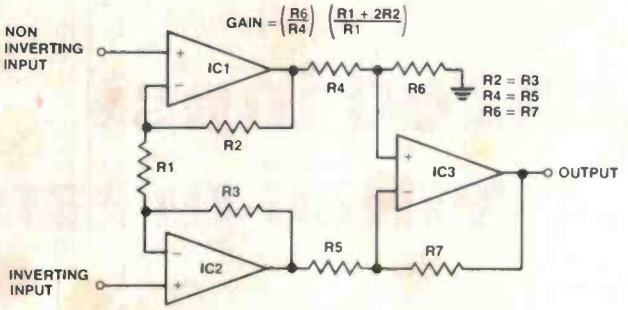


Figure 4. The solution to the problem.

Another disadvantage of this circuit is that it is not capable of delivering the full gain needed of the preamplifier and still give satisfactory distortion figures. If we take a nominal output signal level from a balanced microphone to be around 0.2 mV and the required output from the preamp to be around 100 mV, then a gain of 500 is required, or around 54 dB. The distortion figure obtained using the best op-amps available would be unsatisfactory. For example, an NE5534N at a gain of 500 would have a distortion figure around 0.15%, a poor figure by modern standards and well outside the capabilities of a good transformer. The solution is simply to decrease the gain of the stage and add a second stage to make up the difference. This however, does not solve the problem of degradation of the CMRR on some sources. The real solution is to add a *third* op-amp to the design and implement a full instrumentation amplifier.

The basic circuit for an instrumentation amplifier is shown in Figure 4. The second stage, formed by IC3, is the same as the simple differential amplifier in Figure 3, but its inputs are buffered by the input stages formed by ICs 1 and 2. Resistor pairs R2, R3 and R4, R5 and R6, R7 are made equal. The gain of the second stage is simply R6/R4 as derived above, but the gain of the first stage is given by the slightly more complex formula:

$$(R1 + 2R2)/R1$$

The overall gain is therefore

$$\frac{R6}{R4} \times \frac{R1 + 2R2}{R1}$$

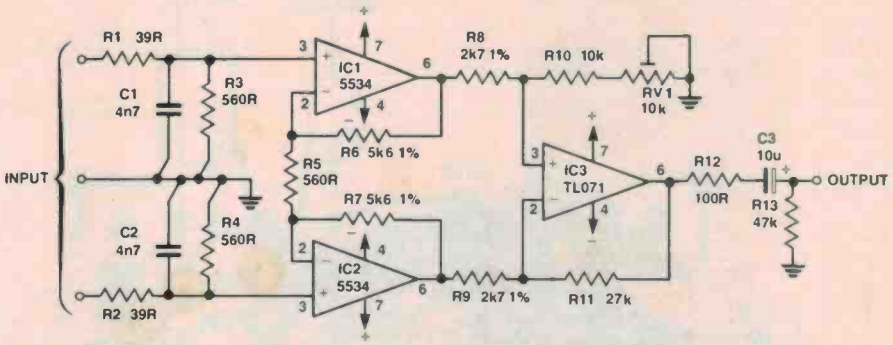
If the value of R4 and R5 is made large in comparison to the estimated difference in the output impedances of the two input op-amps and if the gain of these two op-amps is the same then good CMRR will result.

A problem can occur on many instrumentation amplifiers in ensuring that

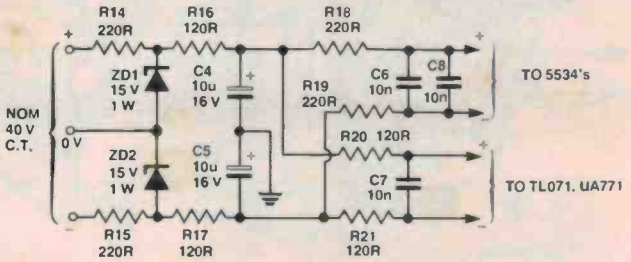
the gains of the input op-amps are as close as possible to being the same. One feature of this circuit is that the CMRR is affected to a lesser extent by the matching of the resistors around the first stage. Furthermore, this will not be degraded by mismatch of the source impedance to the two inputs. The overall gain of the preamplifier is divided into two stages ensuring sufficient amounts of negative feedback to provide low distortion.

Close tolerance resistors (1% or 2%) are specified for R6, 7, 8 and 9 so that any dc inbalance between the input stages, IC1 and IC2, can be balanced out by RV1.

It is a good idea to use low noise metal oxide resistors for the input resistors, R3 and R4, to get good noise performance. They cost little more than standard carbon deposition types. Indeed, metal oxide resistors could well be used throughout, without a significant cost penalty. Most metal oxide resistors are available in 1% or 2% tolerance classes in any case.



NOTE: EXTERNAL CONNECTION MUST BE PROVIDED BETWEEN POWER SUPPLY 0 V POINT AND THE SIGNAL GROUND. SEE TEXT.



HOW IT WORKS — ETI-461

The circuit is a relatively straightforward instrumentation amplifier. The main differential stage is formed by IC3, the TL071. This is a BiFET op-amp with good common mode rejection ratio (CMRR) figures. This stage is buffered from the inputs by a pair of NE5534AN op-amps that also provide additional gain and determine the overall noise performance of the preamp. As mentioned in the main article, the overall gain of the preamp is determined by the gain of the first and second stages. The gain of the second stage is determined by the ratio of R11 to R9, and is around 10. The gain of the first stage is approximately 20, giving an overall gain of about 200, or 46 dB. If you require a different gain to this, try to keep the ratios of gain in the first and second stages the same. The amount of gain provided here should be suitable for most microphones, providing around 100 mV output from a 0.5 mV input signal level.

The circuit is dc coupled at the input. This assumes that the driving source will be transformer or capacitively coupled at the output, which should be a safe assumption. The input impedance of the stage is set by the two input resistors R3 and R4. To increase the input impedance, simply increase the value of these resistors.

The RC networks consisting of R1-C1 and R2-C2 are high frequency filters to reduce the circuit's susceptibility to RF interference.

The split power supply is provided either from two zener regulators or from a well-regulated and filtered dc source. The supply pins to each IC are decoupled by 1k resistors and 10n capacitors to prevent IC-to-IC interaction and possible feedback via the supply rails.

Construction

Construction of the unit is straight forward if the ETI pc board is used, since all components are mounted on the board. The usual precautions should be taken. The circuit employs several electrolytic capacitors so be certain these and the transistors, diodes and ICs are inserted with the correct orientation. The circuit is shown to run from a nominal ±20 V supply. This ensures a clean ±15 V supply to the op-amps giving the circuit good headroom. If this voltage is not available however, the circuit will run perfectly well on a lower supply voltage. If the supply is clean regulated dc, the on-board zeners can be eliminated. If not, replace them with a lower voltage type to suit the supply voltage available. The NE5534ANs are rated for supply voltages in excess of 20 V but some second-source alternatives to the Signetics devices seem to be incapable of running on this supply voltage. If the devices you obtain do not have the NE prefix it might be wise to ensure that the supply voltage to the op-amps does not exceed 15 V. If in doubt, leave the zener diodes in circuit as shown on the pc board layout and the circuit diagram.

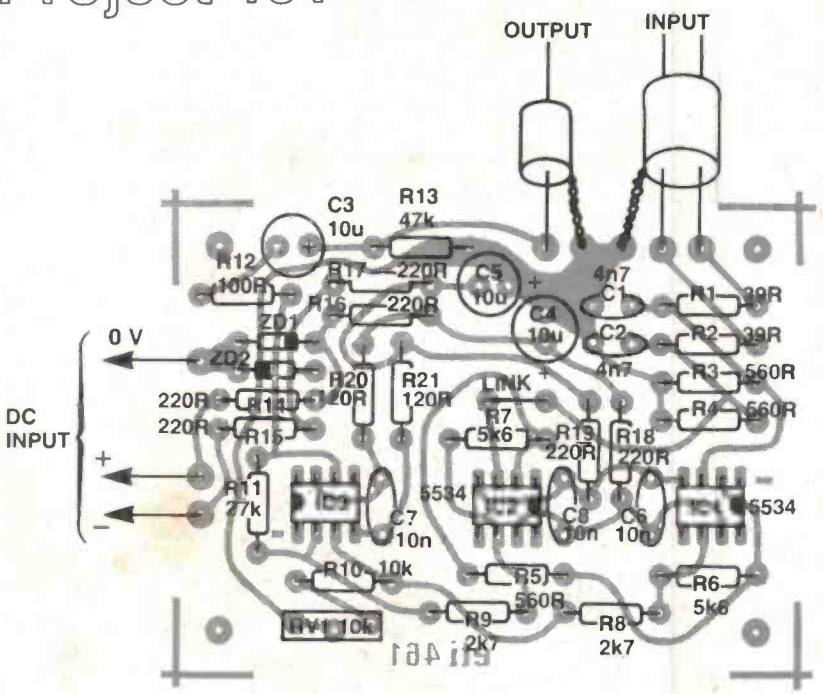
The pc board has been designed so that an external connection must be provided between the 0 V point on the pc board and the signal earth. The correct place for this connection is at the input to the preamplifier, i.e: on the input ▶

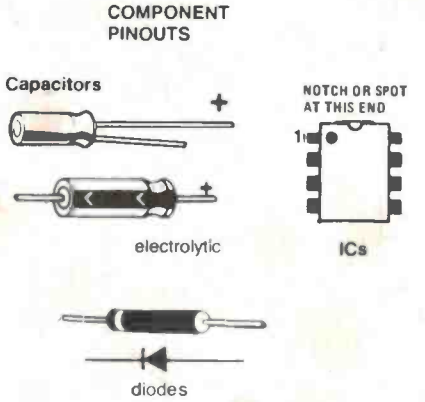
SPECIFICATIONS — ETI-461 DIFFERENTIAL PREAMPLIFIER

Frequency response (10k load)	12Hz - 60 kHz, ±0.1 dB
T.H.D. (at 5 V RMS output)	
100 Hz	<0.007%
1 kHz	<0.006%
10 kHz	<0.012%

Distortion figures can be expected to decrease further at more realistic signal levels but becomes difficult to measure.

Total equivalent input noise (20 kHz bandwidth)	−124 dB (approx)
Input impedance	nominally 560 ohms to ground from each input.
Output impedance	nominally 260 ohms
Common mode rejection ratio	depends on calibration but easily adjusted to 80 dB.





socket. A separate wire is run from the 0 V point to the signal earth point of the input socket. The signal leads from the input socket to the pc board should be shielded cable with the earth braid connected at both ends. The signal earth should not be connected to the chassis directly. RF shielding can be accomplished by connecting a 100n capacitor between the signal earth at the input socket and the chassis. This will eliminate any problems with hum loops that might otherwise be formed around the mains earth line. If in doubt about this, consult the article on the Series 5000 power amplifier published in March 1981. This article describes in detail the earthing arrangement and the principles employed in power amp design are similar to those needed for good earthing of a preamplifier.

Performance

This preamplifier is capable of excellent performance. The noise figures obtained are, to a large extent, determined by the choice of op-amp used. With the NE5534AN the noise figures and distortion performance quoted in the specifications table can be expected. An equally important parameter is of course the slew rate and slew-induced distortion (SID) characteristics of the design. The open loop frequency response of the op-amps used ensures an extended frequency response and all tests for slew-induced distortion gave good results.

The subjective testing of the preamp showed no sign of harshness due to slew limiting or other distortion mechanisms until very high input signal levels caused clipping of the output. The unit was tested with a number of high quality balanced microphones and several unbalanced types as well. If an unbalanced low impedance mic is to be used, the unused input is simply connected to ground at the input socket.

In all tests, the unit performed well and should prove to be a good balanced mic amplifier suitable for incorporation in a large number of high quality audio projects. ●

PARTS LIST — ETI-461

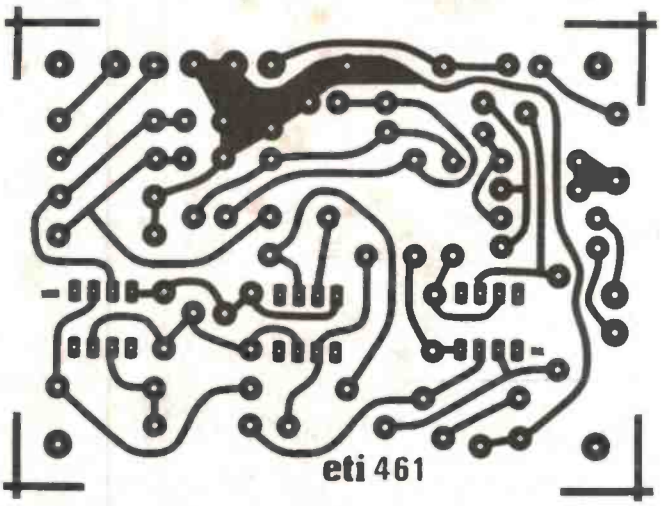
Resistors ..... all ½ W, 5% unless noted
R1, R2 ..... 39R
R3, 4, 5 ..... 560R
R6, R7 ..... 5k6, 1%
R8, R9 ..... 2k7, 1%
R10 ..... 10k
R11 ..... 27k
R12 ..... 100R
R13 ..... 47k
R14, R15, 18, 19 .. 220R
R16, R17, 20, 21 .. 120R

Capacitors
C1, C2 ..... 4n7 greencaps
C3 ..... 10u/35 V RB electro.
C4, C5 ..... 10u/16 V RB electro.
C6, 7, 8 ..... 10n greencap

Semiconductors
IC1, IC2 ..... NE5534N (see text)
IC3 ..... TL071
ZD1, ZD2 ..... 15 V, 1 W zener

Miscellaneous
ETI-461 pc board

Price estimate
$18 — $20

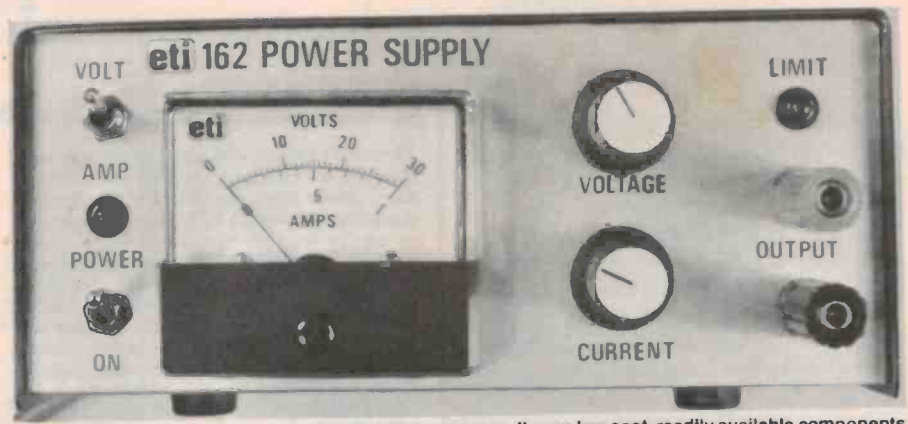


Project 162

30 V/1 A fully adjustable, protected power supply

This low cost, easy to build power supply features full protection, variable voltage output from 1.3 to 30 volts, variable current limit from zero to one amp plus metering of both voltage and current output.

David Tilbrook
Roger Harrison



Our power supply presents a neat, functional appearance. It uses low cost, readily available components and is housed in a standard 184 x 70 x 160 mm metal case. Scotchcals were made up and applied to the front panel and meter scale.

THE FIRST piece of test gear an electronics enthusiast or technician wants after a good multimeter is a *power supply*. But, exactly *what* does that hypothetical person want, we asked ourselves? After much discussion, examining past projects etc, we came up with a specification like . . . A, B, C. As he happened to be a captive in the advertising sales office, which is next door to ETI's lab, we put it to a famous Irish West Australian electronics dealer who walks on water for a hobby (see ETI, April '81, p.11), to 'test the water', so to speak. He said, "No, no, no! What they want is a power supply with D, E, F for XY.Z dollars". Conceding he might be right but that there was an element of pecuniary interest to be deducted, we counter-proposed a power supply with G, H, I but the Irishman said that would cost ZY.X dollars and no electronics person in their right mind would pay that. At this stage we thought compromise would result in a power supply with a camel-hitching rail on the front panel and thought retreat/rethink the wiser move.

Suspecting XY.Z dollars was something like $49.50 ($10 above a current kit supply and $10 below our last low-cost supply project) it was apparent some awful constraints were looming up. Rather than taking a 'better' supply and pruning it to meet a price, we started from the ground and looked at what was necessary and asked could it be done?

Obviously, a 'laboratory standard' power supply with dual digital metering, programmable voltage and current and nuclear blast proofing was not necessary. Most solid-state circuitry requires voltages between 3 V and 30 V and may require currents up to half an amp or so. Any circuitry run from the supply would need to be protected from damage by excess current should there be a fault in it, so current limiting was necessary. Current limiting also has the advantage of providing protection for the power supply if the output should be short-circuited. So, variable output up to 30 V and variable current limit were two prime goals. A pot costs less than a toggle switch so continuously variable current limiting could be included, perhaps.

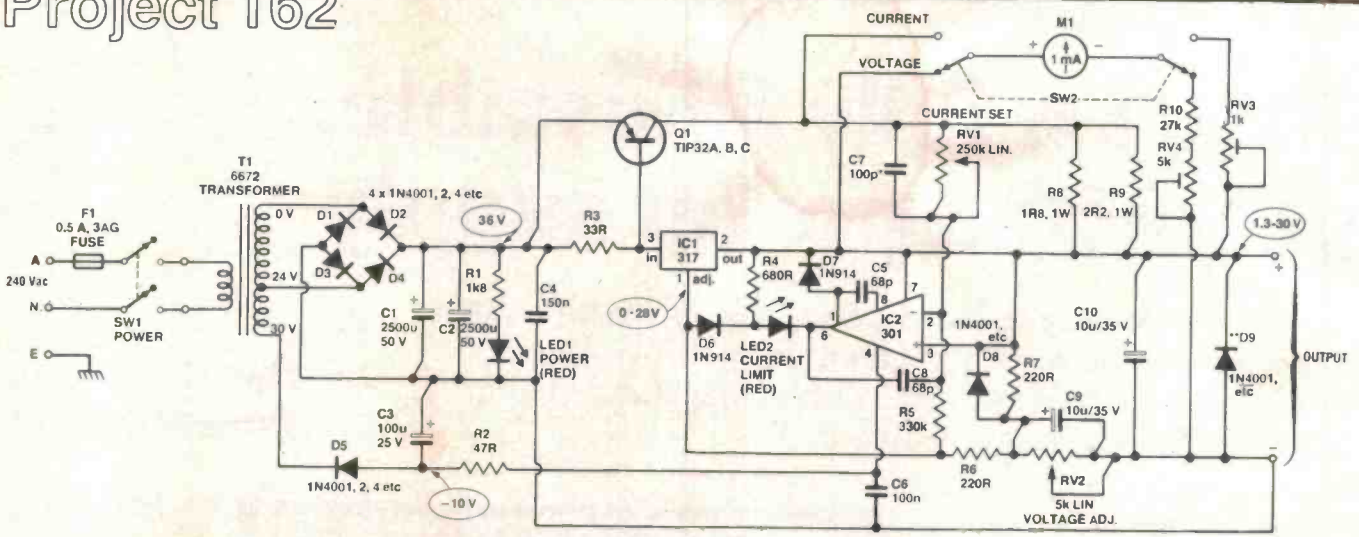
Meters are a relatively expensive item. Assuming the user has a multimeter (you bought that first, remember) then the meter on the power supply only needs to read either voltage or current at any one time. Voltage metering for the supply is an obvious requirement, leaving current to the user's multimeter. But, from experience, you often need an extra meter. Thus, switched metering was desirable. Dual meters are nice, but relatively *expensive*.

Three-terminal IC regulators are cheap, readily available and provide good results. They can also provide thermal overload protection. Internal circuitry turns them off if the case temperature of the device rises above a specified maximum. Getting a variable output from a three-terminal regulator is easy, but providing variable current limit is another matter. Use a specialised regulator? "You'd be in all sort of compost if, and it's inevitable, it was hard to get", said the Irishman-who-walks-on-water. Point there. We looked at some op-amp and transistor regulator circuits, tried one or two, but thermal overload protection was unavailable and the circuits got a little complex — and expensive. Back to the three-terminal regulator and scouring of ▶

SPECIFICATIONS — ETI-162 PROTECTED POWER SUPPLY

Output voltage	1.3— 30 V, variable
Output current	0 — 1 A, variable limiting
Output regulation	better than 0.2% zero to full load
Hum and noise on output	less than 1 mV at full load

- LED indicates current limiting mode
- Output terminals isolated from chassis



application notes. Voila! National Semiconductor's Linear Data Book had something very close to what we wanted. In next to no time (read, close to *deadline*) a circuit was lashed up and working! The project you see before you is the culmination of the aforegoing.

There were a few more parameters to consider. The case? Metal, but cheap. The transformer? Appropriately rated and available *everywhere*. The meter? Ditto. The price? On target.

Specifications are given in the accompanying table.

The design

The power supply is built around an LM317 three-terminal voltage regulator. This device, apart from being inexpensive and widely available, has the following desirable features: internal current-limiting (self-protection), thermal shutdown (more self-protection), adjustable output between 1.2 V and 37 V and excellent regulation figures. We elected to use the TO-220 flat pack style as it's easy to mount (one bolt). National and Motorola designate it LM317T. Fairchild have an equivalent designated uA317UC.

The regulator serves two purposes in this design — to provide a regulated voltage reference and thermal overload protection. The output current is supplied by a transistor. We used a TIP32, which also comes in a TO-220 package. This is a pnp device connected here as a 'collector follower'. This sort of circuit provides current amplification, but no voltage gain. The regulator and transistor are mounted side by side on a heatsink. If the output voltage and current limit are set to maximum and a short circuit occurs on the supply's output for a lengthy period, then a considerable amount of power will be dissipated in the transistor. The temperature of the heatsink will rise considerably, but before it can rise destructively, the internal thermal overload circuit of the regulator will operate and limit the maximum dissipation. You'll burn your fingers on the heatsink by the time that happens.

In normal use, at maximum dissipation the heatsink only gets warm to the touch.

Output voltage variation is provided more or less in the normal manner by 'tapping' the 'adj.' terminal across a resistive voltage divider connected across the regulator output (this involves R7 and RV2). Current limiting is provided by an op-amp. This senses the output current and 'short circuits' the voltage applied to the regulator's 'adj.' terminal. The regulator output, and thus the supply output, drops and only the predetermined current flows in the load on the supply output.

HOW IT WORKS — ETI-162

The heart of the project is the LM317 regulator, IC1. This device is used in conjunction with the main 'pass' transistor, Q1. The IC regulator compares the voltage in its output pin with that — on the 'adj.' pin and regulates the output voltage accordingly. The bias for the pass transistor is derived across resistor R3 and is due to the current drawn by the IC regulator. If the 317 detects excess voltage, for example, on its output pin, it decreases the current pulled through R3, hence decreasing the bias to Q1. In this way the 317 controls the ouput voltage and ensures good regulation for the output.

The control voltage for the 317 is derived from a potential divider formed by R7 and RV2. The electrolytic capacitor (C9) connected across RV2 is to reduce noise on the output. Diode D8 is there to discharge this capacitor in the event the output is short circuited, otherwise it will attempt to discharge via IC1 and IC2, possibly causing some damage.

Capacitor C10 is placed directly across the output to provide both circuit stability and to supply short term peak currents often required by some circuits. It also functions as a low impedance ac bypass.

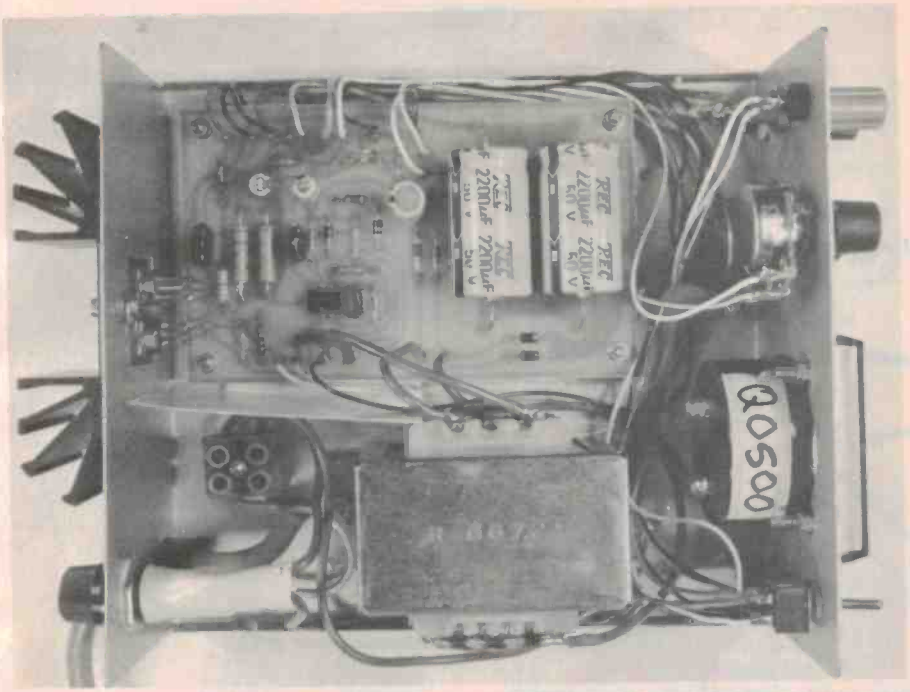
Since multiple power supplies are often used to power a single circuit, it is possible for the power supply to be supplied with a reverse voltage from an external source. To protect against this, diode D9 is included. The 1 A continuous current rating of this diode should be sufficient in most cases, and it will stand very high peak forward currents.

The remaining components are related to the variable current limit feature of this supply. The main device involved is the 301 op-amp, IC2. This device compares the output voltage, which is connected to its non-inverting input pin 3, to the voltage dropped by a potential divider formed by the CURRENT SET potentiometer (RV1) and R5. For any given setting of the CURRENT pot, the voltage on pin 2 of IC2 is proportional to the output current.

When the output current rises high enough, the voltages on pin 2 of IC2 will be 'pulled' above that on pin 3 (which is at the output voltage). The output of IC2, pin 6, then swings toward the negative rail, drawing current via D6 and LED2. LED2 will light, indicating current limit is in operation. The output of IC2 pulls down the voltage on the 'adj.' pin of IC1, lowering the output voltage.

Capacitors C5, 7 and 8 and diode D7 are included to ensure stability in the current limit stage when it is operating. This circuit uses a feature of the LM301 whereby it is capable of working as a differential amplifier with its inputs driven right up to the positive supply rail. The positive supply for the op-amp can therefore be the main output of the power supply and vary as the output voltage is varied. To ensure that the op-amp always has a supply across it, a negative supply rail has been derived by D5 and C3, a half-wave rectifier system that generates about 10 V from a tap on the secondary of T1.

The meter switch, SW2, allows the meter to be connected either as a voltmeter or a current meter. In the voltmeter position, the meter circuit is placed directly across the output with R10 and RV4 in series with M1. RV4 allows voltage calibration of the meter. When SW2 is in the current position, the meter measures the voltage drop across R8 and R9, which have the output current flowing through them. RV3 permits current calibration of the meter.



Overall internal view of the power supply. Note the cardboard 'shield' separating the mains terminal block and leads from the pc board.

Construction

For most electronic enthusiasts the mechanical work involved in a project is usually the tedious bit. We would expect most constructors to purchase a pre-punched and drilled chassis, but if you want to do it yourself or plan to use a different chassis, then start by carefully laying out and marking up the metalwork. Component placement is not critical, but we would suggest you keep a strict division between the mains components and wiring and the rest of the circuitry and components. If you're using the same chassis, or something similar, then our Scotchcal front panel artwork can be used as a template for the front panel. General placement of components can be determined from the photographs. The 184 x 70 x 160 mm chassis we used could have done with some bracing of the front and rear panels. Some small brackets could be made up from scrap aluminium pieces to do this job, if you wish. If you do this, tackle it first, but make sure the brackets won't foul any components attached to the panels.

If you're using the same chassis we used and all holes are prepared, first thing to do is apply the Scotchcal front panel. We made up a metal Scotchcal, rather than plastic, as it's more durable. Carefully lift the backing from one edge and align the edge on the chassis panel. Peel off the backing and carefully smooth the Scotchcal into place across the panel making sure it's correctly aligned as you go. When it's in place, smooth out any bubbles by carefully rubbing them toward an edge. You can cut out the holes with a sharp penknife or modelling scalpel.

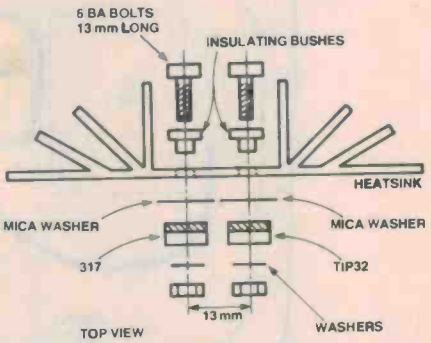
We also made up a metal Scotchcal label for the meter scale. Disassemble the meter and carefully apply the Scotchcal to the original scale, trim the edges if necessary and then re-assemble the meter.

If you want to make your own Scotchcals for this project, the artwork is reproduced on page 107 with a page of blue behind so that you can expose through the page.

Mount the meter to the front panel first, otherwise you will have great difficulty reaching the nuts that secure it as they will be obscured by other components. Then mount the LEDs, switches, pots (and their knobs) and output terminals. On the rear panel, mount the mains fuse and install the mains cable with its clamp grommet, leaving enough of the cable protruding inside the case so that it reaches the terminal block. Mount the terminal block on the chassis bottom next, then terminate the mains cable. Make sure the green and yellow earth lead is the longest so that it's the last to break in the event of a catastrophic accident.

Insert the four pc board mounting bolts next. We used 13 mm long 6 BA bolts. Put two nuts on them to space the pc board up from the chassis. Cut a 'shield' for the mains wiring from a 70 x 70 mm piece of heavy cardboard, bend up one edge about 8 mm in and secure it under the rear mounting nut nearest the mains terminal block by punching a hole in the appropriate place in the bent-up piece — see the internal photograph.

Assemble the 317 regulator and TIP32 transistor to the heatsink next. Insulate each with a mica or plastic thermal washer and bolt insulators. Using a multimeter, check that the metal tag of each device is not shorted to the heatsink. Bend the leads of each device up from the heatsink.



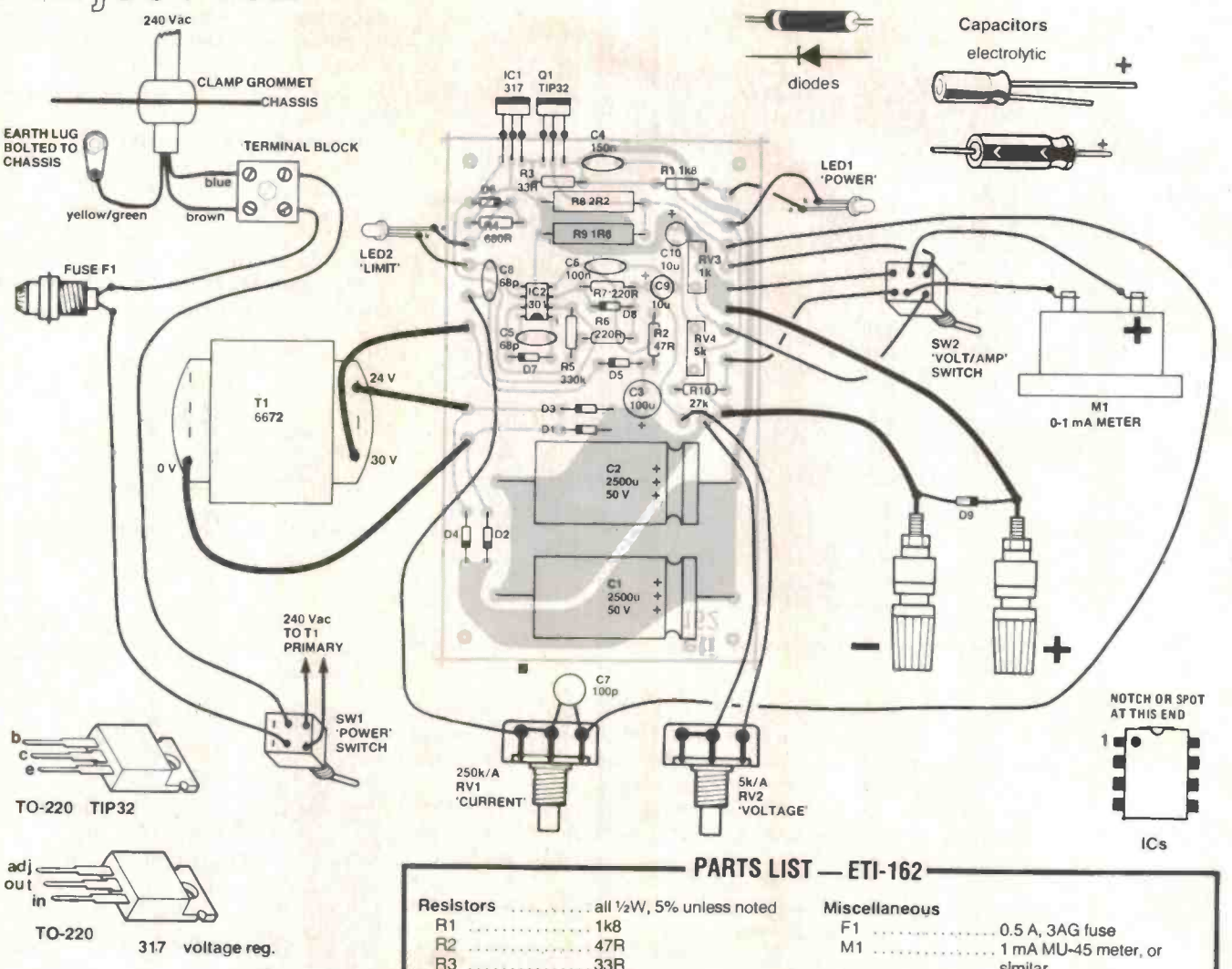
Mounting the 317 regulator and TIP32 transistor to the heatsink.

Internal view of the power supply showing mounting and terminating details for the regulator and transistor. These are assembled to the heatsink as shown above and the heatsink mounted to the rear panel using bolts above and below the cutout visible here.

Now you can attach flying leads to all the components mounted on the front panel and between the mains terminal block and fuse to the mains switch. Put heatshrink tubing over the mains fuse and mains switch, ensuring they are well covered. Make sure all leads are long enough to reach their destination. Solder C7 to the terminals of RV1 and D9 to the output terminals, as shown in the overlay and wiring diagram.

Mount the power transformer next, oriented such that its 240 Vac input terminals are away from the pc board. Terminate the leads from the mains switch to the transformer primary connections, using heatshrink tubing again to shroud the terminals. ▶

Project 162



PARTS LIST — ETI-162

Resistors — all ½W, 5% unless noted

R1	1k8
R2	47R
R3	33R
R4	680R
R5	330k
R6, R7	220R
R8	1R8, 1W
R9	2R2, 1W
R10	27k
RV1	250k lin. pot.
RV2	5k lin. pot.
RV3	1k min. vertical mount trimpot
RV4	5k min. vertical mount trimpot

Capacitors

C1, C2	2500u/50 V axial electro.
C3	100u/25 V RB electro.
C5, C8	68p ceramic
C6	100n greencap
C7	100p ceramic
C9, C10	10u/35 V RB electro.

Semiconductors

D1-5, 8, 9	1N4001, 1N4002, 1N4004, EM401 . . . etc.
D6-D7	1N914, 1N4148
IC1	LM317T, uA317UC
IC2	LM301, uA301
Q1	TIP32A, B or C

Miscellaneous

F1	0.5 A, 3AG fuse
M1	1 mA MU-45 meter, or similar
SW1, SW2	DPDT miniature toggle switches, 250 Vac/1 A rated.
T1	6672 transformer, 240 V primary, 30 V/1 A multi-tapped secondary.

ETI-162 pc board; two binding posts — one red, one black; case — metal, U-chassis & lid type; 184 x 70 x 160 mm (e.g: D.S.E. H2744, Altronics H0444, Electronic Agencies HE1742); two small knobs; mains cable, clamp grommet and terminal strip; fuseholder; Scotchcal panel and meter scale; heatshrink tubing; heatsink — flat sided radial fin type, 30 mm long (e.g: Rod Irving HS1); nuts, bolts, hookup wire etc.

Price estimate
$45 — $50

Note that this is an **estimate** only and not a recommended price. A variety of factors may affect the price of a project, such as — quality of components purchased, type of pc board (fibreglass or phenolic base), type of front panel supplied (if used), etc — whether bought as separate components or made up as a kit.

Now you can tackle the pc board. Start with all the resistors. Then mount the two trimpots. Next, solder all the semiconductors in place. It is *most important* you get all of these the right way round, especially the rectifier diodes. The capacitors can be mounted next. There are five electrolytics and all have to be mounted with the correct orientation. Note that the two filter capacitors are given as 2500 uF in the parts list but the photograph shows 2200 uF types. Either can be used without affecting circuit operation at all. Remember, electrolytic capacitors have a very wide tolerance (like +80%, −20%). We used pc stakes to terminate the leads from the off-board components. You could use short lengths of 22 gauge tinned copper wire with a loop bent at the top, if you wish. Six 30 mm lengths of tinned copper wire are needed to connect the 317 and TIP32.

Carefully check the pc board to see that all components are mounted and the semiconductors and electrolytics are correctly polarised. Mount the pc board and terminate the flying leads from all the off-board components. Use heavy duty hookup wire from the transformer secondary to the board and from the output terminals to the board.

All OK? *Check it!*

Now you're ready to switch it on and try it out. ▶

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See EA Dec. 82.
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NEW

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See ETI Dec. 82.

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Power 50 watts RMS
Freq resp 5K-40 KHZ
SPL 96 db 1w/1mt
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90 watt handling, about 50w RMS
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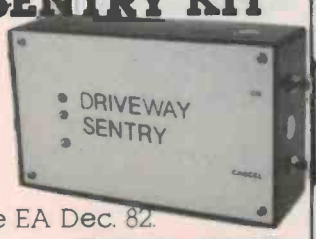
beautiful white cone
Freq response to 3500 hz
SPL 92 db 1w/1mt
CE2140 Res. freq 25 hz
ONLY **$25.00** each

NEW

DRIVEWAY SENTRY KIT



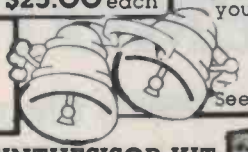
See EA Dec. 82.
KE1088 **$32.00**

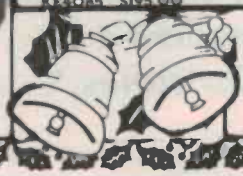
POWER UP.

Switch all your HiFi equipment on with the flick of one switch. Just uplug your power leads from your Tuner, Amplifier, Equalizer, Cassette Deck, etc and plug them into the Power Up and Whammo, by switching off your Amplifier, you switch the power off on everything else.
KE1940 Complet Kit
See EA Nov 82. **$39.50.**

300 WATT INVERTER KIT

See June 82 EA
Run your 12 volt appliances in your car. Great for power strikes. Kit includes everything even handles
KE4085 $195.00



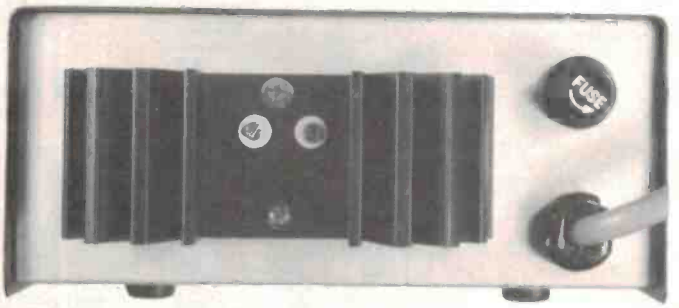


STEREO SYNTHESISOR KIT

Refer E/A Sept '82
KE3020 $55.00
This kit gives you stereo sound from a mono source, like your video

NEW

Internal view from the rear of the front panel.



View of the rear panel showing heatsink and mains fuse placement.

Switch on

Set the CURRENT and VOLTAGE control to about half rotation and the VOLT/AMP switch to read volts on the meter. Hook your multimeter to the output, switched to the 30 V range or a higher one, plug in and switch the power supply on. If all is well, the POWER LED should light and the multimeter will read some voltage. The power supply meter will probably read something quite different. If you don't get these indications, switch off and look for a wiring error or components misplaced or incorrectly oriented.

If all is well, set the VOLTAGE control so that you get a reading of 20 V on your multimeter. Then, adjust RV4 (the trimpot nearest the front panel) until the power supply meter reads the same. Vary the VOLTAGE control and check that the supply's meter corresponds closely with the multimeter. See that you get around 1.3 V at minimum and 30 V (within 0.5 V) at maximum.

Turn the power supply off. Wind the VOLTAGE control fully anticlockwise and set the CURRENT control half way. Set the VOLT/AMP switch to read current on the supply's meter. Switch your multimeter to the 1 A range, or higher. Turn the power supply on. The LIMIT LED should light and the multimeter should indicate about half an amp of current flowing. The supply's meter will likely read something quite different. Wind up the CURRENT control so that your multimeter reads one amp. Adjust RV3 (nearest the back panel) so that the supply's meter reads the same. Vary the CURRENT control and see that the supply's meter corresponds closely to your multimeter. The LIMIT indicator should go out when the CURRENT control is at minimum.

If at any time you don't get the correct indications, or worse still — burning smells!, switch off and hunt for a fault.

If all is well, you can put the lid on your supply and put it proudly on your workbench.

Using it

In use, you set the output voltage to what is required by the circuit you are working on then apply a short to the output terminals and set the current limit to something a little above what you judge the circuit will draw. With most CMOS circuitry, even that containing many ICs, 100 mA is a good safe limit. Allow for relay and indicator (LEDs, lamps etc) currents. A little experimentation will teach you what to expect under a wide range of circumstances.

We trust you get many useful years of use from your ETI-162 power supply. ●

NOTE: this supply is not meant to be used as a battery charger so don't connect lead-acid batteries to it. Accidental reverse connection of a lead-acid car battery will likely destroy D9 and maybe other components. Nickel-cadmium batteries could be charged from the supply operated in the constant-current mode and D9 will prevent damage to the supply if you accidentally reverse-connect them. However, take the usual precautions regarding the charging period and charging current.

NEW! NEW! JAYCAR

Walkie Talkies Sensational price for X'tal controlled units

Sensational price for CRYSTAL CONTROLLED UNITS!! Not your super-regen rubbish!!
Don't be fooled! These units actually do work — well in fact. Will transmit voice or morse over fairly respectable distance (over a mile in ideal conditions).
Fitted with proper transmit/receive crystal controlled superhet circuitry. DO NOT COMPARE with far inferior units that may only be a dollar or so cheaper anyway and almost always are a disappointment.
At only $12.50 each, how could you go wrong?

only $12.50

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You asked for it and here it is. Fully approved 240V mains inlet to International Standard IEC 320.
- Front or rear panel mount
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- Simplifies 240V wiring.
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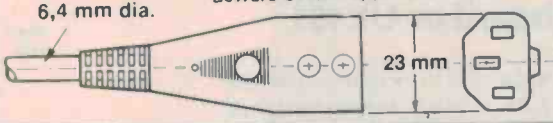
We also have the IEC 320 line plug assembly for ONLY $4.95.

Beware of non-approved units!



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Sensational price for a completely MU-metal shielded unit!!
Until now you had to pay a fortune for a shielded balanced tranny!
- 2-600 ohm (CT) input/output
- 50k output/input
- Can be used either way round
- Standard 9mm bushing mount
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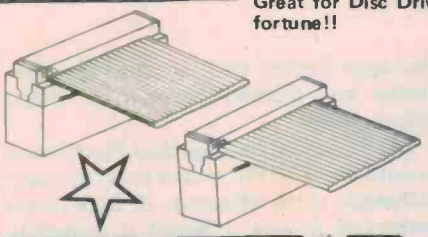
Don't pay over $30!!!

$17.50



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I.D. Insulation displacement. The quick and reliable way of making multiple connections to computer peripheral connectors.
Great for Disc Drives, Printers etc. Crimp them yourself and save a fortune!!

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25 Pin Cannon 'D' Female	$8.95
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16 way	$1.50/metre
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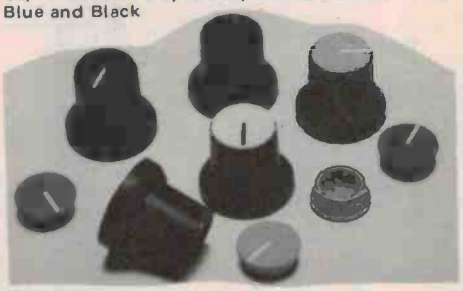
Caps ONLY $0.10 ea any quantity

Cap Colours: Red, Green, White, Yellow, Grey, Blue and Black



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5 pin and right angle types now in stock.

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5 pin female chassis	$6.95
240V Mains line	$6.50
240V mains chassis	$5.25
3 pin male right angle line (Neutrik)	$4.95
3 pin female right angle line	$5.95
3 pin female line (Neutrik)	$4.95
3 pin male line (Neutrik)	$3.95

SCR AND TRIAC SELLOUT!!!!

We only have VERY SMALL quantities of some.

Part No.	Description	IT(RMS)	VRRMAX	PRICE
BT137/500	TRIAC	8 amp	500	$1.50
BT139/600	TRIAC	16 amp	600	$4.00
BT151/500R	SCR	12 amp	500	$1.95
BT151/650R	SCR	12 amp	650	$1.95
BTW24/600R	SCR	35 amp	600	$2.95
BTW33/1000R	SCR (fast)	110 amp	1000	$29.50
BTW38/1000R	SCR	16 amp	1000	$4.95
BTW38/600R	SCR	16 amp	600	$4.50
BTW41/500	TRIAC	40 amp	500	$4.95
BTW43/800	TRIAC	15 amp	800	$3.95
BTW92/1200R	SCR	31 amp	1200	$9.95
BTY79/400R	SCR	16 amp	400	$1.95

superbright LED

The average 15 cent LED has a light output of 0,8mCd (milli Candelas) at 20mA.
Can you imagine a 200mCd LED? (at 20mA)?
Well if you can't — buy one and find out.
They are ideal for panel illumination or very low current work. (They will still give useful light at 1mA!).

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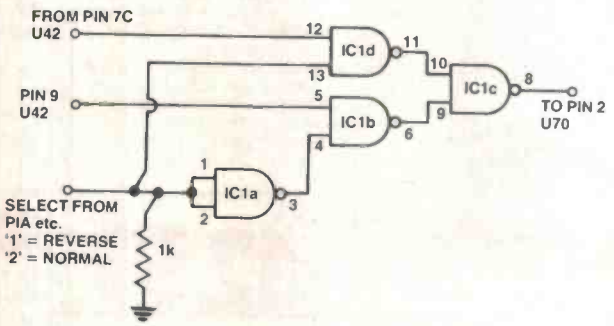
Ideas for Experimenters

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.

Software selectable reverse video for the Superboard or UK101



Imagine being able to switch from white characters on a black screen to black characters on a white screen under program control, just when those alien invaders are about to demolish your last laser turret. **Neil Westgarth** of **Modbury Heights SA** could and came up with this modification.

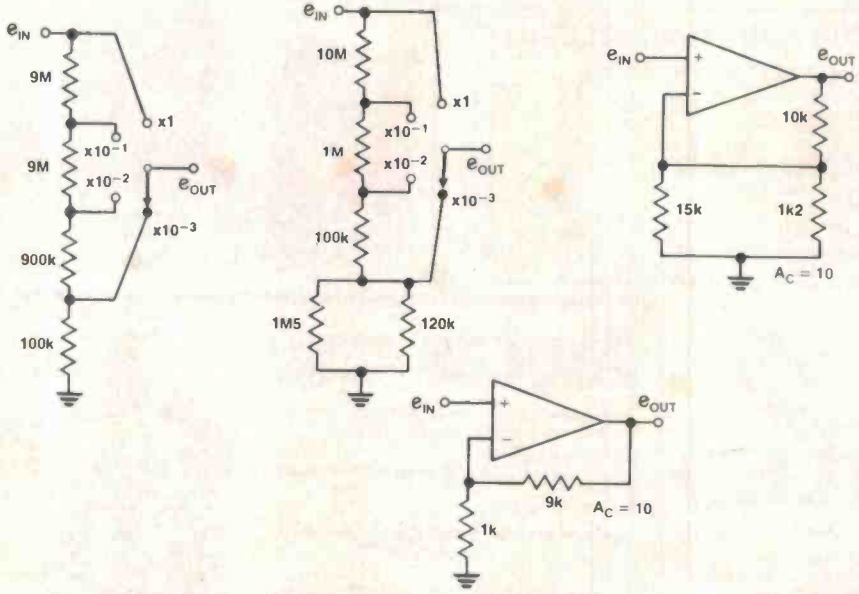
All you need is a spare half hour, a 1k resistor, a 74LS00 and a means to POKE a '1' or '0' to switch the video. In my case I use one bit of a PIA port, however if you have a bare board with no other modifications you can use pin 5 of U14 (ACIA) which is set high by POKE 61440,81 and low by POKE 61440,17. These POKEs have no effect on other operations.

As the video information to be displayed is stored in binary form, i.e: '1' = white dot and '0' = black dot, it is a simple matter to switch an inverter in the appropriate port of the video circuitry and thereby reverse the video information.

All the modifications that I have seen to date use a DPST switch to do this and although it is effective it is a little awkward in use. I found it desirable to have it software switchable. The relevant circuit information can be found on OSI supplied circuits sheet 10 of 13.

As shown U42 is a 74LS165 shift register whose Q output is used to shift the video information to pin 2 of U70. The modification involves cutting this connection and then selecting either pin 9 (Q op) or pin 7 (Q op, previously unused) through to pin 2 of U70 as before. The same modification is done to the UK101 except that U42 and U70 become IC42 and IC70 respectively.

The 74LS00 and resistor can be mounted on the prototyping area of the superboard. Remember to take care when cutting or soldering to the pc board traces.



Voltage divider

Graham Taylor of **Caulfield South, Victoria** wanted to divide a voltage by a multiple of 10 and found the following circuit in application notes. This was all very well but then he couldn't buy a 900k resistor.

So then I started thinking about using different valued resistors. If you parallel 1.2 and 15 you get 1.1. Aha! So now I use dividers as shown. Now it's possible to go to your average hobby shop and buy 1% resistors off the shelf and not mess around with trying to make up 900k.

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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
S9 ETI 443 Expander Compressor
S10 ETI 444 Five watt stereo
S12 ETI 438 Audio Level Meter
S13 ETI 440 25 watt Stereo Amplifier including metalwork
S18 ETI 426 Rumble Filter
S19 ETI 429 Simple Stereo Amplifier
S21 ETI 417 Over led Distortion Monitor
S33 E.A. Musicolour III 1000 w/ch
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 3000 Series Amplifier 25 w/ch
S44 ETI 477 Mosfet power amp module Inc. brackets
S45 ETI 457 Scratch/Rumble Filter
S46 ETI 458 VU Level Meter
S47 ETI 479 Bridging Adaptor
S48 ETI 5000 Series Power Amplifier

STAGE
ST1 ETI 592 Light Show Controller (3 ch.) (1000 w/ch)
ST2 ETI 593 Colour Sequencer (for use with ETI 592)
ST3 ETI 551 Light Chaser 3 ch. 1000 w/ch
ST4 E.A. Light Chaser 3 channel
ST5 E.A. Twin Tremolo for Organs/Stage Amps
ST6 E.A. Light Chaser
ST7 ETI 499 150 w Mosfet P.A. Module
ST8 ETI 498/499 150 w Public Address Amplifier
ST9 E.A. Musicolor IV
all prices are inclusive of sales tax

PRE-AMPLIFIER 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.
P7 ETI 401 F.E.T. 4 Input Mixer
P10 E.A. Playmaster 145 Mixer
P11 ETI 446 Audio Limiter
P12 ETI 471 High Performance Stereo Pre-amplifier–less F/P & Backing Plate
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 ETI 466–includes power supply
P16 E.A. Moving Coil Pre-Amplifier (Battery)
P17 E.A. Moving Coil Pre-Amplifier (Plug pack)
P18 ETI 478 MM Moving Magnet Pre-amp (Series 5000)
P19 ETI 478MC Moving Coil Pre-amp (Series 5000)
P20 ETI 478 Series 5000 Pre-Amplifier
P21 E.A. Vocal Cancellor

GUITAR UNITS
G1 ETI 447 Audio Phaser
G2 ETI 413 2–100 watt Bridge Amplifier
G5 ETI 413 100 watt Guitar Amplifier
G6 ETI 410 A.D.U. for your Guitar
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 E.A. guitar Pre-amplifier
G21 Sonics ME2 Sonics ME2 Wah Wah Pedal–less pedal

AUDIO TEST UNITS
AT1 ETI 441 Audio Noise Generator
AT2 ETI 128 Audio Millivolt Meter
AT4 ETI 102 Audio Signal Generator
AT5 E.A. A.F. Tone Burst Generator
AT7 ETI 137 Audio Oscillator
AT9 HE 105 Bench Amplifier (less case)
AT10 E.A. Audio Test Unit
AT11 E.A. Function Generator

TIMERS
T1 ETI 650 STAC Timer
T2 ETI 564 Digital Wall Clock
T3 E.A. Universal Timer and Stopwatch
T4 ETI 540 Universal Timer

COMMUNICATION EQUIPMENT
CE1 ETI 711 Remote Control Transmitter Switch
CE2 ETI 711R Remote Control Receiver
CE3 ETI 711D Remote Control Decoder
CE4 ETI 711B Single Control
CE5 Double Control
CE6 ETI 711P Power Supply
CE7 ETI 707A 144 Mhz Converter
CE8 ETI 707B 52 Mhz Converter
CE9 ETI 708 Active Antenna
CE11 ETI 780 Novice Transmitter
CE12 ETI 703 Antenna Matching Unit
CE18 E.A. All Wave I/C 2
CE21 E.A. Fremodyne 4 RF Section
CE29 E.A. Short Wave Converter for 27 Mhz
CE31 E.A. 27 Mhz Pre-amp
CE32 E.A. 10–30 Mhz Pre-amp
CE33 ETI 718 Shortwave Radio
CE34 ETI 490 Audio Compressor
CE35 ETI 721 Aircraft Band Converter (less XTALS)
CE36 ETI 726 6 or 10 metre Power Amp
CE37 ETI 475 Wide Band A.M. Tuner
CE38 E.A. Masthead Pre-amplifier
CE39 ETI 731 R.T.T.Y. Modulator
CE40 ETI 729 UHF TV Masthead Preamp. (less external box)
CE41 ETI 735 UHF to VHF TV Converter
CE42 HE 104 AM Tuner (less case)
CE43 HE 106 Radio Microphone (less case)
CE44 E.A. R.T.T.Y. Demodulator
CE45 E.A. Voice Operator Relay

METAL DETECTORS
MD1 ETI 549 Induction Balance Metal Detector includes wire for search head
MD2 ETI 561 Metal Locator less dowel and tubing, potplant stand
MD3 ETI 1500 Discriminating Metal Locator (undrilled case)
MD4 ETI 1500 Discriminating Metal Locator (predrilled case)
MD5 ETI 562 Geiger Counter with ZP 1310 Tube
MD6 ETI 566 Pipe and Cable Locator
MD7 E.A. Prospector Metal Locator including headphone

TEST EQUIPMENT
TE2 ETI 133 Phase Meter
TE4 ETI 129 R.F. Signal Generator
TE6 ETI 706 Marker Generator
TE8 ETI 122 Logic Tester
TE9 ETI 124 Tone Burst Generator
TE11 ETI 116 Impedance Meter
TE15 ETI 704 Cross Hatch Dot Generator
TE16 ETI 120 Logic Probe
TE17 ETI 121 Logic Pulser
TE34 ETI 487 Read Time Audio Analyser
TE35 ETI 483 Sound Level Meter
TE36 ETI 489 Read Time Audio Analyser
TE37 ETI 717 Cross Hatch Generators
TE38 E.A. 3 Mhz Frequency Counter
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.O. 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

WE HAVE NOW BEEN APPOINTED OFFICIAL INTERSIL DISTRIBUTORS AND ARE CURRENTLY STOCKING SUPPLIES OF THESE FABULOUS PRODUCTS IN CONJUNCTION WITH ALL OUR OTHER COMPONENTS.

TE61 ETI 135 Panel Meter
TE62 E.A. Modulated Signal Injector
TE63 HE 103Transistor Tester
TE64 HE 111 Ohm meter
TE65 ETI 157 Crystal Marker
TE66 ETI 161 Digital Panel Meter
TE12 ETI 533 Digital Display

MODEL TRAIN UNITS (see also "SOUND EFFECTS")
MT1 ETI 541 Model Train Control
MT2 E.A. 1974 Model Train Control
MT6 E.A. 1978 Train Control less Front Panel
1978 Train Control with Front Panel

SOUND EFFECTS
SE1 E.A. Sound Effects Generator*
SE2 E.A. Musical Tone Generator
SE3 E.A. Cylon Voice
SE4 E.A. Steam Whistle
SE5 ETI 607 Sound Effects
SE6 E.A. 492 Audio Sound Bender
SE7 E.A. Electronic Sea Shell Sound Effects
*set as for Steam Train and Prop Plane noise

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
V8 E.A. Inverter 12v D.C. input 230v 50hz 300 VA output
V10 E.A. Zero-voltage switching heat controller
V11 E.A. Inverter 12v D.C. input 230v 50 hz 300VA output not incl. switch 35 amp.

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
WS18 ETI 250 Simple House Alarm
WS19 ETI 570 Infrared 'Trip' Relay (including plug pack)
WS20 ETI 585 T&R Ultrasonic Switch
WS21 ETI 330 Car Alarm
WS22 ETI 322 Dver Rev Car Alarm incl. case
WS23 ETI 1505 Fluorescent Light Inverter
WS24 ETI 1506 Xenon Bike Flasher

PHOTOGRAPHIC
PH1 ETI 586 Shutter Speed Timer
PH3 ETI 514B Sound Light Flash Trigger
PH4 ETI 532 Photo Timer
PH7 ETI 513 Tape Slide Synchronizer
PH12 ETI 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 including optional parts
PH19 E.A. Sound Triggered Photoflash
PH20 HE 109 Extra Flash Trigger
PH21 E.A. Photographic Timer

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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
PS14 E.A. Power Supply for Dream 6800
PS15 ETI 577 Dual 12V supply
PS16 E.A. Power Saver
PS17 ETI 480 PS Power Supply for ETI 480 (100 watt Amp.)
PS18 E.A. Bench Mate Utility Amplifier/Power Supply
PS19 HE 108 Power Supply

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C5 ETI 632B Part 2 Control Logic V.D.U.*
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C8 ETI 632 U.A.R.T. Board*
C9 ETI 631-2 Keyboard Encoder*
C10 ETI 631 A/Sch. Keyboard Encoder (less keyboard)*
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C15 ETI 637 Cuts Cassette Interface
C16 ETI 651 Binary to Hex Number Converter
C17 ETI 730 Getting Going on Radio Tele Type
C18 E.A. Dream 6800 Computer for Beginners less keyboard and cover
C22 ETI 660 Basic Computer
C23 ETI 660 Basic Computer incl. colour option on board expandable memory, RF modulator, case and power supply
C24 ETI 760 Video RF Modulator
C25 E.A. Eprom Programmer
*all V.D.U. projects priced less connectors

BIO FEEDBACK
BF1 ETI 546 G.S.R. Monitor (less probes)
BF2 ETI 544 Heart Rate Monitor
BF3 ETI 576 Electromyogram

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A3 ETI 316 Transistor Assisted Ignition
A4 ETI 240 High Power Emergency Flasher
A6 ETI 312 Electronic Ignition System
A7 ETI 301 Vari-Wiper
A14 E.A. Dwell Meter
A15 E.A. Variwiper
A16 E.A. Tacho for Tune-ups
A17 E.A. Ignition Analyser and Tachometer
A18 E.A. Strobe Adaptor for Ignition Analyser
A19 E.A. 1975 C.D.I. Capacitor discharge Ignition
A22 ETI 318 Digital Car Tachometer (less metalwork)
A23 ETI 319A Variwiper Mk. 2 (no dynamic Braking)
A24 ETI 319B Variwiper 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 Oil Temp Meter less V.D.D. probe
A30 ETI 321 Auto Fuel Level Alarm
A31 ETI 332 Stethoscope
A32 ETI 325 Auto Probe Tests Vehicle Electricals
A33 ETI 333 Reversing Alarm
A34 E.A. Low fuel Indicator
A35 ETI 326 Led Expanded Voltmeter
A36 ETI 329 Ammeter (expanded scale)
A37 ETI 327 Turn and Hazard Indicator
A38 ETI 159 Expanded Scale Voltmeter

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EG1 ETI 043 Heads and Tails
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EG5 ETI 814 Dinky Die
EG6 E.A. Selectalott
EG7 HE 107 Electronic Dice
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EG9 HE 123 Alien Invaders

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M4 ETI 547 Telephone Bell Extender
M5 ETI 602 Mini Organ (less case)
M7 ETI 044 Two Tone Doorbell
M10 ETI 539 Touch Switch
M25 E.A. Digital Metronome
M37 ETI 249 Combination lock (less lock)
M39 E.A. Electronic Combination lock (including lock)
M46 E.A. Power Saver for induction motors
M48 E.A. Lissajous Pattern Generator
M53 ETI 247 Soil Moisture Alarm
M54 E.A. Electrochune Keyless Organ
M55 E.A. Pools/Lotto Selector
M56 ETI 256 Humidity Meter
M57 ETI 257 Universal Relay Driver Board
M58 E.A. Simple Metronome

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12V MARINE MODEL WITHOUT REMOTE MIKE
Features as above but only 3 speaker outputs. $152

240vAC/12vDC MODEL WITH 20WRMS OUTPUT
Features- siren/fog horn switch, mike and aux. volume controls, 4/8/16 ohms output imped. inputs for radio cassette recorder, tuner, tape deck, mike 200-50k ohm. $159

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This model illustrated above.
Features- 2 mike inputs, siren/fog horn and 4 tone chime switch, 4/8/16 ohms plus 25/70/100 volt outputs, other features as above. $249

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58,000uF	20V	$8.00
8,200uF	25V	$4.00
12,000uF	25V	$4.50
19,000uF	25V	$6.00
22,000uF	25V	$6.50
50,000uF	25V	$8.00
71,000uF	25V	$9.00
2,000uF	30V	$1.50
16,000uF	30V	$5.00
26,000uF	30V	$6.50
37,000uF	30V	$7.50
40,000uF	30V	$8.00
8,300uF	40V	$4.00
5,500uF	45V	$4.00
20,000uF	45V	$7.00
8,000uF	50V	$7.50
15,000uF	63V	$9.00
6,300uF	75V	$4.00
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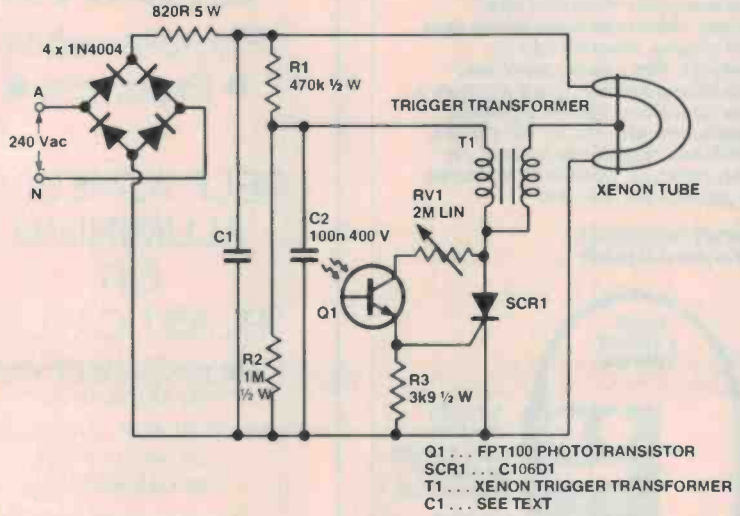
Ideas for Experimenters

Inexpensive slave flash



Geoff Condick of **Tarnagulla Vic.** has come up with an idea for a slave flash which he claims is much more powerful than cheap flashguns which amateur photographers buy for bounce and side lighting in studio shots.

Since LASCR's are difficult to obtain these days, the circuit uses a phototransistor to turn on the SCR when the light from the master flash impinges upon it. The 2M pot in series with the phototransistor is used to set the unit's sensitivity. C1 is the main flash capacitor and the larger its capacitance, the brighter the flash. It's value should be between 200u and 1000u at 400 Vdc to give an extremely bright flash. Capacitors of this size may frequently be found in a discarded black and white TV chassis.

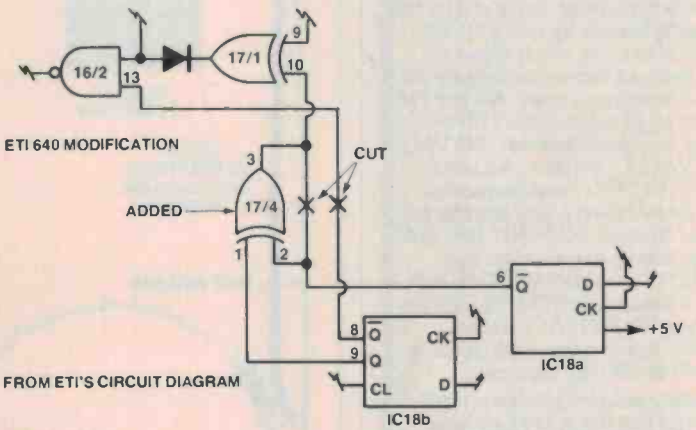
Modifications to the S-100 VDU

A modification to the ETI-640 project has been sent in by **B.N. Coomer** of **Carlingford NSW.**

The modification changes the 'flashing' mode so that it flashes between normal and inverse, instead of between normal and blank. This requires a spare exclusive-OR, which is conveniently located in IC17 (pins 1, 2 & 3). The circuit diagram shows the changes.

On the component side of the board, between ICs 17 and 18:

- cut track from IC18, pin 6
- cut track from IC18, pin 8

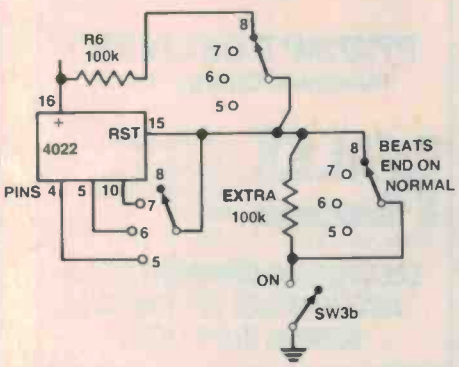


On the other side:

- IC17: connect pin 3 to pin 10
- connect IC17 pin 1 to IC18 pin 9
- connect IC17 pin 2 to IC18 pin 6

If you want to lengthen the inverse duration, substitute R16 (10k) for any value between 20k and 30k. (R16 is located under the flash rate trimpot.)

Modifications to the sequencer for percussion synthesiser



A sequencer which couldn't provide a true waltz rhythm just wasn't acceptable for **M. Dowson** of **Stanwell Tops NSW** so some modifications were worked out.

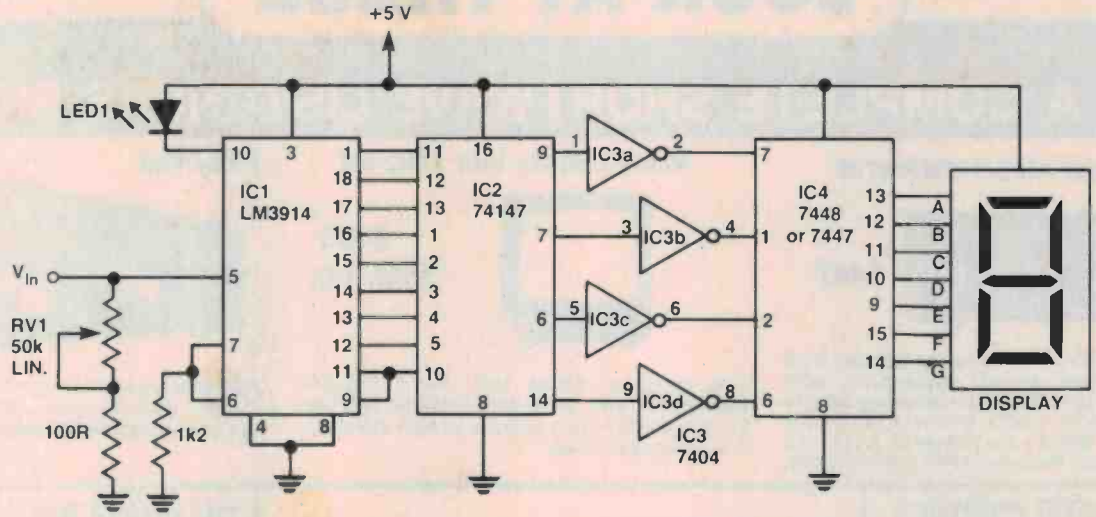
You can't get a true waltz rhythm with the sequencer since the fixed eight steps cannot be aborted, and a three step sequence will not divide exactly into eight steps. But by simply adding a three-pole four-position switch as shown, all steps from one through to eight are available.

A true waltz rhythm is obtained by setting the switch to reset the 4022 on the sixth count which is exactly divisable by the three step waltz rhythm. The emphasised first beats are turned on by SW2(1) and SW2(4). This extra switch can terminate the counts at 5, 6, 7 and the original 8. Counts of 1, 2, 4 and 8 divide exactly into 8 and can therefore be set up on the two DIP switches.

The pc board requires only one cut to isolate pin 15 of the 4022, and one extra 100k resistor.

When controlled by SW3b the sequence may recommence on any random count (a minor point) if pin 15 was not held high when SW3b opened.

Ideas for Experimenters



Simple 'flash' type A/D converter

IDEA OF THE MONTH

Brian King, Elizabeth Park S.A.

The LM3914 dot/bar LED driver is put to use in this circuit to form the basis of a so called 'flash' type analogue-to-digital converter. This device (IC1) will send one of its ten comparator outputs low in response to a voltage applied to its input. Which output will go low is determined by that voltage. The outputs of the LM3914 are fed to the inputs of a 9-line to 4-line BCD priority encoder (IC2), the outputs of which are inverted by IC3 and taken to the inputs of a BCD to 7-segment decoder (IC4). If a voltage is applied to the input of IC1, one of its outputs will go low (as stated before-hand) which, in turn, sends one of IC2's inputs low and its 4-bit BCD equivalent will be set on IC2's output. This is then decoded to 7-segment format, by IC4.

Full scale deflection can be adjusted by RV1. As there are ten outputs from IC1 and only nine inputs to IC2, a LED is connected to the tenth output of IC1 and this effectively functions as an over-range indicator.

The LM3914's outputs change linearly, but if logarithmic changes are needed the LM3915 could be used. It must also be noted that for a full scale deflection of say 12 volts, each output will only change state when the voltage on its comparator input rises at least 1.2 V above the previous comparator's threshold. (See Lab Notes, ETI March 1980 for more data.)

Despite this limitation the circuit could be used for joystick controls (two circuits per stick, leaving out IC4) for computer games, photo print meters, thermometers (where only a scale and not the exact temperature is required); in fact, anything requiring a non-critical one-digit readout from an analogue input.

'IDEA OF THE MONTH' CONTEST

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

RULES

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

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

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

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

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

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

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

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

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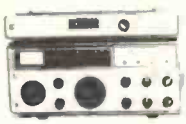

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This new receiver is full of performance advantages including general coverage, all modes of operation, PLL digital VFO for digital tuning, 96-channel frequency memory (option), direct mixer, passband tuning, etc.

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8510 8510P

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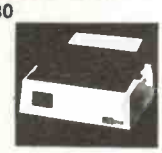

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ETI-162 Power supply

Every hobbyist needs a bench supply. If you've already got one, two you'll find three times as useful! All parts used in this project are available pretty well everywhere and kits will be widely stocked. In Perth, Altronics will have kits; in Melbourne, Rod Irving and All Electronic Components; in Sydney, Electronic Agencies and Jaycar; all over the country, Dick Smith Electronics.

ETI-1508 Model train controller

This project will be available in various 'kit' forms from a number of suppliers. Some will have 'short form' kits only, others complete kits. In Sydney, Electronic Agencies and Jaycar will be stocking some form of this project. In Melbourne, Rod Irving Electronics will stock a kit and you might try All Electronic Components.

If you're customising your setup using the controller as a basis, then components should be widely available, nothing 'specialised' has been used, apart from the switches. However, standard C&K types were used in the prototype and many suppliers stock them. In Sydney, Electronic Agencies and Jaycar stock a wide range; in Melbourne, Rod Irving Electronics and Radio Parts are good places to start.

Printed circuit boards can be obtained from the aforementioned suppliers and additionally, from suppliers listed on page 70 of the August issue.

ETI-461 Preamp

Nothing out of the ordinary here, all parts are widely stocked. So far as we know, only Rod Irving will actually be stocking a kit. Printed circuit boards will be available from Jaycar and Electronic Agencies in Sydney as well as the suppliers listed on page 70 of the August issue.

ETI-653 16 channel computer output driver

Altronics in Perth are now stocking this kit (November issue). Existing stockists are Electronic Agencies in Sydney and Rod Irving Electronics in Melbourne. Dick Smith Electronics has decided not to stock it after all.

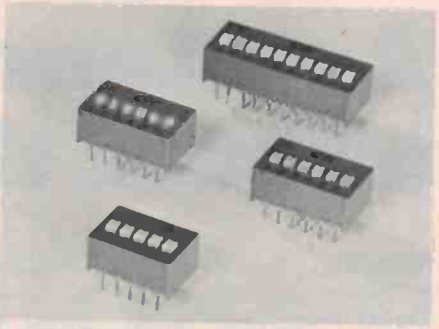
ETI-644 Modem

The list of suppliers stocking kits for this project has grown some since the October issue was published. Here is the total list of current suppliers, in alphabetical order: Altronics, Perth; Billco, Melbourne; Jaycar, Sydney; Microtrix, Melbourne and Rod Irving Electronics, Melbourne.

For those who can gather their own bits, printed circuit boards are still available at a cost of $50 each, post free, from:

ETI-644 pc board
ETI Magazine
15 Boundary St
Rushcutters Bay NSW 2011.

For a list of parts suppliers who stock the specialist parts for this project, see the October issue, page 51.



NEW C&K DIP SWITCHES

These DIP switches are part of the new C&K range and would be suitable for any of our past projects specifying DIP switches. They are available in two-pole through 10-pole configurations with a positive detent slide mechanism that is said to all but eliminate accidental switching. Wiping contacts are gold over nickel with solder-clad or gold-plated terminals. Further information from C&K Electronics, now at their new address: 15 Cowper St, Parramatta NSW 2150. (02)635-0799.

COMMUNICATIONS

Amateur radio to fly aboard the Space Shuttle?

Astronaut Dr. Owen Garriott, W5LFL has been granted tentative permission from NASA to use 2m FM from the Shuttle Columbia orbiter during the STS-9 mission scheduled to fly in October next year.

Present plans call for Garriott to use a low power rig such as a handy talky or a 'black box' constructed in the ARRL Lab. The radio will be required to meet the rigid specifications of the shuttle as determined by NASA.

ARRL president Vic Clark, W4KFC is personally overseeing the project for the League and it is expected that all coordination for the amateur portion of the STS-9 mission will be handled through Bernard Glassmeyer, W9KDR, the ARRL's satellite coordinator. AMSAT is also expected to play a significant role.

Garriott's amateur operation from Columbia will be limited to the lower 2 MHz of the band in the interest of making this a world-wide goodwill mission, and to avoid 20m-type pile-ups on US and Canadian repeater systems.

The exact frequencies that will be used, as well as the proper procedure to work the spacecraft will be announced later.

To avoid confusion and pile-ups, several ideas are being considered, including the designation of specific repeaters around the world to act as 'gateway' stations through which all QSOs will be coordinated.

The approvals for this first manned space amateur experiment have been okayed by NASA in Houston and only await a final 'green light' from Washington.

Credit for this first belongs to the ARRL, along with Garriott and NBC Network News Correspondent Roy Neal, K6DUE according to Westlink Report.

Amateur satellite TV?

World-wide fast-scan amateur TV by satellite has been proposed by ATV pioneer Henry Rue, KB9FO in a recent letter to A5 Magazine, the journal of amateur TV experimenters.

Rue suggests that amateur fast-scan TV experimenters build and orbit a satellite of their own with the intention of enhancing ATV operation.

He proposes a satellite carrying a 2 MHz-wide transponder capable of relaying 'fair quality' monochrome or reduced bandwidth heterodyned colour pictures. It would operate in either the 1240 MHz or 3.5 GHz C-band downlink region.

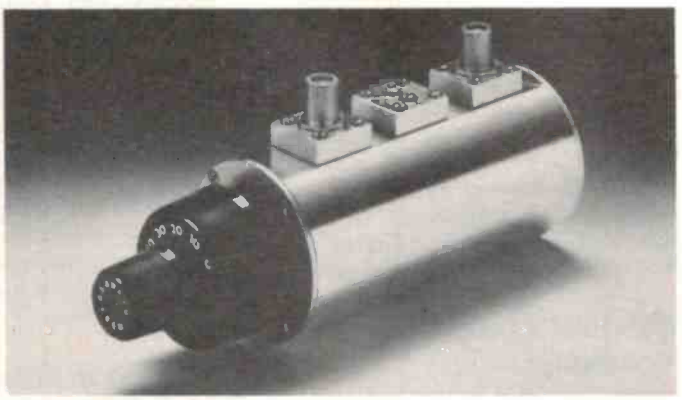
A5 Magazine has endorsed the proposal and pledged an initial US$500 to a fund to get the project off the ground. Mike Stone, Editor of A5, has written to Cablesat General Corporation President Ray Kassis WA40HK to ask that ATV be included in the Cablesat Amateur transponder proposal (see November issue Communications News), according to a recent issue of Westlink Report.

Proposed US phone-band extensions on HF

The ARRL has recommended to the US Federal Communications Commission (FCC) that all HF phone bands be extended, except on 40m (7 MHz), partially segmented by licence class. A chart of the proposed extensions appears below. (From Westlink Report.)

Band	Extra & Above	Advanced & Above	General & Above
80/75	3.750 - 3.775	3.775 - 3.850	3.850 - 4.000
40	No change prop.	No change prop.	No change prop.
20	14.150 - 14.175	14.175 - 14.225	14.225 - 14.350
15	21.200 - 21.225	21.225 - 21.300	21.300 - 21.450
10	28.300 - 29.70*	28.300 - 29.70*	28.300 - 29.70*

* No Novice or Technician privileges between 28.300 - 28.500 MHz.



Up or down a notch

Two new dual-concentric rotary attenuators for operation up to 1 GHz and covering 0 to 50 dB in 1 dB steps have been released by Vicom recently.

Made by the US-based JFW Industries, one model is for 75 ohm systems, the other for 50 ohm systems, each is designated 75DR-003 and 50DR-003 respectively.

Attenuation accuracy is claimed to be better than 0.5 dB up to 500 MHz and the attenuators can handle an input power of 1 watt average or 1000 watt peak, according to JFW. Connectors available are BNC, TNC, N, SMA or F types.

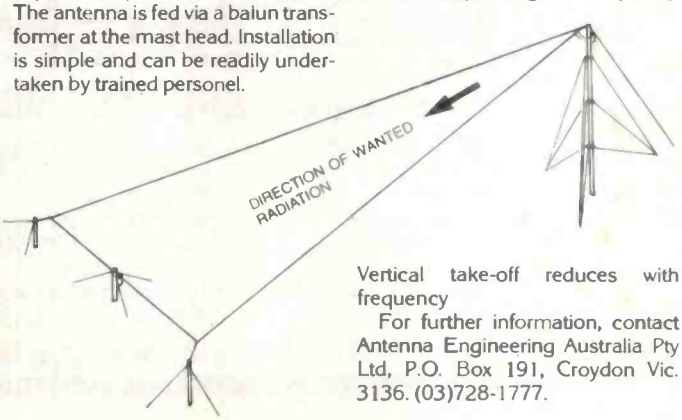
Further details, pricing and availability are available from Vicom Melbourne, Sydney or Wellington (New Zealand).

New directional HF antenna

Model 4131 HF Sloping Triangle antenna from Antenna Engineering Aust. is a simple low cost broadband directional antenna designed for medium to long range transmission or reception.

The antenna comprises two sloping wires resistively terminated at the centre point of the vee near ground level. The apex of the vee is supported by a suitable 15m mast. The antenna is fed via a balun transformer at the mast head. Installation is simple and can be readily undertaken by trained personel.

This broadband antenna covers 5-30 MHz without adjustment. Power rating is optional to 1kW average. Power gain varies from 0 to 10 dBi depending on frequency.



Vertical take-off reduces with frequency

For further information, contact Antenna Engineering Australia Pty Ltd, P.O. Box 191, Croydon Vic. 3136. (03)728-1777.

Private launchings for amateur satellites?

The Amateur Satellite Corporation (AMSAT) had observers present at the first launch of the privately-owned 'Conestaga I' American spacecraft.

Built and launched by Space Services International at a cost of US$6 million, the Conestaga I carried a dummy payload of 400 lbs of water on its first flight late in September.

The craft was launched from Madagorda Island off the Gulf Coast of Texas and reached an altitude of 320 km (200 miles) before falling into the Gulf about 480 km (300 miles) downrange.

S.S.I. officials said the launch was an overwhelming success and say that private enterprise is now firmly established in the space business. AMSAT have not commented at this stage. Fifty investors put money into the venture.

Cut out the noise!

GFS Electronic Imports of Mitcham, Victoria, recently announced the availability of a new HF noise reducing antenna system called the 'Wandra'.

The antenna is designed to allow successful HF Communication directly from electrically noisy sites such as city and industrial locations in which ordinary antennas normally operate poorly.

The Wandra is a complete antenna system tuned specifically to the users' frequencies and is claimed to offer up to 30 dB of noise reduction on one, two or three frequencies using automatic switching and having a preset low VSWR. Noise reducing characteristics are maximum on the two frequency version. All preset frequencies can be changed at a later date if necessary and feed impedance is 50 ohms.

An attractive feature, particularly for a city situation, is that only one mast is required to mount the Wandra. Designed to stand up to the elements, it is constructed using stainless steel, fibreglass and aluminium. (Wandra is an abbreviation for West Australian Noise Decreasing Radio Antenna.)

Contact GFS Electronic Imports, 15 McKeon Road, Mitcham Vic. 3132. (03)873-3939.

UOSAT back to normal

Amateurs at the Stanford Research Institute in Palo Alto, California, were successful in using their 60' dish antenna to function off OSCAR 9's 2 m and 70 cm transmitters, thereby normalising the satellite.

UOSAT, built by AMSAT-UK in conjunction with the University of Surrey, was launched into orbit in October 1981 from Vandenberg AFB in California. Late in April this year, what was termed an "anomaly in its control system" caused both transmitters to be activated simultaneously, thereby desensing both command receivers.

When it became apparent that no normal amateur station could punch through the 'RF curtain' created by the satellite's receiver desensitisation, a last-ditch attempt to save the bird and its experimental package using the Stanford Antenna was decided upon.

That attempt was successful, and it is expected that AMSAT-UK will announce a new schedule for resuming experimentation with OSCAR 9.

UOSAT differs from previous OSCAR missions as it does not carry any relay transponders. Instead, its purpose is experimental, with collection of data and telemetry as its main function. When turned on, its main beacon can be heard at 145.825 MHz. (Westlink Report.)

New UHF power/SWR meter

The Maldol HS450 power and SWR meter is now available from Imark Pty Ltd. The frequency range is quoted as 130 — 500 MHz and it has three power measuring ranges.

The unit is fitted with 'N' Type RF connectors. Insertion loss is quoted as less than 0.5 dB. The meter is designed for use with 50 ohm equipment. Dimensions are only 220 mm (w) x 66 mm (h) x 86 mm (d). Power ranges covered are 5 W, 20 W and 150 W.

For further details, contact Imark Pty Ltd, 167 Roden Street, West Melbourne 3003. (03)329-5433.

OOPS! More books!

Mail order coupon on page 83.

CHEAP VIDEO COOKBOOK
21524P **$11.75**
Complete discussion of a new, low-cost way to get words, pictures and opcode out of your computer and onto any ordinary TV screen, using a seven-IC easy-to-build circuit which you can build for less than $20.

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

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

ELECTRONIC MUSIC AND CREATIVE TAPE RECORDING
BP51 **$5.92**
Shows how electronic music can be made at home with the simplest and most inexpensive of equipment. Describes how the sounds are generated and how these may be recorded to build up the final composition.

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

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

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

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

SONICS 1982 YEARBOOK **$5.35**
An interview with Kraftwerk, how to cope with recording, lighting, rock acoustics, guitars, equipment reviews and more.

SONICS MAGAZINE **$2.35 ea**
The Australian music magazine dedicated to the art and craft of sound. Published April, July, October, Yearbook in December. $15 for one year subscription. Please indicate starting issue.

computers for beginners

COBOL FOR BEGINNERS
39378P **$21.95**
It is a solid text for introductory programming courses in Cobol, using a format that is easy to understand, yet comprehensive enough to make supplementary readings unnecessary.

THE PET PERSONAL COMPUTER FOR BEGINNERS
61827P **$20.95**
This handy guide is written for use with all varieties of PET computer, from the original 2001 to the new 8032 Super PET. It is suited to novices with no practical experience and provides advice and practical examples.

BIG THINGS FROM LITTLE COMPUTERS
77859P **$19.25**
A layperson's guide to personal computing with all the basic information and lots of examples of how personal computers can be used.

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

BEGINNER'S GUIDE TO MICROPROCESSORS & COMPUTING
BP66 **$5.92**
Introduction to basic theory and concepts of binary arithmetic, microprocessor operation and machine language programming. Only prior knowledege assumed is very basic arithmetic and an understanding of indices.

A MICROPROCESSOR PRIMER
BP72 **$5.92**
Learning about microprocessors is easy with this book, written in a style that is easy to follow. The shortcomings of this basic machine are discussed and the reader is shown how these are overcome by changes to the instruction set. Relative addressing, index registers follow as logical progressions.

AN INTRO TO BASIC PROGRAMMING TECHNIQUES
BP86 **$6.56**
Ideal for beginners seeking to understand and program in BASIC. Book includes program library for biorhythms, graphing Y against X, standard deviations, regressions, generating musical note sequences, and a card game.

BEGINNING BASIC
39806A **$19.95**
Intended for beginners with no computing experience, one should be able to intelligently program in BASIC in a short time.

BEGINNING FORTRAN
46011A **$19.95**
Starts with simple elementary examples and proceeds to intermediate level programs. Also includes references, tutorials, flow charts, deck set-ups and matrix algebra.

UNDERSTANDING COMPUTERS
39815A **$17.95**
This book describes how computers work. For people who use small computers, it starts with the most elementary gates and works up to the complete computer. Gives an understanding of languages and how they operate in the computer.

NAILING JELLY TO A TREE
39842A **$24.95**
This guide to software teaches you about machine language, assembly language programming and BASIC. The emphasis is not on learning to write programs but on learning to use the thousands of available programs that have already been written.

PEANUT BUTTER AND JELLY GUIDE TO COMPUTERS
39813A **$14.95**
A simple, easy-to-digest source of information on personal computing for the potential buyer who is less than an expert in the field.

INTRODUCTION TO WORD PROCESSING
88076A **$17.95**
Written for the non-technical reader, this book tells about the concepts common to all word processing systems, then analyses all features in detail.

YOUR FIRST COMPUTER
88045A **$12.50**
An easy-to-understand beginner's book to small computers. Understanding them, buying them and using them for personal and business applications.

FROM CHIPS TO SYSTEMS: AN INTRODUCTION TO MICROPROCESSORS
88063A **$19.95**
Explains exactly what a microcomputer system is and how it works. Introduces fundamental concepts and covers all aspects of microprocessors and related components: internal operation, memories, interfacing and system development etc.

COMPUTERS FOR EVERYBODY
39849A **$8.95**
In this easy-to-understand book it is explained how a computer can be used at home, in the office or at school. Includes a consumer's guide to computer equipment that will help the reader decide what to buy and who to buy it from.

computers hardware & techniques

USING THE 6800 MICROPROCESSOR
21512P **$13.25**
This will guide the reader through the conception, configuration, writing and running of a variety of programs that demonstrate practical use of a 6800 system.

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

MICROPROCESSOR CIRCUITS VOL. 1
21877P **$14.75**
Presents basic microprocessor concepts in simple language for beginners and teaches you to construct a useful microcontroller system. Offers 30 demo circuits which take you through assembly, operation and programming of a microcontroller.

INTERFACE PROJECTS FOR THE APPLE II
69387P **$15.95**
A series of interface projects that are easily built and enable the user to realise the computer's potential through project construction. Projects are primarily hardware-orientated, with some software supporting the hardware.

PET INTERFACING
21795P **$25.25**
Demonstrates how to build numerous interfacing devices for PET hardware. BASIC language programs are used throughout, and the book includes a discussion of the microprocessor's internal architecture and general hardware/software interfacing.

6809 MICROCOMPUTER PROGRAMMING AND INTERFACING, WITH EXPERIMENTS
21798P **$21.95**
Gives a solid understanding of how to program and interface the high-performance 6809 microprocessor. The author completely explores internal structure, addressing modes, data movement instructions, registers, arithmetic logic and test instructions for the 6809.

Z80 MICROCOMPUTER HANDBOOK
21500P **$17.50**
This thorough handbook covers hardware, software and microcomputers built around the Z80.

THE S100 AND OTHER MICRO BUSES
21810P **$13.25**
The key to successful computer expansion is a complete understanding of the bus system, through which the computer communicates with peripherals. This book will give you that understanding.

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

DON LANCASTER'S MICRO COOKBOOK, VOLUME 1
21828P **$20.75**
This 'cookbook' starts with the very fundamentals of microprocessors and microcomputers and takes you through number systems, codes, memory, etc, until you can work intelligently with micros.

DON LANCASTER'S MICRO COOKBOOK, VOLUME 2
21829P **$20.75**
Carries on where Volume 1 left off.

APPLE INTERFACING
21862P **$15.95**
Using this book, you will be able to perform useful experiments which will provide a much clearer understanding of the fundamentals of computer interfacing and computer electronics. A better understanding of interactions between hardware and software will enable you to communicate more effectively with your Apple.

MICROPROCESSOR CIRCUITS VOL. 1
21877P **$14.75**
Presents basic microprocessor concepts in straightforward language for beginners. Teaches you to construct a useful microcontroller system through progressive demonstration circuits.

8080 MICROCOMPUTER EXPERIMENTS
39808A **$29.50**
This 'hands on' book includes 105 experiments presenting programs and diagrams as required for clarification.

A STEP-BY-STEP INTRODUCTION TO 8080 MICROPROCESSOR SYSTEMS
39804A **$16.95**
Doesn't require any electronics or computer background. This book describes the 8080 architecture and instruction set through simple examples. Some basic software is introduced.

DIGITAL CIRCUITS WITH MICROPROCESSOR APPLICATIONS
46032A $39.50
An introductory text, this book provides readers with the basic ideas and tools needed to analyse and design digital circuits and computer systems. Discusses microprocessor computer organisation, machine language number systems and gate circuits.

MICROPROCESSOR INTERFACING TECHNIQUES
88029A $24.95
Teaches you how to interconnect a complete microprocessor system and interface it to the usual peripherals. The hardware and software skills needed to effectively interface peripheral devices are covered along with various buss standards and A/D conversion.

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

BEGINNER'S GUIDE TO MICROPROCESSORS & COMPUTING
BP66 $5.92
Introduction to basic theory and concepts of binary arithmetic, microprocessor operation and machine language programming. Only prior knowledge assumed is very basic arithmetic and an understanding of indices.

A MICROPROCESSOR PRIMER
BP72 $5.92
Learning about microprocessors is easy with this book, written in a style that is easy to follow. The shortcomings of this basic machine are discussed and the reader is shown how these are overcome by changes to the instruction set. Relative addressing, index registers follow as logical progressions.

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

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

COMPUTERS & COMPUTING YEARBOOK 1980
$4.95
Includes beginners buying guide, the Apple, Tandy's TRS-80, the Vector MZ, introducing BASIC, S100 VDU, EPROM programmer, microcomputer power supply and lots more.

COMPUTERS & COMPUTING YEARBOOK 1982
$4.95
Includes disks, CP/M and your computer, learners microcomputer, programming in CHIP-8, alphasort, fast plotter, PET talk, the System 80 etc.

computing software

CP/M PRIMER
21791P $21.95
A complete one-stop course on CP/M, the very popular operating system for 8080, 8085 and Z80-based microcomputers. Complete terminology, hardware and software concepts, startup of a CP/M system, and a complete list of CP/M-compatible software.

THE CP/M HANDBOOK (WITH MP/M)
88048A $19.95
Contains a step-by-step description of all the CP/M command features. Designed for the beginner, the book progresses to detailed explanations of the file transfer program, the debugging program and CP/M's text editing program.

HOW TO GET STARTED WITH CP/M
39832A $19.95
This practical book eases the reader into the essentials of the system, giving an overview of the operating system, an idea of what it will be like to use and what it can do for the reader.

AUSTRALIAN MICROCOMPUTER HANDBOOK
72505 NOW $15.00
Normally $25.00. A detailed buyer's guide to microcomputer systems and application packages in commercial, industrial, scientific, educational and home/hobby areas.

THE C PROGRAMMING LANGUAGE
10163P $21.95
C is a general purpose 'low-level' programming language. It is not specialised to any particular area of application, but its absence of restrictions make it convenient and effective for many tasks.

THE 68000: PRINCIPLES AND PROGRAMMING
21853P $19.95
An easy-to-read, systematic approach to the 68000 advanced 16-bit microprocessor. The book guides you through the complex architecture, instruction set, pinouts and interfacing techniques. Written for design engineers, programmers and students.

PROGRAMMING IN BASIC FOR PERSONAL COMPUTERS
30739P $14.75
Simple instructions show how to give BASIC commands and statements a wide range of applications, from programming video games to developing business or scientific programs.

PROGRAMMABLE CALCULATORS
46008A $24.95
This book suggests which calculators to buy, their possibilities and limitations, and the how-tos of programming them.

TAKE A CHANCE WITH YOUR CALCULATOR
39807A $14.95
An introduction to modern mathematics, this book deals with programming of programmable calculators and includes probability problems.

AN INTRO TO BASIC PROGRAMMING TECHNIQUES
BP86 $6.56
Ideal for beginners seeking to understand and program in BASIC. Book includes program library for biorhythms, graphing Y against X, standard deviations, regressions, generating musical note sequences, and a card game.

BASIC FOR EVERYONE
61481P $19.75
349 pages of BASIC information for all purposes.

BEGINNING BASIC
39806A $19.95
Intended for beginners, this book discusses how a programmer and a basic computer interact with the computer, problems likely to be met by the beginner, the need for and uses of documentation etc.

FIFTY BASIC EXERCISES
88056A $17.95
Designed to teach BASIC through actual practice, this book contains graduated exercises in math, business, operations research, games and statistics. The programs were designed to run directly on a TRS-80 and will run with minor or no changes on any system with Microsoft BASIC.

INSIDE BASIC GAMES
88055A $19.95
The medium of games teaches readers how to design error-free, interactive BASIC programs. Rules, algorithms and coding differences for the PET, APPLE II and TRS-80 are also included.

MICROSOFT BASIC
39823A $19.95
Includes branching and loops, arithmetic in BASIC, strings, editing, arrays and files, the disk and a description of the Radio Shack Level II BASIC.

INTRODUCTION TO FORTH
21842P $14.95
The most complete book available on the MMS FORTH version of FORTH, but also a fundamental approach to programming in all versions of FORTH. Many programming examples are provided, with direct comparisons to the Microsoft Level II BASIC version of these programs.

STARTING FORTH
42922P $23.75
A clear and complete guide to FORTH, this book covers fundamental principles and then a full set of high-level FORTH commands. It concludes with advanced techniques and style.

A FORTRAN PRIMER
80454P $6.95
Assumes no previous knowledge of program writing. It covers the fundamentals of the FORTRAN language, enables extensive program writing and concentrates on programming style.

INTRODUCTION TO STRUCTURED FORTRAN
46007A $19.95
Written for the beginner, the text incorporates the new FORTRAN 77 with a discussion of structural programming. Includes a discussion of time-sharing, pseudo language programming and WATFIV statements.

MICROSOFT FORTRAN
39846A $24.95
An introductory text on FORTRAN in general and Microsoft FORTRAN in particular. The latter is exceptionally well suited for use on microcomputers using CP/M and others of the 8080/8075/Z-80 family.

BEGINNING FORTRAN
46011A $19.95
Introduces readers to FORTRAN. Included are references for further study, brief tutorials on key punching, flow charting, deck set-ups and matrix algebra.

QWIKTRAN
39824A $19.95
Quick FORTRAN for Micros, Minis and Main Frames. Starts with the basic concepts of computing and Qwiktran, a fundamental subset of FORTRAN IV. Lots of examples to increase the reader's proficiency.

THE UCSD PASCAL HANDBOOK
35536P $23.75
Language descriptions organised in a quick and easy reference are given in this book for readers with no prior experience of Pascal programming.

INTRODUCTION TO PASCAL
91522P $19.95
The second edition of this popular book has been updated to conform to the new international standard of Pascal. The contents illustrate the design and construction of Pascal programs, involving a wide range of basic computer algorithms in a practical context.

PASCAL
46028A $19.95
For people with little or no programming experience, this book gives lots of examples that clearly explain proper usage of language features. Discusses top-down programming, debugging, self-documentation etc.

THE PASCAL HANDBOOK
88053A $23.50
This book summarises the entire Pascal vocabulary, including the variations introduced by different commercial versions of Pascal. All in dictionary format.

PASCAL PROGRAMS FOR SCIENTISTS AND ENGINEERS
88058A $23.50
Over 60 of the most frequently used scientific algorithms, along with their program implementation in Pascal, are in this book.

COBOL FOR BEGINNERS
39378P $21.95
It is a solid text for introductory programming courses in Cobol, using a format that is easy to understand, yet comprehensive enough to make supplementary readings unnecessary.

STARSHIP SIMULATION
39810A $11.95
This book offers both a specific simulation which can be implemented, modified and played, and a complete look at how to put together a simulation on almost any subject.

BASIC PROGRAMS FOR SCIENTISTS AND ENGINEERS
88073A $19.95
This book contains scientific and engineering application programs written in BASIC.

COMPUTER GRAPHICS PRIMER
21650P $21.95
Almost every page has a colour drawing, photograph, picture or a schematic to help you learn computer graphics quickly and easily. Programming concepts apply to all microcomputers, and examples are given in BASIC for the Apple II.

INTRODUCTION TO TRS-80 GRAPHICS
39818A $17.95
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amateur radio, DX, communications

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general

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The Commodore Information Centre,
3 Campbell St., Artarmon NSW 2064. Phone: 437 6296.

commodore COMPUTER

MLVL1655

COMPUTING TODAY

Mitsubishi Electric's 'Move Master' micro-robot

Mitsubishi Electric Corporation has recently developed the 'Move Master', Japan's first micro-robot designed for use in training operators, as a teaching aid, or as a point of purchase (POP) display, as well as for hobbyists. The Move Master was first released in Japan in April 1982 and is now available in Australia.

The 245 mm high Move Master is a six-axis articulated robot with five degrees of freedom of motion. The manipulator weighs only about 10 kg for easy portability and can lift objects weighing up to 500 gm. Move Master can be used in combination with either a robot controller or a personal computer.

The Move Master has a built-in power supply for control and drive motors. Each axis is driven by a pulse motor. It has a repeatability of ±0.3 mm which is as good as most industrial robots.

Since the Move Master is equipped with a microcomputer, instructions to the Move Master can be externally given in simple robot language. In addition, programming can be done with BASIC. The Move Master is equipped with a semi-Centronics interface for connection to personal computers made by Mitsubishi Electric and by other major computer builders. It is provided with a software package and a manual for these computers, offering a wide range of applications. A high-performance microprocessor adopted as a robot controller can be used as a CP/M base for various purposes, in addition to controlling the manipulator.

Despite its low price, the Move Master is provided with functions equal to those of industrial robots, and can be used for a wide range of purposes such as training operators in robot language and operating techniques, and by hobbyists in conjunction with a personal computer.

For more information contact Mitsubishi Electric, 73-75 Epping Rd, Nth Ryde NSW 2113. (02) 888-5777.

Low profile S100 microprocessor released by SME systems

SME Systems of Mitcham Victoria has released the latest of its Unicorn microcomputer series, the low profile MPU-100, a Z80 S100 bus microprocessor.

This entirely Australian designed and manufactured unit is a single user and multi-user system, accommodating up to 15 terminals. The low profile cabinet is achieved by using a vertical motherboard with five S100 slots per side. This allows rack mounting and minimises the likelihood of transmission line defects.

The basic system is configured with an SBC 800 CPU, an FDC II floppy disk controller capable of running four drives and the DRC II dynamic RAM card. Other cards can be added in the remaining seven slots to allow up to fifteen extra terminals or modems to be connected and at least 50M of hard drive. Colour graphics, video and 128K CMOS RAM cards are also available from SME to expand the system further for specific applications. All the cards are manufactured by SME in Melbourne, who are S100, Z80 specialists.

On the rear panel of the MPU-100 provision has been made for twelve, 25-way 'D' connectors, two 50-way Centronics connectors and two 36-way Centronics connectors. Two switched 240 V outlets are provided for connection to other peripherals such as disk drives, terminals and printers.

Full information is available from SME Systems, 22 Queen St, Mitcham Vic. 3132. (03)874-3666.

New Ferguson 'Big Board II'

Jim Ferguson, the designer of the 'Big Board' distributed by Digital Research Computers, has produced a new computer called the 'Big Board II'. It runs at 4 MHz, its monitor code is lean, uses Mode 2 interrupts and makes good use of the Z80-A DMA chip.

Big Board II has 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 2K x 8 static RAMs, or pin compatible E(E)PROMs. The third memory bank is for RAM or ROM added to the board via the STD buss.

The Ferguson single board computer has a multiple density disk controller and brings its buss signals to a convenient place on the pc board where an STD buss connector can be attached so you can plug in an STD cable or other cards.

In single quantities full kits cost $750 plus tax, and assembled and tested they cost $895. There are discounts that range to 35% for OEMs and dealers. For more details contact Rod Irving on (03)489-7099.

Computerland enters joint venture in Australia

Computerland Corporation has entered a joint venture with Computerland Australia Pty Ltd to open Computerland franchises in Australia. The new joint venture will be known as Computerland Australia Limited.

The purpose of this joint venture is to provide additional support from the US corporation and to provide a permanent structure for the Computerland stores in Australia.

Computerland Australia Ltd will be capitalised and staffed by both parent companies and headquartered in Sydney. Previously, Computerland Australia Pty Ltd, the company formed by Mr. and Mrs. Hoess in 1977, was a sub-franchise of the US Corporation.

Printout

Two new personal computers and new software from Hewlett-Packard

The lowest priced personal computer ever offered by Hewlett-Packard Company, the HP-86, has been introduced along with an increased-memory version of the recently introduced HP-87 personal computer.

The new HP-86 is priced at $2450 tax free, the first HP personal computer for less than $2500. A complete HP-86 system carries a recommended list price of around $5500.

The new modularly designed HP-86, together with new software for accounting, data-base management and word processing, adds broad new solutions to HP's personal computers for professionals. The new software complements HP's existing graphics, electronics worksheets and data-communication programs.

All of HP's Series 80 BASIC software will run on the new HP-86, as will CP/M operating-system software, with the addition of HP's plug-in CP/M system. The new machine is also compatible with a variety of HP's printers and graphics plotters, as well as several mass storage devices.

The HP-86 system features a choice of 9" or 12" display monitors, a 270K capacity flexible disk drive and an HP 82905B dot matrix impact printer. Memory in the HP-86 itself consists of 128K, of which 64K is user RAM, 48K is operating system ROM and 16K is RAM devoted to the display. User RAM can be increased to more than 500K with the addition of plug-in memory modules.

Accounting software from Peachtree Software Inc. General-ledger, accounts-receivable and accounts-payable software packages are being introduced by HP and make up a complete solution for many professionals who need small business accounting. Peachtree's inventory-control and PeachPay Payroll System packages for the HP-86 will be available late 1982. These accounting programs carry a suggested list price of about $1020 excluding tax.

A second new offering, the HP-87XM premier personal computer, features user memory expandable to 640K and built-in HP-IB interface (IEEE-488) for professionals who need larger memory and a variety of peripherals. The HP-87XM (for 'extra money') is an increased-memory version of the HP-87A.

New software for the HP-86 and existing Series 80 software will run on the HP-87XM. HP also introduced the HP-86/87 BASIC Training Pac, designed to let new owners teach themselves the HP BASIC programming language. The HP-87XM sells for $4075 recommended tax free.

More information can be obtained from Hewlett-Packard, 31-41 Joseph St, Blackburn Vic. 3130. (03)89-6351.

New name, old face

Linx Computer Systems Pty Ltd was formerly known as Halifax Facilities Pty Ltd, a member of the Halifax computer group.

Managing Director of Linx, Peter Flett, said the name change was necessitated because of a new market direction taken by the company and a broader range of services being offered. "We are still principally a software house which tailors packages for a broad range of industry applications, but we also have some excellent ready-made packages that have a proven track record. And, of course, one of our major products is still Computerplan, a complete software package tailored for applications in wholesale, distribution and stock control oriented type businesses," he added.

Module packages available from Linx include: Financial Reporting, Purchasing, Order Entry, Stock Control, Asset Register, Job Cost, Payroll, Word Processing, Invoicing, Bills of Materials and others.

For further information contact Mr. P. Flett, Managing Director, Linx Computer Systems Pty Ltd, 160 Johnston St, Fitzroy Vic. 3065. (03)419-6311.

Talk to your computer

Intel Corporation has announced a set of new products aimed at the evaluation, simulation and implementation of speech-transaction system applications. The products are intended to permit designers to proceed in an orderly fashion as they investigate the viability of speech recognition and synthesis for their systems.

Intel's new products are oriented toward discrete word/speaker-dependent applications and include system, board and component levels to support designers from concept to all levels of production. The board- and system-level products are designed to save time and cost in implementing production-ready systems. The three levels of integration, all using identical firmware, provide the engineer with a cost-effective solution vehicle that matches his requirements.

Intel's iSBC 570 consists of the speech-transaction board, a flexible diskette with an application example and the speech-transaction generator software on it, plus a microphone and a new front panel for the Intellec system. The board plugs into the Intellec system's chassis and the user loads the software via the Intellec system's built-in disk drive.

The iSBC 576 is a Multibus-compatible speech-transaction board (which is included with the iSBC 570) that can be used in conjunction with other Multibus products to implement a prototype or volume production system. The board contains two Intel 2920/21 single-chip analogue signal processors, an 8048 single-chip microcontroller, four 27128 (16K x 8) EPROMs, and an 8086 16-bit microprocessor. These chips make up the speech-transaction recognition subsystem on the board. Their functions, combined with the resident firmware, enable them to recognise speech input.

These same chips make up the iSBC 577 Speech Transaction Recognition Chip Set; the user receives them with recognition firmware and the Speech Transaction Manager already in place. With them, designers can tailor the speech-transaction subsystem to their own particular applications need.

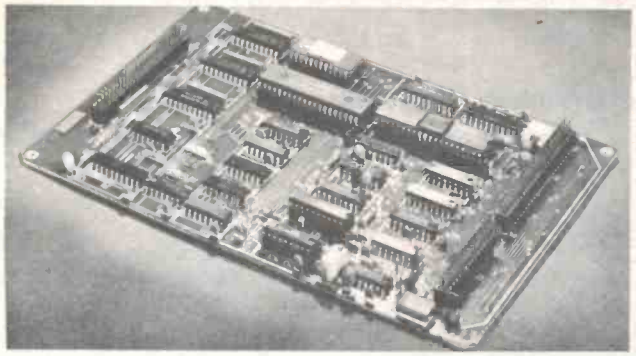
For further information please contact Total Electronics, 9 Harker St, Burwood Vic. 3125. (03) 288-4044.

Club Call

If anyone is interested in joining the **Sorcerer Users Group of South Australia** they should contact the secretary, Brian Richards, P.O. Box 647, Salisbury SA 5108. He'll tell you everything you need to know about the club.

The Western Australian ZX Users Group commenced operations in September. For further information ring Phil Taylor (09)328-4111 bh or (09)328-8111 ah.

The Blue Mountains Computer Club committee would like the dates of their meetings clarified. They meet on the Friday of the second and fourth weeks of each month at the Springwood Civic Centre at 7.30 pm.



6502/6809 microcomputer workshop

The Department of Electrical Engineering at the Queensland Institute of Technology is planning an advanced microcomputer workshop during April 1983. The successful basic workshop in April 1982 was attended by over 100 participants.

Papers are invited for the 1983 workshop and these should be related preferably to the following topics: techniques for good program structuring practice; development of operating systems; comparison of high level languages for real-time operation; use of microprocessor development systems; practical techniques for hardware debugging, using logic state analysers etc; practical techniques for software debugging; DMA techniques and multiprocessor systems. They should be examples, with demonstrations, of practical applications of 6502 and 6809 microcomputing systems.

Please direct enquiries and correspondence to Dr. C.J. Chesmond, Senior Lecturer — Control Engineering, Department of Electrical Engineering, Queensland Institute of Technology, GPO Box 2434, Brisbane Qld 4001. (07)223-2484.

◁ Sorcerer disk controller

Digitrio has announced the availability of their floppy disk controller for the Sorcerer microcomputer. The Digitrio product is Australian designed and built and connects directly to the expansion slot on the back panel of the Sorcerer. An S100 unit is therefore not required. High speed operation is achieved through the use of DMA. The board will fit beside a 5" drive so it can be conveniently packaged in the same unit as the disk drives.

Digitrio claim that their product is the most versatile controller for the Sorcerer. Up to four soft sector drives of virtually any type can be connected at one time. Eight inch and five inch drives can be intermixed. The selection of single or double density operation is transparent to the user as is the selection of single or double sided operation. A full featured single drive capability is implemented to allow single drive installations the use of all multi drive facilities. The flexibility of the Digitrio BIOS is achieved without sacrificing user memory space. The CP/M fits within 8K.

CP/M 2.2 is supplied with the controller board. An extensive collection of Digitrio utilities, in addition to the standard Digital Research products, accompany the controller. Comprehensive documentation thoroughly outlines how to use the controller and describes all software in detail. The controller should be of interest to OEMs who wish to package the board with disk drives as well as end users who are willing to build their own case and power supply.

The retail price of the controller is $500. Complete disk systems are also available. Further information may be obtained from Digitrio, P.O. Box 4553, Melbourne Vic. 3001. (03)578-4064 bh or (03) 419-3026 ah.

CASE provides access to Austpac

CASE Communication Systems has announced the release of an X.25 interface and multiplexor product specifically for use with the Austpac packet switching system.

The DCX 816 enables terminals and computers operating with simple asynchronous RS232 interfaces to be connected to the Austpac network without hardware or software changes.

The DCX 816 enables up to eight terminals, printers, modems or computer ports to be multiplexed onto a single Austpac X.25 access line. The multiplexed devices can be attached at any of ten speeds up to 9600 bps and devices of differing speeds may be freely intermixed.

Providing full X.25 Packet Assembler and Disassembler (PAD) functions, the DCX 816 features automatic or manual call request, CR and LF padding, port selection and speed conversion. Calls may be set-up and cleared down from the terminal keyboards. A printer slaving facility and the ability to transfer calls are additional features also available from the keyboard.

The DCX has been proven in the UK, USA and Europe working into such packet switching networks as PSS (UK), Telenet and Tymnet (USA) and Transpac (France).

For further information contact Barry Foster, CASE Communication Systems Ltd, 1-3 Atchison St, St. Leonards NSW 2065. (02) 438-2400.

Apple signs publishing agreements

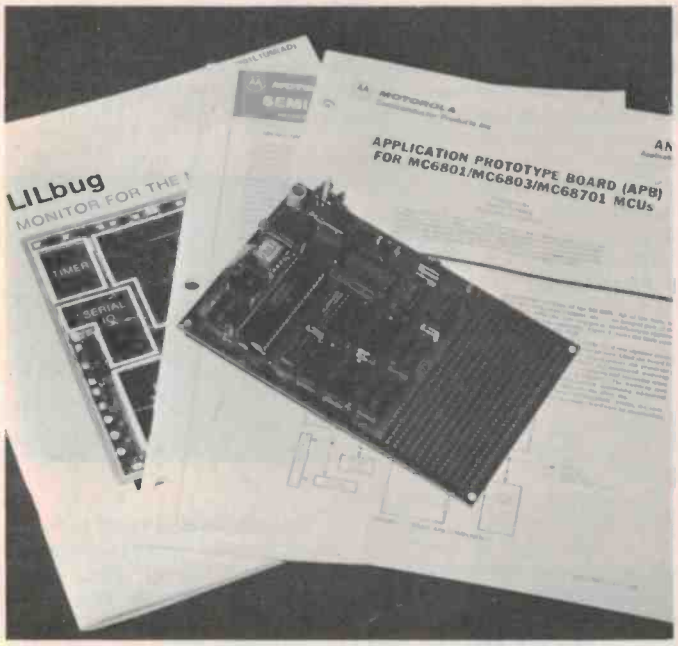
Apple Computer Inc has signed separate agreements with Milton Bradley Company and Hayden Software Company for the development of educational software to be used by Apple Personal Computers.

The non-exclusive contracts call for technical and marketing cooperation between Apple and the publishers in the areas of software development, product demonstration and training.

Apple Computer will support the publishers' efforts by providing technical information, computer training, access to Apple Computers and marketing support. The publishers have signed agreements that outline general areas of cooperation for the development of courseware.

The Milton Bradley Company is the world's largest game manufacturer. The publisher is developing language arts and math programs for middle grade levels.

Hayden Software Company, a new subsidiary of Hayden Publishing Company, is developing language arts, science and math programs for both the institutional and home markets.



Microprocessor applications prototype board

A MC6801 microprocessor applications prototype board is available from Paris Radio Electronics in NSW. This small board from Innovative Technology US, supports the MC6801 family of microcomputers.

A typical 6801 contains an enhanced 6800 processor, 2K of ROM, 128 bytes of RAM, a 16-bit programmable timer, parallel I/O, and a serial communications interface. In addition to the resources of the 6801, the board provides an additional 2K EPROM (TMS2716), 2K of RAM (TMS2114), and a full Duplex RS232 interface.

The board comes with full documentation and is only 4" x 6" and includes a 4" x 2" prototyping area. Priced at only $129.95 + sales tax. The bare board is also available for only $32 + sales tax from Pains Radio Electronics, 161 Bunnerong Rd, Kingsford NSW 2032. (02) 344-9111.

Help for personal computer users

ARPAGE Business Software was set up with the aim of provlding information, advice, custom software and consumables for the Tandy TRS-80 model I and model III and the Dick Smith System-80 microcomputers.

They claim to have the best and fastest accounts receivable system that is available for this range of computers, designed for use with the absolute minimum of operator training. They also have a small taxi fleet management system that provides detailed information on as many as 20 separate repair cost/failure items. There's also a system for security companies to log all alarm events, verify voice identity codes and provide detailed printouts of all events for the client at the end of the month. Accounts payable and general ledger systems should be ready for installation soon.

For more information on ARPAGE Business Software contact them at P.O. Box 386, Gladesville NSW 2111. (02)816-2471.

National announces 24-pin PAL devices

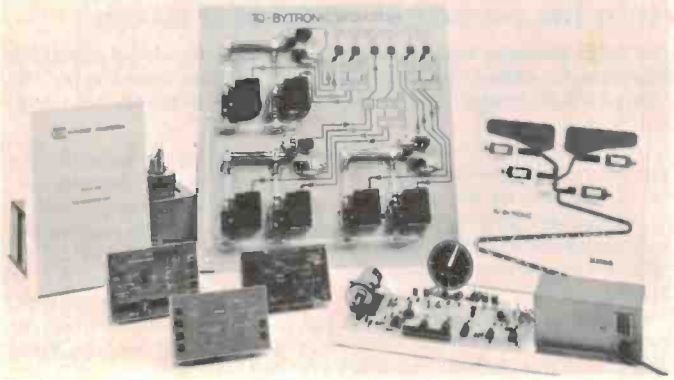
National Semiconductor Corporation has introduced the Series-24 family of programmable array logic (PAL) medium-size devices in 24-pin packages. The new Series-24 family complements National's PAL Series-20 family by providing two additional inputs and two additional outputs, allowing more complex functions in a single package.

In addition to providing more logic functions per chip, 24-pins allow for many natural functions which were previously unavailable in 20-pin packages such as: 8-bit parallel-in, parallel-out counters; 8-bit parallel-in, parallel-out shift registers; 16-line-to-one-line multiplexers; dual 8-line-to-one-line multiplexers; quad 4-line-to-one-line multiplexers.

The family lets the systems engineer design his own chip by blowing fusible links to configure AND and OR gates to perform his desired logic function. Complex interconnections which previously required time-consuming layout are thus 'lifted' from pc board etch and placed on silicon where they can be easily modified during prototype check-out or production.

The entire PAL family is programmed on inexpensive conventional PROM programmers with appropriate personality cards and socket adaptors. Any one of these medium PAL devices can replace five to 15 packages of standard SSI/MSI logic. These devices are available now in plastic and ceramic packages and can be obtained from National Semiconductor, cnr Stud Rd and Mountain Hwy, Bayswater Vic. 3153. (03)729-6333.

Printout



Microprocessor application equipment for the student

These teaching aids, designed to illustrate the principles concerned with the industrial application of microprocessors, have been introduced by a British company.

Developed in conjunction with microprocessor specialists, all items in the TQ Bytronic range, from TecQuipment International Ltd, are based on standard industrial circuitry and equipment.

The teaching aids are designed for student experimental work and are said to be usable at most course levels from schools to universities. They are compatible with all major microcomputers currently available.

The range consists of a stepper motor with software and notes, an A-D converter, a D-A converter, a sorter, a sequencing unit, a traffic flow controller and a motor.

Enquiries to the British Consulate-General, Gold Fields House, Sydney.

Apple's plea to enjoin Franklin denied

A US District Court judge has denied Apple's request for a preliminary injunction to prevent Franklin Computer Corp. from marketing an Apple compatible computer, citing lack of merit in Apple's case.

Apple claims that Franklin's Ace 100 personal computer violates Apple patents and copyrights. Franklin, in a countersuit, claims that several Apple patents and copyrights are invalid.

Apple's suit now advances to the discovery stage, and officials with both Apple and Franklin say it could take as long as a year before the suit comes to trial.

The judge considered Apple's request on the basis of a reasonable probability for success on the merits of the claim, and on the risk of irreparable harm being caused Franklin by an injunction. The judge said that although Apple's arguments were strong he did not believe that it had shown a reasonable probability of success.

In his ruling the judge also cited one of Franklin's counter-arguments as decisive. "Franklin's argument is that it has created not an Apple-compatible system, but rather a system compatible with Apple-compatible software, which must, of necessity, share a great deal of the essential structure of Apple," he noted.

Apple's response was short. "We will take this to the next step, the trial stage," a spokesman said. "That could be over a year from now," he added.

Since the suit was filed, Franklin has replaced the Ace 100 with an upgraded version, the Ace 1000, a move Franklin chairman Barry Borden said was not related to the Apple suit. Compared with the 100, the 1000 is a faster machine with greater ROM expansion and color capabilities, but operates on the same basic 6502-based design that Apple alleges infringes its copyrights and patents.

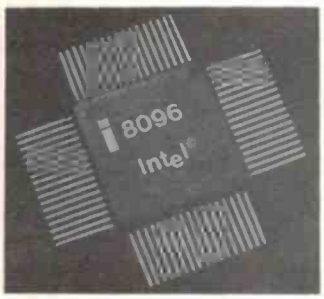
Franklin plan making 1000 Ace 1000 units per month, Mr. Borden noted. The firm distributes the Ace through High Technology, Inc, St. Louis, and markets directly to retailers.

Franklin's countersuit has not been heard in court yet. In addition to claiming that Apple patents and copyrights are invalid, Franklin also alleges Apple violated antitrust law, and seeks treble damages exceeding $150 million.

Intel's 16-bit microcontroller

Intel has announced a new 16-bit microcontroller, designed for high-speed maths and control operations. The part will be available for general sampling in the first quarter of next year.

Intel's first 16-bit microcontroller diverges from the dual in-line package of the company's eight-bit microcontroller offerings and is being sampled in a 68 lead flat-pack. A less complex 48-pin DIP version of the 8096 will be available, the company said.



The single-chip microcontroller uses over 120 000 transistors and carries 232 bytes of RAM, including 16 bytes of power-down RAM, 40 I/O lines and a 10-bit A-D converter. A version with 8K of ROM, the 8396, is also available.

According to the company, the 8096's I/O is designed to interface with a wide range of transducers and sensors, and to offload real-time I/O operations from the CPU. The I/O includes an eight-level priority interrupt structure, analogue input, PWM output, high resolution pulse measurement and pulse output, full-duplex serial I/O and a watchdog timer, along with the 40 parallel I/O ports.

New human interface enhancements for its Intellec Series II and Series III microprocessor development systems have also been announced by Intel.

The new features result in fewer keystrokes and higher productivity, claim Intel, helping shorten the development cycle time. They make file viewing on the system screen more versatile, speed up command-line editing and guide the user in choosing the correct commands.

The upgrade kit consists of four 2716 EPROMs, a single 8741 microcontroller and two flexible diskettes. The EPROMs and microcontroller replace those currently in the system, and the diskettes are loaded on top of the ISIS operating system.

Case data communication adaptors

CASE Communication Systems has announced the availability of a comprehensive range of data communication adaptors designed to solve a wide range of terminal, computer and peripheral interfacing problems.

Comprising some 30 different devices the 'Blue Box' range enables computer users to configure large or small terminal systems in the most efficient manner and implement them at a minimum cost.

The product range includes limited distance modems, modem eliminators, asynchronous to synchronous converters, IBM loop adaptors, modem sharing devices, code converters, interface adaptors and fallback switching equipment.

For further information contact Case Communication Systems, 1-3 Atchison St, St. Leonards NSW 2065. (02)438-2400.

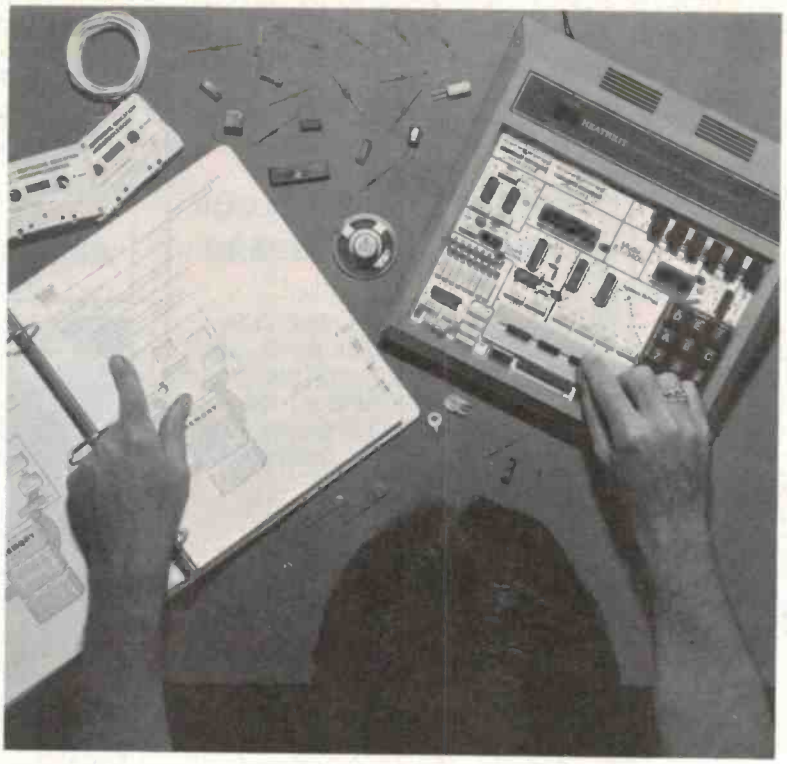
Apple clone causes problems

A restraining order has been issued by the Supreme Court of Victoria prohibiting the sale of alleged bogus Apple II computers by Micro Pro Computers of Melbourne.

The Supreme Court order not only restrains Micro Pro from selling bogus Apples, but also requires the company to provide the names of all suppliers.

In the USA, the US Customs Service has begun detaining, seizing and destroying imitations of the Apple II being imported into the USA. Most of the imitations were coming from Taiwan and Hong Kong, the company said.

Apple Computer Inc. has filed a number of lawsuits in Taiwan, Hong Kong and New Zealand to prevent the manufacture and export of fake Apples. Sunrise Computer of Taiwan, maker of the Apolo II computer, has agreed to cease production and in New Zealand, Orbit Electronics, which was selling 'Orange' computers from an unknown Taiwanese manufacturer, has ceased trading.



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Monsteria Ridiculosa

If we collected all the Apple Computer copies together we'd have a good fruit salad. Apple Computer Inc has filed suit against Formula International Inc of Los Angeles for copyright, patent and trademark infringement. The lawsuit, filed in the US district court in Los Angeles, charges Formula with selling copies of the Apple II computer in kit form under the brand name 'Pineapple'. (Now that's the best name yet.)

The kits are being imported from the Far East and include all components necessary for an Apple copy, including ROM containing Apple's copyrighted programs. Formula is also selling diskette-form copies of Apple's copyrighted programs.

Apple seeks injunctions against the importation and sale of the kits in addition to the profits, if any, from Formula's sales. The suit has been brought by Apple to supplement the actions of US Customs which has been confiscating Apple copies being imported into the US.

Vendale ZX80/81 programmable character generator and video upgrade

The ZX80/81 programmable character generator removes the limitations of the ZX character set by allowing users to define their own characters. This feature is normally only available on more expensive machines and allows you to create your own graphics for games, charts and interesting patterns.

The programmable characters can be any shape defined on an 8 x 8 matrix of black and/on white dots and are created by using simple BASIC commands. Because the Vendale ZX80/81 programmable character generator has onboard RAM it does not interfere with memory expansions etc. The pc board plugs into the ROM socket inside the ZX80/81 (the Sinclair 8K ROM plugs into the add-on board) leaving the edge connector free for other add-ons and requires one simple internal connection. The fully assembled price is $95 incl p&p (Australia).

The video upgrade add-on will allow the ZX80 to run at two speeds, slow and fast. Like the ZX81, this add-on will cause the ZX80 to compute and display information on the screen at the same time. Now the ZX80 can run animated displays completely free of annoying screen flicker and also overcomes the problem of the top lines of the display slanting to one side.

The Vendale video upgrade is fully assembled and will fit easily inside the case of the ZX80. If you are handy with a soldering iron, you could install this add-on quite simply or Vendale could do it for you at a minimal charge. The fully assembled price is $38.50 incl p&p Australia. If you would like Vendale to install the video upgrade for you, the charge will be $15 for an unmodified ZX80 and Vendale ask that the ZX80 owner pays his own postage and insurance. The video upgrade will only work in conjunction with the Sinclair 8K ROM.

Both units are available from Vendale Pty Ltd, P.O. box 456, Glen Waverley Vic. 3150.

Software for TRS-80 and System 80

Aiming to capture the swelling demands from TRS-80 and System 80 users for quality software, Molymerx has established a mailorder network with outlets in Gosford and Auckland.

Managing Director, Alistair Campion, says that the last 12 months have been spent compiling together an extensive catalogue encompassing some of the best software currently available in Europe and North America. The catalogue is being marketed as a reference tool, with extensive descriptions and screen photos accompanying many of their products. Regular updates of the catalogue will be mailed to subscribers as new software is released.

Readers will be able to choose between a wide range of programming utilities, arcade and adventure games, data management systems, disk operating systems, education and communications software. For business users, there will be a number of small accounts packages, stock control, time recording, word-processing and mailing systems.

The Molymerx software catalogue is available through mailorder for $2 (NZ$3). For further information contact Molymerx at P.O. Box 900, Gosford NSW 2250. (043)694-888. New Zealand readers should write to P.O. Box 60152, Auckland. (817)4372.

Two views of the MicroBee

There is no point repeating here the boasts of this locally designed and manufactured personal computer — read the advertisements! But, just what do you get? Two builder-users relate their experiences and give their views.

Eric Lindsay
Tom Moffat

THIS ARTICLE is the combined contributions of two authors, Eric Lindsay and Tom Moffat. Both purchased MicroBee kits and relate their experiences with the kit and their impressions of the working machine. Eric Lindsay bought his kit early in 1981 when the MicroBee was first released, whereas Tom Moffat bought his some six months later.

To bee or not to bee . . .

Eric Lindsay, Faulconbridge, NSW

AFTER some two hours of playing with a prototype MicroBee, I phoned Applied Technology to order one. They would not accept an order until the components were to hand. This attitude rather pleased me, although I admit that I did try to bribe them to put me at the top of the list for orders, because when I ordered my first computer, from a very well known organisation, I had to wait nine months for delivery.

I bought one of the earliest kits delivered and I did have problems. There were some etch cuts and jumpers on the board. The manuals were photocopied and loose-leaf, the connection diagrams were wrong, testing procedures incomplete, and the circuit diagram was both incomplete and incorrect in areas. Even worse, not one step of construction went to completion without extensive debugging. After finding plated-through holes on the boards that were not plated through, I sought expert help and we then spent about 36 hours, without achieving much more than considerable admiration for the ingenuity of the designer. Eventually we gave up, and sent the kit back to Applied Technology. They spent about four days on it before also giving up. The offending board was returned to the supplier as an example of problems, and with a new board my MicroBee started running and has been trouble-free since.

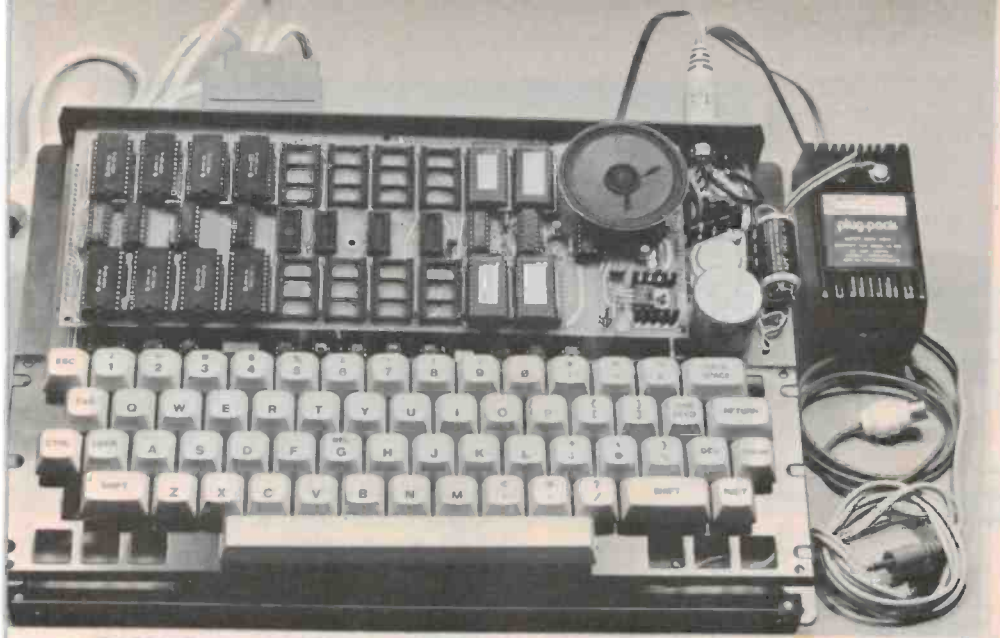
Construction is reasonably straightforward. The memory board is completely assembled and contains most of the expensive components. The bottom board is nicely marked with components, double-sided and solder-masked, and although closely packed, should provide no problems for the experienced hobbyist. A number of MicroBees have been constructed by inexperienced builders of my acquaintence, and only one other had a plated-through hole problem, and that was also from the earliest production run. There have been some board changes. The jumpers and etch cuts are absent from boards after the first 500, the mounting of the 7805 has changed, with the TO3 case mounted on the metal baseplate replaced by two flatpack 7805s with heatsinks. This is an advantage as poor construction on the earlier method could drive the leads into the 7805 case, causing power supply problems. The plugpack power supply that provides 12 V dc to the board is adequate, as a fully expanded MicroBee draws less that 900 mA, but hardly inspires confidence. Several owners have built up replacement supplies, just in case. If you need low power consumption, you can replace some ICs with 74C series. However, Applied Technology do not give advice on this. I can tell you that 74C151s and 157s do not give good results, and most of the video components also need LS chips.

The manuals with the MicroBee now include a corrected construction guide, in which I could not find any errors (after my initial experience, I can assure you I looked long and hard). The BASIC tutorial manual gives a guide to some of the commands, and explains some of the differences between the MicroWorld BASIC used, and the more standard Microsoft BASIC as found in Apples TRS-80s, and PETs. The 27-page tutorial manual also contains the only mention of the "On Error" command, which is not mentioned in the 110-page BASIC manual. The documentation is adequate for a person who has a little program experience, however the complete beginner would find it hard going, despite the tutorial. The manuals are bound in the same format as those with the Apple, but as could be expected with a new computer, are not as extensive. As most textbooks tend to cover Microsoft BASIC, if they mention home computers, I would advise newcomers to BASIC to join a user group or seek out others with a MicroBee before they get too involved. Since the MicroBee is designed to meet school needs, I anticipate that better guides will be available in the future.

Running the MicroBee was a *delight*. I have never owned a cheap home computer that was so easy to interface to other equipment. I needed a listing of a program the first day I had the Bee. Plugged an RS232 cable into the Bee, typed "Out#4 on", and listed it. No problems for my ancient 300 baud Terminet. There are some printers with serial connections that give problems, but if the printer can take 300 or 1200 baud, 8-bit ASCII with two stop bits and no parity, it will run. Centronics printers are another matter. There is no official way to run them, at least in the MicroBee advertisements. However the Bee contains the required software, and the only changes required are to fit a 15-pin right angle D socket to the Bee in the position marked on the circuit board, and then add a 74123 to widen the strobe. "Out#1 on" then transmits to a Centronics printer, such as the Tandy Model VII with proper handshake. Connecting modems is a matter of plugging them into the RS232 socket.

Communication with other computers is equally easy. I dumped a lengthy BASIC program from a System 80 to the MicroBee by typing "in#4" on the MicroBee, and then "LLIST" on the System 80. This transmitted straight through the RS232 connection. I did have to add a short program to the System 80 to put nulls out after each line of BASIC, however you can just LLIST line number and transmit a line at a time if the program is short.

Another beauty of the design is memory designed to be 'continuous', that is, to remember its contents without mains power, using a battery. Adding the backup battery is easy. Two soldered connections and a 4.5 volt photo battery. Unfortunately, you can sometimes have a cold start, usually when you have been relying on the battery backup to retain the program you have been working on for the past month. I found I was getting into the habit of just unplugging the MicroBee, confident that programs would be there when I returned . . . but when I started doing that with other computers, I decided it was time to start backing up



The MicroBee exposed! The 'core' board is prominent above the keyboard. This can be changed to provide different configurations for the machine — PROM-based software, more RAM etc.

programs to cassette! I started at 300 baud, since I don't trust cassette. Those of you with early TRS-80s, Apples or System 80s will know what I mean. After a bit I tried 1200 baud. Then for portability, I started using my micro-cassette recorder, at 1200 baud. I can dump a 350-line program in a few minutes, and can only provoke a bad load by having totally flat batteries. The cassette interface is *very impressive*. It dos however lack remote control of the cassette motor.

Video output is not so impressive. It lacks power. I tried the amendments suggested in a MicroWorld newsletter, but they did not help much. I must admit that output is not low enough to cause viewing problems; merely that you have to adjust your monitor brightness and contrast, and if you run several computers, this gets to be a problem. Synchronisation is excellent. No wavering or swimming of the image, unlike every other home computer I've owned. To my considerable delight, the MicroBee also produced an excellent picture on an unmodified US monitor, so I will carry the Bee with me overseas to use as a word processor.

Software

The MicroWorld BASIC is somewhat slow, about half the speed of the Apple. Since most real time games are written in machine code, this probably won't be a problem. It is also fragile: you find errors where you don't expect them, if you have used Microsoft BASIC. Most come from having integer and real variables being incompatible and unable to be mixed within a line, a method common in early BASICs, and familiar to those who program in Fortran IV. String manipulation is also different, being to the ANSI Standard, or like the early HP BASICs. For example, to pick characters 1 to 3 from a string, you would use A1$(;1,3). You can do everything that LEFT$, Right$ and MID$ will do. In the fancier commands, the GX, global search and replace, and PLOT commands are very nice, as is the SD — set decimal precision. The loudspeaker tends to be standard now, but having the PLAY command run exact musical notes was a good idea.

However, the major problem with any home computer is to justify the purchase. At $399 the MicroBee is less expensive than most, and needs less justifying. If you are using it for business it is more difficult. There are relatively few programs available as yet, and unless the capabilities of the MicroBee fit your particular need, writing a program is hardly cost effective. Apart from the educational market, where MicroBees could form an effective network machine with a single master running multiple slave MicroBees, there are a few very small business uses, where the cost of a MicroBee plus cheap printer could be justified.

Take a milk vendor. A MicroBee and monitor could run off the milk float battery and list all customers and their orders. Changes could be indicated at once, and the MicroBee removed after the run for accounting. No other machine has the combination of small size, low power, battery backup, printer outputs and low cost needed to suit a one-person business with limited resources. There are probably a whole range of small businesses for which a MicroBee is the ideal size computer.

Expansion

Future expansion is always problematical. Most manufacturers take far longer than anticipated to produce expansion units. However it appears that a four-slot S100 expansion, with in-built power supply and disk drive will be available for the MicroBee. This will have room for two drives, and be fitted with a single MPI B51 running double density to obtain 180K capacity. A new core board to provide 64K of memory would be required, and a disk boot EPROM. There would probably be minor changes to the main MicroBee board to obtain an 80 column display to match the standard expected in CP/M2.2 equipped micros. A light pen and perhaps some form of external ROM pack for programs might appear by next year.

Graphics

The MicroBee's graphics are achieved in a similar fashion to the Sorceror — that is, a programmable character generator (PCG) is used. This is memory economical but it is possible to overflow the PCG by just blindly plotting on the screen, with little consciousness of PCG usage. Not quite as flexible as the Apple's bit-mapped approach, but if you think about it carefully, it can do as complex a pattern as you are likely to need and it costs you less than the brute force techniques.

Another memory economy is the storage of BASIC words as tokens, rather than as the strings of characters which make them up. A program to find what tokens mean what, just as a matter of interest, is appended (over the page).

Summary

In summary, an excellent machine for learning computing, and for the ultra small business, with considerable expansion potential. A little time will show just how much potential is realised. It is excellent value for money.

The MicroBee revealed

Tom Moffat, Fern Tree, Tasmania

THIS isn't a review, as such, but an account of experiences . . . the frustrations, and sometimes the joys, of buying and building Australia's latest homegrown computer. MicroBee . . . where'd they get a name like that in the first place? Is it a $400 wonder, or a $400 headache?

Getting the MicroBee from Applied Technology was a hassle from the start. You don't just go out and buy one, you get put on a waiting list, and you wait and you wait and you wait. As quoted delivery times kept slipping back and back, two of us, myself and a friend named 'J.J.', decided to take the bull by the horns and order two MicroBees, with a notice on the order saying if they didn't appear within 30 days the order ▶

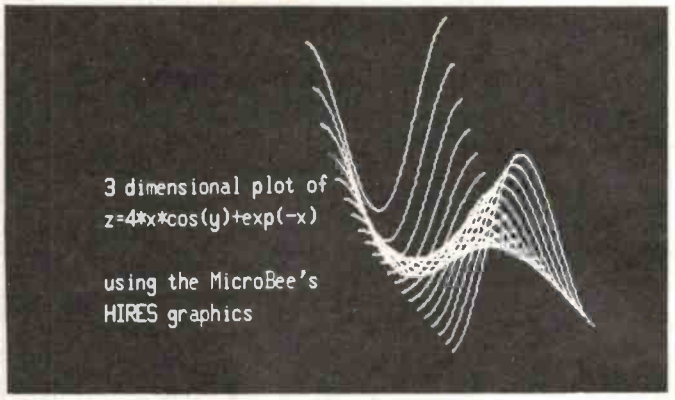
```
list

00100 REM Care, include the space between line no and rem
00130 FOR T =129 TO 240:POKE 2308,T
00140 PRINT "token ";T;"    ";:LIST100
00150 A1$=KEY$:IFA1$=""THEN150
00160 NEXT T
00170 POKE2308,161
>run

token  129
00100 LET Care, include the space between line no and rem
token  130
00100 LPRINT Care, include the space between line no and rem
token  131
00100 PRINT Care, include the space between line no and rem
token  132
00100 IF Care, include the space between line no and rem

Stop at 00150
>
```

Example program from Eric Lindsay to show what tokens stand for which BASIC commands. e.g: token 129 is LET, token 130 LPRINT, etc.



This one speaks for itself!

would be considered cancelled. On the 30th day they arrived, along with a stinging bill for $46 for double-speed, door-to-door, air express delivery. Oh well, we would now consider the investment $422 each — $399 for each computer, plus the freight.

Our MicroBees arrived as kits . . . a large circuit board which was to be filled with ICs and a few other bits, a ready-built keyboard, and a ready-built core board (the plug-in section with most of the memory chips). Construction was uneventful. It took each of us about eight hours, following a generally well-written manual, pausing to carry out tests at the recommended stages. Both computers survived the final smoke test working the first time.

Within an hour of completion, the first problem surfaced: heat, and lots of it. Two 5 V regulators attached to the keyboard frame as a heatsink, and a third on the core board simply flapping in space were all hot as a firecracker. And the 12 V/1 A plugpack supplied with the kit — same thing. There is an old rule of thumb in the electronics business, . . . if a part is too hot to touch, it's too hot! Just about every active part of the power supply produced painful burns. Inquiries to Applied Technology brought the response that 'all the parts were running within their ratings'. J.J. and I, being of a more conservative nature, found a source of Sinclair ZX81 plugpacks rated at 9.5 V/1.2 A. One of these for each computer got the heat down to a more reasonable level, at a cost of $15 each. Total system cost now $437 each. Another Hobart MicroBee user didn't get there in time — his 12 V plugpack 'blew its guts'.

Another loud grizzle concerns the case supplied with the MicroBee kit. The blank moulded plastic case probably started out all right, but then someone cut the hole for the keyboard, from the looks of it *either with a nail file or an axe.* The holes were marked with blue ball point pen, and then the cuts were made inside the lines, leaving the blue marks behind. In other words, a real mess. Applied Technology promised some replacement cases, but at the time of writing, there's been no sign of them. Same goes for the software cassette tapes promised as a reward for returning the user registration card. When I tell people I built the MicroBee from a kit, in the next breath I must save face and deny responsibility for cutting the hole in the case.*

The BASIC interpreter

MicroWorld BASIC is a real enigma. It's a bit on the slow side, it's choosey about how you assign variable types, and it can produce some strange crash conditions. But within its 16K it has some features usually found only on multi-thousand dollar systems, such as a 'global search and replace' facility, full editing, and the ability for the programmer to define some of his own functions.

Variables come as three types: integer, real (floating point), and string. There's absolutely no mixing of different variable types allowed, and if you try to take the square root of A, for instance, you'll bomb out to an error message: mixed mode. 'A' is an integer variable. If you want the square root of a number represented by A, you'll have to call it 'A1' or 'A2', a letter and a number. String variables need a letter, a number and '$' — A1$. Actually, for the right applications, integer mathematics are very handy — division results in the fractional part being dropped, and all variables can be expressed as 16-bit binary values. The upshot of all this variable mode stuff is that it's easy enough to write original programs, but a bit messy to translate material from other dialects of BASIC.

BASIC funny business

There are a few strange things that occur under BASIC which haven't been successfully explained. When working on a large program, inserting and moving lines around, program material far removed from the area being worked on is sometimes corrupted. This happens before an attempt is even made to run the program. If you fix the corrupted line using the edit commands and then go back and look at it again, it will once again be faulty. An educated guess is that there are two versions of the line, the faulty one and the one fixed under edit.

When Applied Technology were told of this, they said it was the first case of its kind they'd heard of. They offered to look into it if I sent the core board back, but before I could do this my friend J.J. advised that his MicroBee was sometimes developing bodgy lines that 'he couldn't get rid of'. Aha! It's not just my computer after all. Further investigations are to follow.

The current theory is that the 'funny business' gets worse as the computer is used more and more. Now the MicroBee has what's called 'continuous memory', a small battery keeps its RAM contents intact, even when the power is switched off. The suspicion is that some 'little crashes' poke bad values into areas of RAM, with resulting weird effects, and as time goes on these 'bad bytes' keep building up since nothing is ever actually erased. When you hit 'NEW', 'RESET', or even a full blown cold start, RAM contents remain. Only the 'end of file' marker gets moved to the start, making the computer think it's empty.

Enter upon the scene a small program called 'purge'. Its purpose is to clear, in a violent manner, all memory between zero and the end of a 32K system! As it resides in an area of RAM above the VDU, it's out of range of the 'wipe' and won't be affected. Both a machine language and a BASIC version are given. When the computer is playing up with much 'funny business' under BASIC, run this program and you will notice a considerable improvement.

Editor/Assembler/Monitor

Not many MicroBee owners will have this $50 software package in two 4K

* *Applied Technology supplied new cases just as we went to press. MicroBees now have 'proper' moulded cases.*

EPROMs. Pity. It is one *beauty-bonzer-rip-snorter-crash-hot option.* I am an incurable machine code freak, and this software package helps write machine code. Helps? It damn well does it for me! I've hand assembled thousands of lines in Motorola 6800 code. Now I'm into Z-80 and I just type in what I want the instruction to do. The assembler does all the looking up of operation codes, notifies any syntax errors, works out the machine code, puts it in the desired area of memory and prints out the result of the whole works. *Magic.* The machine code version of 'purge' was made on this system; all that nice labelling and formatting is automatic.

The original plan for a program is worked out on the Editor. Before attempting an assembly you can type in lines, change them, add them, drop them, compose whole blocks of material and then dump them in the middle of the main file, pushing existing lines apart to fit it all in. And the Editor isn't restricted to machine code program lines, it works on text as well. This entire article was composed on the Editor, saved on cassette tape and when completed (after much chopping and changing), the whole file was played out to an old 50 baud teletype machine. Typewriters, my friends, are old stuff now.

The Monitor allows the programmer to look at memory contents, change or enter material into memory, search memory for specified contents, or move blocks of memory. You can also record and load machine language tapes, and run machine language programs.

An interesting fact about the Editor/Assembler is that it does not indulge in 'funny business'. This is the private domain of BASIC. The Editor/Assembler appears to be perfectly behaved, once one learns how to drive it. Commands are in the form of one- or two-letter codes that must be looked up, or memorised. It's got its own instruction manual. My copy has a few mistakes but one would assume these will be corrected in later editions.

A final word from J.J. came the week before this article was written. "My MicroBee blew up last night," he said, "just as my wife was typing programs in for me" . . . (Eh?) . . . "The keyboard froze, she lost complete control of it, and then it went pffft . . . dead, snuffed it, expired."

We had one worried fellow there for a couple of days as all normal trouble-shooting procedures failed. Nothing made sense, all ICs were changed until all that remained were the big 40-pin chips. And the culprit? — the Z80 itself. Why? Who knows . . . could it be the original heat problem somehow weakened it?

How reliable the MicroBee turns out to be will be interesting to observe. At the price they're selling for, Australia will likely be flooded with them, in schools, in homes and even offices as their uses as 'el cheapo' word processors and accounts machines become evident. If they're good they're going to be glorious. But if the problems persist . . .?

The heat trouble is the first priority — this must be sorted out in future machines. The BASIC bugs will not be quite as obvious, as they don't appear during program run time, only when it's being written. So users of pre-written software, such as students running maths drills, will never see the bugs. But programmers will scream in frustration until it's fixed. If Applied Technology would care to supply a sorted out version of MicroWorld BASIC, I'll be happy to test it out and eat my words if necessary.

In the meantime, have a program to play with. Yes, you've seen it before, in another vesion, published in ETI with a review of the Sharp/Tandy pocket computer. Now it's been translated again, and souped up a bit to provide some printer-style graphics. Since it's been printed out on the old teletype machine, built before ASCII characters were ever heard of, a few substitutions have been made. 'X' means multiply. '(' means less than. ')' means greater than. Of course, in the proper context, '()' are brackets as well. If you go back and compare this version of the program with the one published earlier, you'll see how variable types have to be shuffled around. Happy landings! ●

```
        THE FOLLOWING TWO LISTINGS ARE OF THE SAME
PROGRAM.. 'PURGE'. IN THE ASSEMBLER VERSION THE
ACTUAL PROGRAM IS THE HEXADECIMAL NUMBERS LISTED
UNDER 'CODE', STORED AT THE LOCATIONS UNDER 'ADDR'.
THE BYTES CAN BE ENTERED INTO THE COMPUTER MANUALLY,
OR BY USING THE BASIC PROGRAM BELOW. IN THIS CASE
THE NUMBERS IN THE DATA STATEMENTS ARE THE SAME
PROGRAM CODE, ONLY IN DECIMAL FORM. THE PROGRAM,
ONCE ENTERED, IS RUN BY TYPING 'PRINT USR(62464) AND
HIT RETURN. AFTER A BRIEF PAUSE THE COMPUTER WILL
CONDUCT A BASIC COLD START, WITH A CLEAR MEMORY.

ADDR   CODE    LINE   LABEL  MNEM   OPERAND

0400           00210         DEFB   16       ,ALL VALUES ARE HEX
F400           00220         ORG    0F400    ,PUT PGM AT F400
F400 210000    00230         LD     HL,0     ,START OF CLEAR AREA
F403 010080    00240         LD     BC,8000  ,HOW MANY BYTES
F406 3600      00250 CLEAR   LD     (HL),0
F408 23        00260         INC    HL
F409 0B        00270         DEC    BC
F40A 78        00280         LD     A,B
F40B B1        00290         OR     C
F40C 20F8      00300         JR     NZ,CLEAR
F40E C30080    00310         JP     8000     ,JUMP TO BASIC.
0000           00320         END
00000 TOTAL ERRORS

CLEAR   F406

00100 REM PURGE... A MICROBEE LAXATIVE.
00110 FOR A=0 TO 16
00120 READ B
00130 POKE (62464+A),B
00140 NEXT A
00150 END
00160 DATA 33,0,0,1,0,128,54,0,35,11
00170 DATA 120,177,32,248,195,0,128
```

```
00100 REM SPACECRAFT LANDING SIMULATION, TOM MOFFAT, 12/9/82
00110 CLS: PRINT 'SPACESHIP LANDER'
00120 PRINT 'ENTER DESTINATION...'
00130 INPUT 'EARTH, MOON, MARS, VESTA:',S1$
00140 IF S1$='EARTH' THEN LET K1=980.7: E1=6371: GOTO 200
00150 IF S1$='MOON' THEN LET K1=162: E1=1738: GOTO 200
00160 IF S1$='MARS' THEN LET K1=374: E1=3380: GOTO 200
00170 IF S1$='VESTA' THEN LET K1=17.5: E1=195: GOTO 200
00180 PRINT 'X NAVIGATION ERROR. TRY AGAIN.'
00190 PLAY 5,2,5,2: PRINT'': GOTO 120
00200 CLS: PRINT S1$, ' GRAVITY=', K1
00210 UNDERLINE: PRINT ' BURN   HGT   VEL    FUEL': NORMAL
00220 L1=K1/36: M=INT (SQR (L1)X100)
00230 IF M(175 THEN LET M=175
00240 N=55XM
00250 IF N(10000 THEN LET N=10000
00260 O1=FLT(N)X(2.30258)XLOG(K1)/20+10000
00270 A1=-6400: B1=5000: C1=15000: D1=10
00280 M1=FLT(M): N1=FLT(N)
00290 H1=D1: F1=B1: P1=M1: Q1=N1
00300 IF P1(7 THEN LET Y1=P1X5 ELSE LET Y1=P1/10
00310 Z=62-INT(Y1)
00320 PRINT (F6.1 J1),(F7.2 P1),(F7.1 F1),(F7.0 Q1),
00330 PRINT TAB(Z),'X', TAB (63),'/'
00340 PLAY 1: OUTO OFF: INPUT J1: OUTO
00350 IF J1=0 THEN 380
00360 IF (J1(0) OR (J1)100) THEN 450
00370 T1=Q1/J1: IF T1(10 THEN LET H1=T1
00380 Q1=Q1-J1XH1: W1=G1
00390 I1=L1+L1XP1/(-2XE1)-(J1XO1)/(C1+Q1)
00400 G1=F1+I1XH1: R1=P1
00410 P1=P1+(G1+F1)/A1XH1: F1=G1
00420 IF P1(0 THEN 480
00430 IF Q1(=0 THEN 460
00440 GOTO 300
00450 PRINT 'ILLEGAL BURN, USE 0-100.': GOTO 340
00460 X1=SQR(F1XF1+5650XP1XL1)
00470 PRINT 'OUT OF FUEL.': GOTO 510
00480 X1=SQR (ABS (R1/26X11))X11+W1
00490 IF X1(20 THEN PLAY 4,11,8 ELSE PLAY 22,14,22,14
00500 CLS: PLAY 10,9,10,0
00510 SPEED 180: PRINT 'YOU HAVE...'
00520 IF X1(20 THEN PRINT 'LANDED OK.': GOTO 580
00530 IF X1(100 THEN PRINT 'CRASHED.': GOTO 600
00540 IF X1(250 THEN PRINT 'BEEN BLOWN UP.': GOTO 640
00550 IF X1(5000 THEN PRINT 'MADE A NEW CRATER.': GOTO 640
00560 IF X1)4999 THEN PRINT 'BEEN VAPORIZED.'
00570 PRINT 'XXX BOOM. XXX'
00580 IF X1(1 THEN PRINT 'NICE TOUCH - VERY GOOD.': GOTO 640
00590 IF X1(5 THEN PRINT 'A BIT ROUGH...': GOTO 640
00600 IF X1(30 THEN PRINT 'UNABLE TO TAKE OFF.': GOTO 640
00610 IF X1(45 THEN PRINT 'LANDER ON FIRE.': GOTO 640
00620 PRINT 'THERE ARE NO SURVIVORS.'
00630 PRINT 'CONDOLENCES TO YOUR FAMILY.'
00640 PRINT 'IMPACT VELOCITY= ', X1, ' METERS PER SECOND.'
00650 SPEED 0: FOR X=1 TO 2000: NEXT &: PLAY 9: GOTO 110
```

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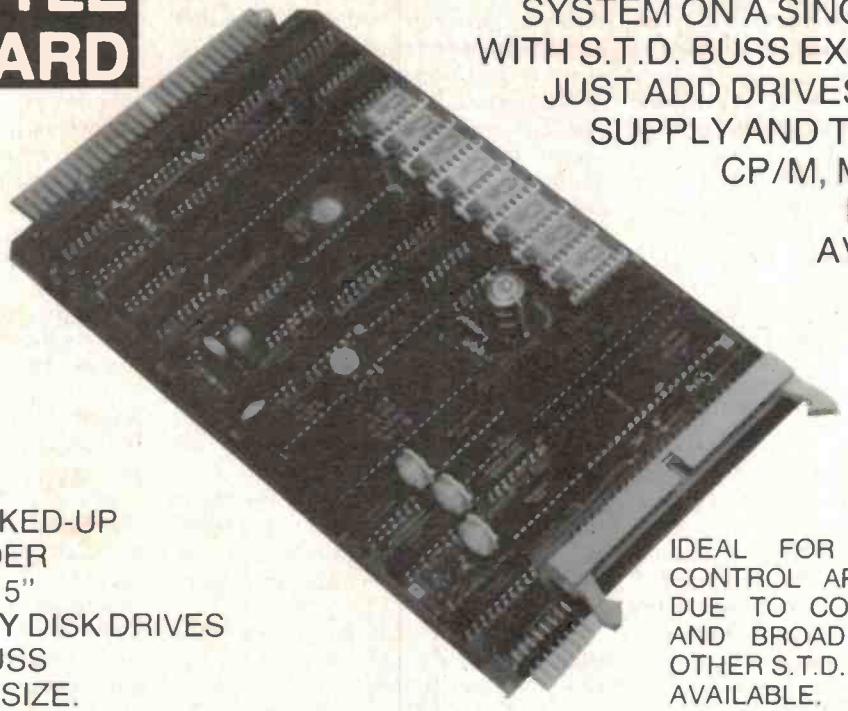

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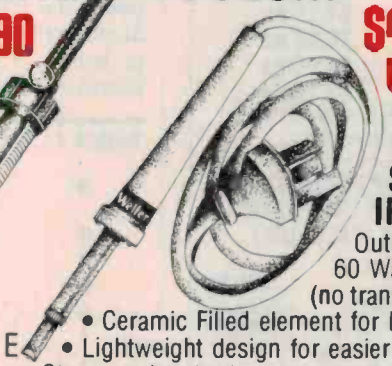

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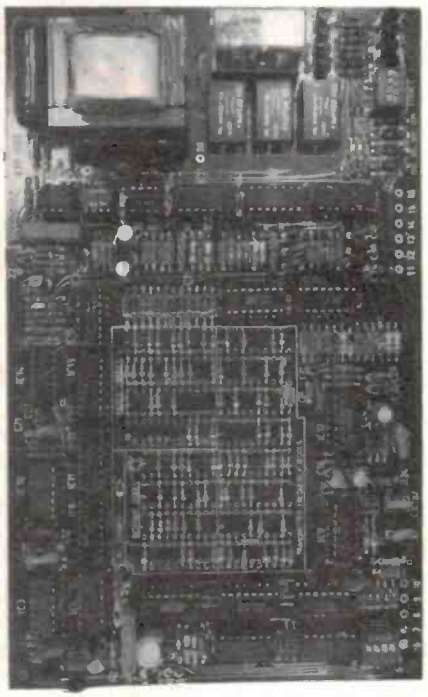
Modem follow-up No. 1

Geoff Nicholls

In response to many requests from keen computerists who have constructed the ETI-644 modem we present here details on how the diode matrices are programmed to produce the desired transmit, receive and filter frequencies.

THE THREE diode matrices on the modem provide considerable scope in re-arranging the operating parameters of the modem. This article gives general details on how it's done and illustrates the techniques with reference to the setup as detailed in the original article.



Transmit frequency matrix

There are diode positions for up to eight transmit frequencies. These are arranged as four frequency-pairs. The Baud Rate Control Inputs, S1 and S0, select which frequency-pair is being used and the data coming in (data to be transmitted) is then switched between the two frequencies of the frequency-pair. The following table shows which diode matrix column number, as on the pc board, is selected for different combinations of S1, S0 and the data input.

TABLE 1

S1	S0	DATA	Column No.
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

The diodes are placed within the column according to the following procedure:-

First calculate the required division from the crystal frequency using this formula:

$$\text{Division Number} = \frac{\text{crystal frequency}}{16 \times \text{desired transmit frequency}}$$

or

$$\simeq \frac{316\,200}{\text{desired transmit frequency}}$$

This gives a close enough approximation to the desired result, regardless of whether you use a 5.06 or 5.07 MHz ceralock resonator or a 5.0688 MHz crystal.

Round-off the result to an integer. Convert that number into binary. Diodes are then placed in matrix positions corresponding to 'ones' in the binary number, where the rows (IC6 outputs) intersect the appropriate frequency column.

For example: if the required transmit frequency is 390 Hz

$$\text{Division Number} = \frac{316\,200}{390}$$

$$= 811$$

or in binary presentation, see Chart 1.

CHART 1

IC6 OUTPUTS	Q9	Q8	Q7	Q6	Q5	Q4	Q3	Q2	Q1	Q0
DECIMAL VALUE	512	256	128	64	32	16	8	4	2	1
BINARY NO.	1	1	0	0	1	0	1	0	1	1
ROWS	K	J	H	G	F	E	D	C	B	A

So diodes are placed down the 390 Hz column at row positions K, J, F, D, B and A.

Receiver diode matrix

The baud rate control inputs, S1 and S0, select which receiver reference frequency is used. The reference frequency should be equal to *twice the average of the two incoming frequencies*, which is simply the sum of them. Table 2 shows which column is selected for the S1-S0 combinations.

TABLE 2

S1	S0	Column No.
0	0	0
0	1	1
1	0	2
1	1	3

The filter diode columns are selected as for the receiver diodes.

To program the receiver diode matrix for frequencies f_L and f_H, use the following formula to calculate the division number:

$$\text{Division Number} = \frac{5.0688 \times 10^6}{f_L + f_H}$$

Just take the integral part of the result, convert it to binary and put diodes where there are 'ones'. Ignore the lowest three bits (there are no matrix positions for them anyway!).

For example: to program the receiver for the transmit frequency pair 390/450 Hz, the division number is:-

$$\frac{5.0688 \times 10^6}{390 + 450}$$

$$= 6034$$

In binary form, see Chart 2.

Filter diode matrix

For the high and low pass filter component values given in the original article, the following −10 dB filter cutoffs are obtained by placing diodes as indicated by an X in Table 3. Rows ABCD determines the high pass control, rows EFGH the low pass control.

TABLE 3

HIGH PASS −10 dB	H	G	F	E	LOW PASS −10 dB
	D	C	B	A	
1600 (Hz)	-	-	-	-	4800 (Hz)
1500	-	-	-	X	4400
1400	-	-	X	-	4150
1300	-	-	X	X	3850
1200	-	X	-	-	3500
1100	-	X	-	X	3200
1000	-	X	X	-	2850
875	-	X	X	X	2600
750	X	-	-	-	2250
675	X	-	-	X	1900
540	X	-	X	-	1650
430	X	-	X	X	1280
325	X	X	-	-	960
225	X	X	-	X	675
110	X	X	X	-	330

Filter combinations are selected by S1-S0 logic which selects which Y row of IC8 is 'active'. From experience better filter performance is obtained by placing diodes according to Table 4 (note that rows JKLM remain as per the original).

TABLE 4

S1	S0	Y	A	B	C	D	E	F	G	H
0	0	0	-	-	-	X	X	-	X	-
0	1	1	X	-	X	X	X	-	X	X
1	0	2	X	-	-	X	-	X	-	X
1	1	3	X	-	X	-	X	X	X	-

Table 5 shows the frequency pairs and transmit/receive baud rates against the S1-S0 data.

CHART 2

IC5 OUTPUTS	Q12	Q11	Q10	Q9	Q8	Q7	Q6	Q5	Q4	Q3	Q2	Q1	Q0
DECIMAL VALUE	4096	2048	1024	512	256	128	64	32	16	8	4	2	1
BINARY NO.	1	0	1	1	1	1	0	0	1	0			
ROWS	K	J	H	G	F	E	D	C	B	A			

In practice, you can use 5.06 or 5.07 x 10^6 as the crystal frequency, but the lowest few binary digits make little practical difference.

Diodes should therefore be placed in the appropriate matrix column at the row intersections K, H, G, F, E and B.

TABLE 5

S1	S0	FREQ. PAIR	BAUD RATE
0	0	1300/2100	1200
0	1	390/450	75
1	0	980/1180	300
1	1	1650/1850	300/600

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1. Introduction to Basic

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VIC 20

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'DODGE' game for the ZX81, 1K (or 16K)

Benjamin Smith, Mt Nelson Tas.

'DODGE' is a fast, real-time moving graphics game in which the player must try to guide his spacecraft (represented by 'V') across an enemy space zone without being hit by one of the missiles which constantly emerge from the lower part of the screen. The keys '5' and '8' are used to move the craft left and right respectively. If the ship is hit, a score appears, along with the highest score so far. In his next game (which begins as soon as a key is pressed), the player must attempt to beat this record. The program may be terminated by BREAK.

This particular version is designed for the 1K ZX81, hence the use of expressions instead of numbers in lines 20 and 30 (numeric literals on the Sinclair chew up an additional six bytes). If 16K is available, however, the following modifications should be made:

```
20 LET B = 0
30 LET S = -1
60 PRINT AT 0, 31
70 IF PEEK (16928+P)<>0 THEN GOTO 130
85 PRINT AT 9, P+RND-RND-1;
90 IF RND<.3 THEN PRINT "■";
95 PRINT TAB 31
```

Beware of making any other alterations as the address reference in line 70 will be invalidated.

```
 10  POKE 16418, 14
 20  LET B = PI-PI
 30  LET S = -PI/PI
 40  LET P = INT (RND*12+2)
 50  LET S = S + 1
 60  PRINT AT 0, 14
 70  IF PEEK (16897+P)<>0 THEN GOTO 130
 80  PRINT AT 0, P; "V"
 90  IF RND<.3 THEN PRINT AT 9, P+RND-RND-1; "■"
100  LET P = P+(INKEY$ = "8")*(P < 13)-(INKEY$ = "5")*(P > 1)
110  SCROLL
120  GOTO 50
130  CLS
140  IF S>B THEN LET B = S
150  PRINT "YOU SCORE "; S; ", BEST SO FAR "; B
160  PAUSE 550
170  CLS
180  GOTO 30
```

"RAPID DESCENT" for the 1K ZX80

R.A. Chalmers, Inala Qld.

THE PROGRAM starts by giving the height and acceleration, in this case 1000 feet and acceleration of 32 ft/sec/sec*, the pull of gravity. After inputting both the period of time one wishes to check, and the initial velocity at the 1000 ft mark, the program will give adjusted height and new velocity. The catch now is to bring the vehicle to zero height and velocity. Input F is the accelerator, and −F will allow the vehicle to move towards the surface, while F will increase height by applying sufficient retard acceleration to reverse the vehicle.

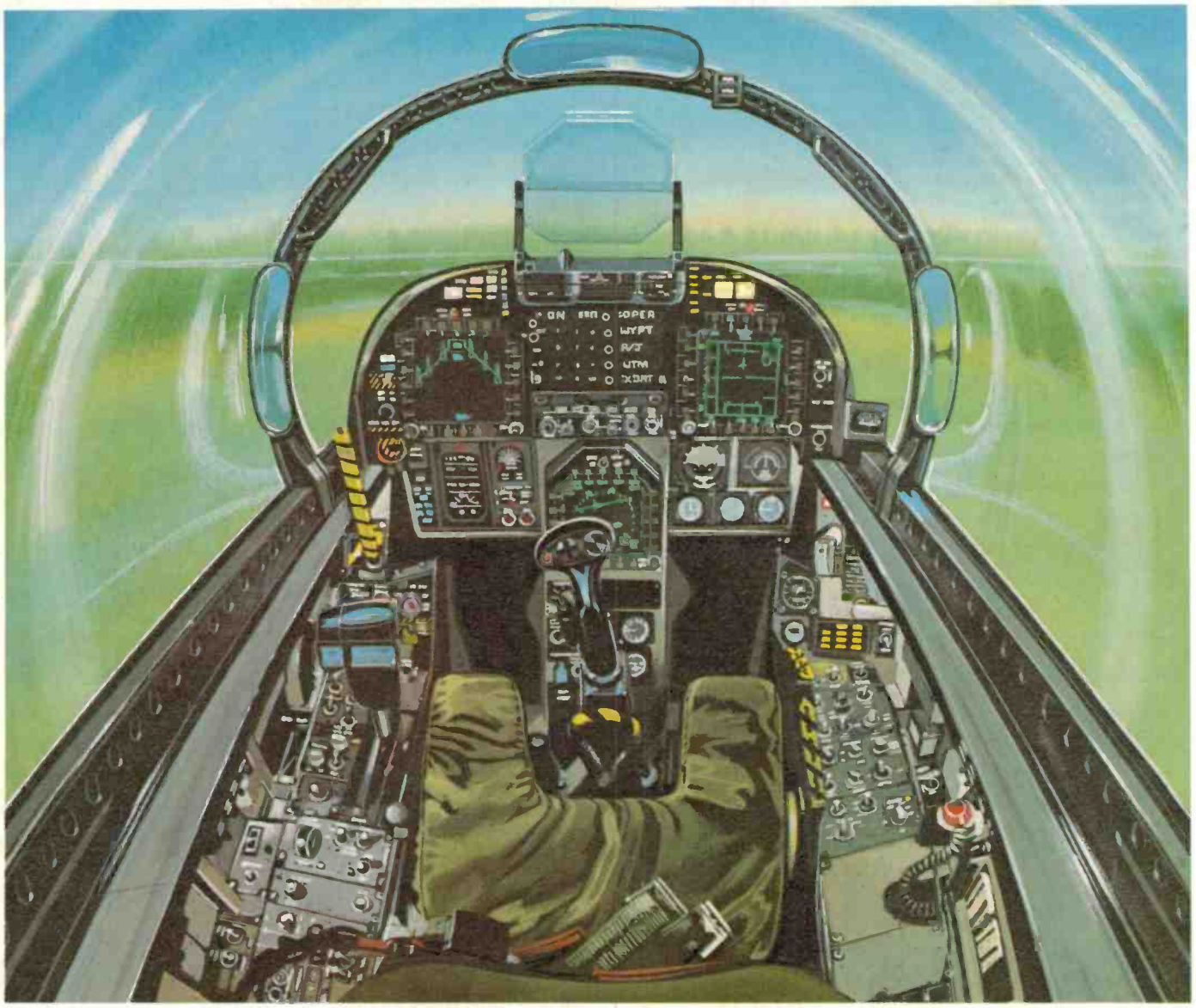
The program is based on the calculations of acceleration and velocities and, as it stands, is stretching the memory to its limits. However, as the calculations remain the same, the program is eminently suitable for expansion and use on larger computers.

Notes U = initial velocity
F = given acceleration
V = velocity at end of time T, in feet/second.

* The program is run in feet as the equivalent in metric to 1 ft/s/s is 981 cm/second/second. The ZX80 has limited maths ability. The reason for the programs name will be immediately obvious to anyone attempting to land safely!

```
5   LET H=1000
10  PRINT " INITIAL HEIGHT = ";H;"FEET AND ACC.OF 32 FT/S/S"
12  PRINT " INPUT T(FLIGHT TIME IN SECONDS)"
13  PRINT "AND U(INITIAL VELOCITY)"
15  INPUT T
16  INPUT U
18  CLS
40  LET T=T
55  LET F=32
56  LET V=U+F*T
65  IF U>Ø THEN LET S=((U+V)*T)/2
70  LET H=H-S
80  PRINT " HEIGHT NOW  ";H;" FEET"
85  PRINT
90  PRINT "VELOCITY = ";V;" FEET/SECOND"
95  PRINT
100 PRINT "DISTANCE TRAVELLED ";S;" FEET"
102 PRINT "INPUT F +/- ACC, TO RETARD FLIGHT"
105 INPUT F
106 CLS
120 PRINT H; "= LAST KNOWN HEIGHT"
130 PRINT
200 LET S= U*T+(-F)*T**2
300 PRINT
400 PRINT S;"  FEET = DISTANCE TRAVELLED TOWARDS EARTH"
500 LET V= U+(-F)*T
501 PRINT
555 PRINT V; " FT/SECOND = VELOCITY AFTER ";T;" SECONDS WHEN
    ACC, IS RETARDED BY  ";F;" FT/S/S"
556 PRINT
560 LET H=H-S
567 IF S AND V<Ø THEN PRINT" VEHICLE IN REVERSE "
568 PRINT
570 PRINT H; "= NEW HEIGHT "
580 GO TO 102
```

IF YOU'RE SWITCHED ON, THIS IS PARADISE.



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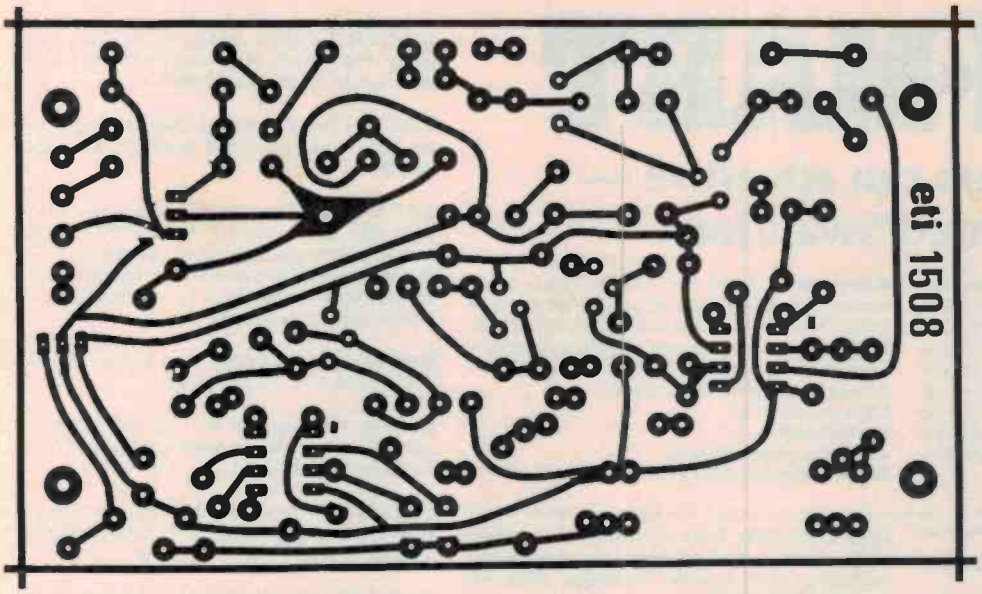
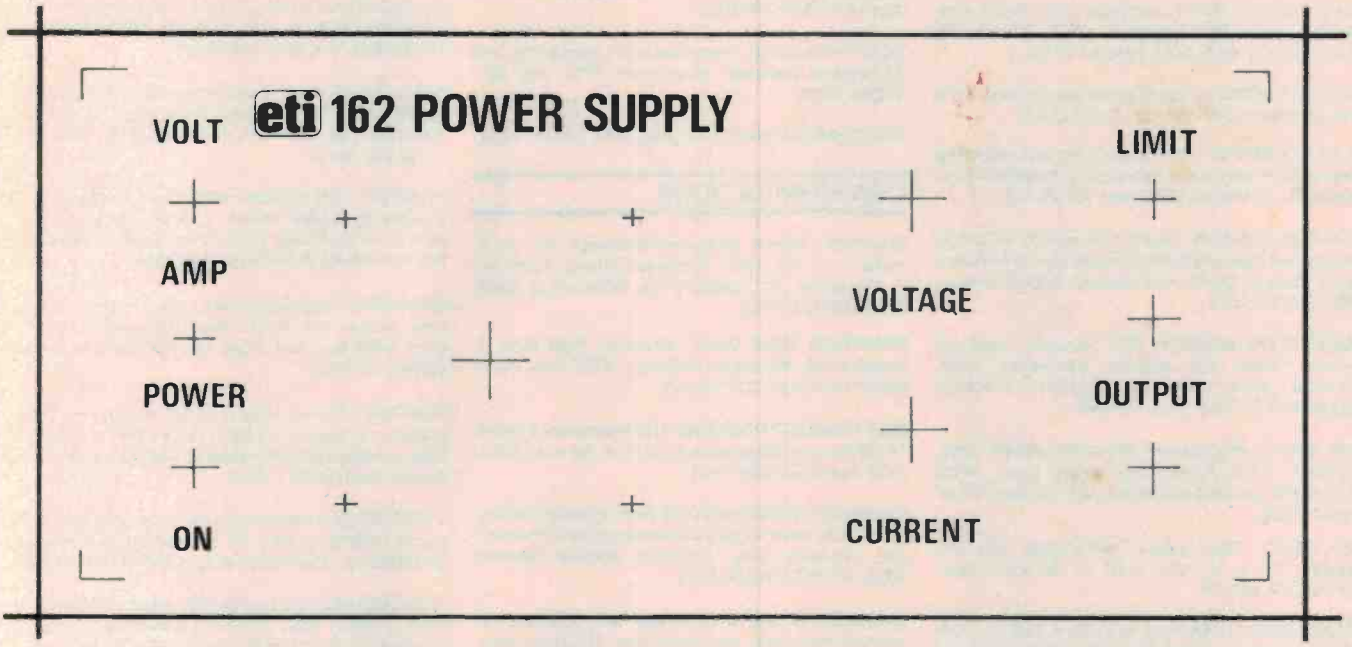

eti 1508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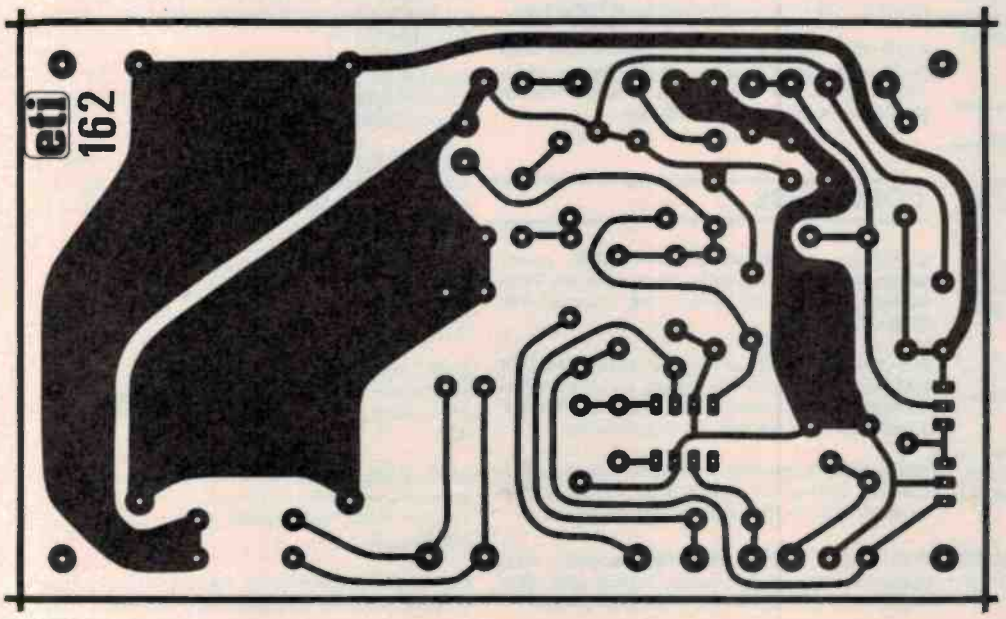
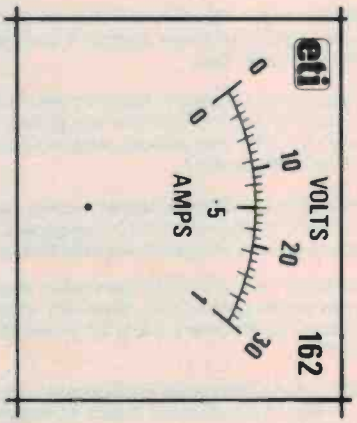
VOLTAGE
POWER
OUTPUT
ON
CURRENT


eti
162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Hints for CHIP 8 programmers

Part 1

For owners of the ETI-660 Learner's Microcomputer, the COSMAC VIP, or any other machine running CHIP 8, this short series will help you with programming and to understand a little more how the computer works.

THIS SHORT SERIES of articles has been compiled from the contributions of several authors and will cover such aspects of CHIP 8 as the various dialects and how to translate between them, displaying data and characters on-screen, sorting, using the sound generator etc. Let's go to it, then!

Dialects & Translation

Frank Rees, Boort, Vic.

At present, there are three main CHIP 8 dialects. The earlier two, which we will call CHIP 8 dialect 1 (CHIP 8.D1) and CHIP 8 dialect 2 (CHIP 8.D2), have programs listed from address location 0200 onwards. The dialect used in the ETI-660, which we shall refer to as CHIP 8.D3, has programs listed from address location 0600 onwards. As a result, any programs written for CHIP 8.D1 and D2 must be relocated to 0600 onwards to run on the ETI-660 under CHIP 8.D3. Thus, all instructions containing addresses must have 400H added to them. These instructions are:

0MMM
1MMM
AMMM
BMMM

Two of these are special cases — 0MMM and AMMM. The first, 0MMM, refers to a machine code subroutine and this part of any program may require rewriting, preferably with a CHIP 8 subroutine, where possible. The other special case, AMMM, is the 'pointer'. If it points to a location in or at the end of a program, OK. But A100 to A1FF in CHIP 8.D1 and D2 refers to the screen memory which starts at location 0100H whereas in CHIP 8.D3 it starts at 0480H. Any other AMMM pointers must be studied with knowledge of more memory allocation differences (i.e: refer to the machine's memory map. For convenience, the ETI-660's memory map is shown in Figure 1).

Now follows some useful routines you can incorporate in your own programs.

Captions-to-Screen Movers

Frank Rees, Boort, Vic.

In the CHIP 8 Column on page 108 of the August '82 issue of ETI I showed how we can, with the aid of the FX55 instruction, 'stack' the contents of variables in reserved memory locations beginning at a location indicated by the 'pointer' AMMM and later recover them with the same pointer and the FX65 instruction. The same combination of instructions was used also to shift 16 consecutive bytes into view on screen.

Now, to move more than 16 bytes there are many options, but before getting right into it, switch on the computer and try the routine listed in Table 1 for moving data to the screen. Table 1 shows two methods. Method 1 takes data from consecutive memory locations and stores it in consecutive memory locations. The differences between Method 1 and Method 2 are threefold: (i) Method 2 is confined to use in screen memory; (ii) It *moves* bytes of data from consecutive memory locations and *stores them at locations that are eight bytes apart.* 'Move' is used in the computer sense, but actually means 'copy'. Because each line of screen is made up of eight bytes, this results in each byte moved being stored under each other and, in this case, forming a block that is one byte (or eight bits) wide by 16 bytes deep, which gives us an 8-bit x 16-bytes matrix of 128 dots. With this you can construct graphics and alpha-numeric characters; (iii) When the DXYN display instruction is used to move data to screen, it only 'selectively erases' any previous display. Erasure only occurs at points where the previous display and the new one coincide. Example: if you displayed 0 and later displayed 0 in the same spot, it would be erased, but if you displayed 8 on top of the original 0 then only the centre bar of the 8 (one dot) would be displayed. This can be used to great advantage in graphics.

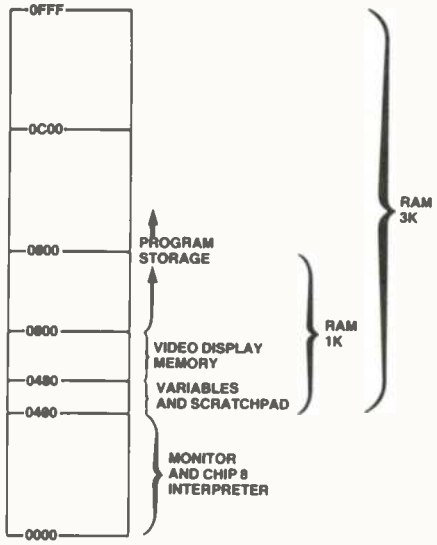

Figure 1. **Memory map of the ETI-660. The memory map of the VIP VP-111 (CHIP 8.D2) can be found on page 78 of the April '81 ETI.**

The DXYN instruction can be read as "*display* at horizontal coordinate *X* and vertical coordinate *Y*, *N* number of bytes". The X,Y coordinates are numbered from the top left hand corner of the screen, remember. Note that X is a left-to-right count of *bits* in eight bytes of each line, 0 to 3F (hex), a total of 40H (64) bits across the screen. Also, Y is a top-to-bottom count of *lines* in screen display of 0 to 1F for the VIP etc, and 0 to 2F in the ETI-660. Figure 2 shows the two screen configurations. This totals 20H (32) lines in the VIP etc, and 30H (48) lines in the ETI-660. Note that N is numbered one to zero which equals 10H (16 decimal). Two variables, often A and B, are assigned to hold the current value of coordinates for the 'pointer' to be computed by the DXYN instruction.

The objective is to display captions. If we use the five dots high by three dots wide format of characters, as used in the 'memory window' display in the bar at the bottom of the screen, then either Method 1 or Method 2, suitably modified to move, would do.

While CHIP 8 is fast for game visuals, it's lost for words without some help. At present, we shall not discuss how data was raised but only how to move and display it.

While studying a CHIP 8 program to find out how it let you know game results it was found that a machine code routine had been used for this section of program and, as it limited a good program to one machine design, the following Method 1 CHIP 8 version of the routine was written. What the routine does is to display across the top of the machine one of three messages indicating your performance at the end of a game.

Table 2 shows Method 1 expanded to move a lot more than 16 bytes and has been commented to show how it operates.

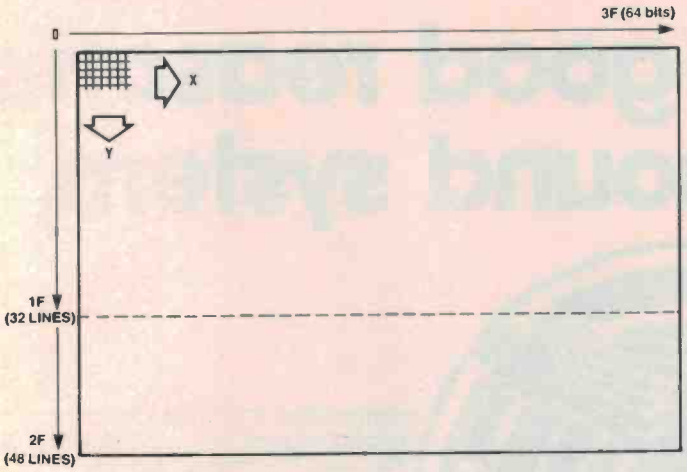

Figure 2. **The two different screen areas used by CHIP 8 dialects. The smaller screen (down to 32 lines) is used by CHIP 8.D1 and D2, the larger is used by CHIP 8.D3 (as in the '660).**

To find out what the game results captions have to say, enter the program and run it. Pressing any key will throw up a display. As you press keys nearer 0, the display gets more complimentary.

Table 3 shows Method 2 also expanded to move a single message which again, you'll have to enter and run to read what it says.

Note: In the program listings, some instructions have another instruction in brackets following. e.g: A480 (A100). The first refers to ETI-660 instructions (CHIP 8.D3), those in brackets refer to the equivalent in other CHIP 8 dialects. ●

— to be continued.

TABLE 1

Location	Instruction	Comments
0600 0200	1650 (1250)	Go to method 1 & 2 routine
	RESET	
		Method 1
0650 0250	A662 (A262)	Set pointer to data start
	FF65	Load V0-VF there
	A480 (A100)	Set pointer to -creen start at top left hand corner.
	FF55	Store V0-VF starting there
		Method 2
0658 0258	A662 (A262)	Set pointer to data start
	6A00	VA=0,use as screen X coord. at left hand edge.
	6B04	VB=4, use as screen Y coord. fourth line down.
	DAB0	Display data starting at X,Y 16 bytes, 8 bytes apart.
0660 0260	1660 (1260)	GOTO self to 'stop'
		Data
0662 0262	FFFF	16 FF bytes
	FFFF	
	FFFF	
	FFFF	
	FFFF	
	FFFF	
	FFFF	
	FFFF	

TABLE 2

Location	Instruction	Comments
0600 0200	1602 (1202)	Go to "Games Video Captions"
0602 0202	F70A	V7=KEY IN. Key wait. (Loop 1 start).
	6800	V8=0, use to change pointer
	3700	Skip if V7=0. If score = 0.
	4701	Skip if V7≠1. If score ≠ 1.
	6850	V8=50, use to change pointer
	3702	Skip if V7=2. If score = 2.
	4703	Skip if V7≠3. If score ≠ 3.
	6828	V8=28, use to change pointer
	6900	V9=0, counter of bytes moved
(Loop 2)	A700 (A300)	I=0MMM. Set pointer to data start.
	F81E	I=I+V8. Change pointer (start).
	F765	V0:V7=MI. Load V0-V7 starting there.
	A480 (A100)	I=0MMM. Set pointer to screen start.
	F91E	I=I+V9. Change pointer as required.
	F755	MI=V0:V7. Store V0-V7 starting there.
	7808	V8=V8+8. To alter pointer to next eight bytes.
	7908	V9=V9+8. To count bytes moved.
	3928	Skip if V9=28. If all bytes moved.
	1614 (1214)	Go to loop 2 if more bytes to go.
	1602 (1202)	Go to start of Loop 1 to demo further.

Games captions data

0700 (0300)	0EFB BBAB 8100 0000 0AAA 922A 8100 0000
0710 (0310)	0EAB 93AB 8100 0000 0AAA 922B 0000 0000
0720 (0320)	0AAA 93BA 8100 0000 0AEE A0EE EC04 0000
0730 (0330)	0A8A A08A AA04 0000 0AEE E0AA AA04 0000
0740 (0340)	0A8C 40AA AA00 0000 04EA 40EE EC04 0000
0750 (0350)	0EAE FBBB B810 0000 08AA AA92 A810 0000
0760 (0360)	08EE AB92 A810 0000 08AA AA12 A800 0000
0770 (0370)	0EAA AA3B A810 0000

TABLE 3

Location	Instruction	Comments
0600 0200	1680 (1280)	Go to "Win caption"
0680 0280	1682 (1282)	Go to next, no operation.(Loop 1).
	6A00	VA=0, use as screen X coord. starting at top left.
	6B00	VB=0,use as screen Y coord. top line.
	6C00	VC=0. Use to change pointer.
(Loop 2)	A780 (A380)	I=0MMM. Set pointer to data start.
	269A (229A)	Do CHIP 8 subroutine at 0MMM
	FC1E	I=I+VC. Change pointer.
	DAB5	Show at coord. VA,VB five bytes.
	7A04	VA=4. Add 4 to X coord.
	7C05	VC=5. Add 5 to pointer.
	3A40	Skip if VA=40. If end of line.
	1688 (1288)	Go to Loop 2 to move more.
	1680 (1280)	Go to Loop 1, start and repeat.
069A 029A	68FF	VB=FF. Delay counter = -1.
	80C0	V0=VC. Copy, so unchanged by 'greater than' routine.
	6134	V1=34. Use to check 'cursor' pos.
	8015	V0=Vo-V1. To compare VC to V1.
	3F00	Skip if VF=0, if VC greater than 34H then VF = 1.
	6800	V8=0. Change delay count to 0.
(Loop 3)	7801	V8=V8+1. Add 1 to delay count.
	3800	Skip if V8=0. 01 to 00 = 100H count.
	16A6 (12A6)	Go to Loop 3 delay routine.
	6602	V6=2, use for bleep duration.
	F618	Tone = V6. 'bleep'.
	00EE	Return to location after caller.

Data

0780 (0380)	0000 0000 00E0 4040 4040 A0A0 E0A0 A0E0
	80C0 80E0 0000 0000 00A0 A0A0 A0F0 A0A0
	A0A0 A0E0 A0A0 A0A0 E0A0 A0A0 A0E0 80C0
	80E0 E0A0 E0C0 A000 0000 0000 E080 C080
	E0E0 4040 4040 E040 4040 E000 0000 0000

Here are four good reasons to dbx your sound system

No matter how good your sound system is, you are limited by one major thing: the record. Every normal record is severely limited in musical range. Compression during cutting results in half the dynamic range being eliminated. The excitement of the music is lost. This applies to digitally mastered and direct to disc recordings. The other problem is something you hear every time the stylus enters the groove: surface noise. We went to the source of the problem, the cutting of the record. We encode the record by compressing it 2:1. The decoder expands back in a mirror fashion. In this way, the vinyl record can achieve a staggering 90dB dynamic range, compared to 50dB achieved on normal high quality recordings. Only through dbx can you truly appreciate digital recordings. The range of dbx discs is growing. There are now over 150 titles available,including a wide variety of Classical, Popular and Jazz discs. Hear "The Empire Strikes Back" by John Williams, Vivaldi's "Four Seasons" and artists such as Oscar Peterson, Dave Brubeck and Almeida.

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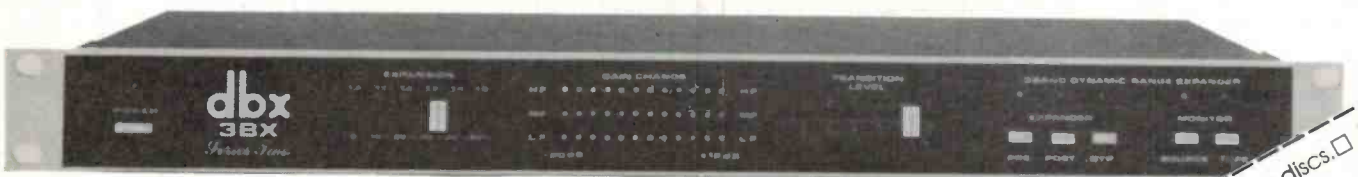

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ELECTRONIC LIFESTYLE

New Beta-format portable video tape recorder

Seven Beta-group companies recently announced that they have jointly developed the smallest and lightest portable VTR, using the existing half-inch Beta cassette tape. The new VTR can record and play back for five hours continuously.

The seven companies which will work on their respective prototypes are AIWA, General, New Nippon Electric, Pioneer, Sanyo, Sony and Toshiba. They plan to introduce their new VTRs on to the market in Japan sometime around May in 1983.

The Beta group companies have been developing the portable VTRs with the objectives of higher portability with more compact and lightweight units, longer recording time to accommodate long TV programs and complete compatibility for all Beta videocassette tapes.

They say that this new portable VTR has a full, versatile range of functions and it can be easily combined with a video camera for active and speedy outdoor recording. It can also operate as an integral part of a component video system, when combined with a tuner-timer unit and a PCM adaptor.

TDK change their audio cassette range

The complete range of TDK tapes has been upgraded and re-packaged so that the product can be clearly seen. The cassette mechanism has been improved by employing 'Laboratory Standard Cassette Mechanism' for AD, SA as well as the SA-X, MA and AD-X series. The AD-X series is a newcomer to the range, replacing the OD series.

The AD, SA and MA series are for the ordinary man in the street who wants a tape that offers a good sound at a reasonable price, say TDK. AD (Acoustic Dynamic) employs a re-developed magnetic formulation of linear ferric oxide particles. TDK claims that it has the lowest noise level of all Type I (normal bias) tapes on the market.

The AD-X and SA-X series cater for the specialist market and hi-fi 'buffs'. The AD-X is the first tape to employ TDK's Avilyn formulation for use on the normal bias setting. And to satisfy all needs, TDK has the MA-R (metal position) series in the 'Reference Standard Cassette Mechanism' diecast cassette.

Compact disc system is getting around

The Compact Disc Digital Audio System, announced in June 1980, is the result of a cooperative venture between Sony and Philips. In this joint research program Philips investigated the basic operating principles and designed the hardware. Sony's contribution centered mainly on the development of software, including the signal processing method. Now over 40 leading hardware and software companies in the world have taken out licenses to manufacture Compact Disc players or records.

Sony has recently been demonstrating their new Compact Disc Digital Audio player, the CDP-101, in Australia. It is not known exactly when it will be available in Australia but it is now on the market in Japan and will be in Europe in March 1983.

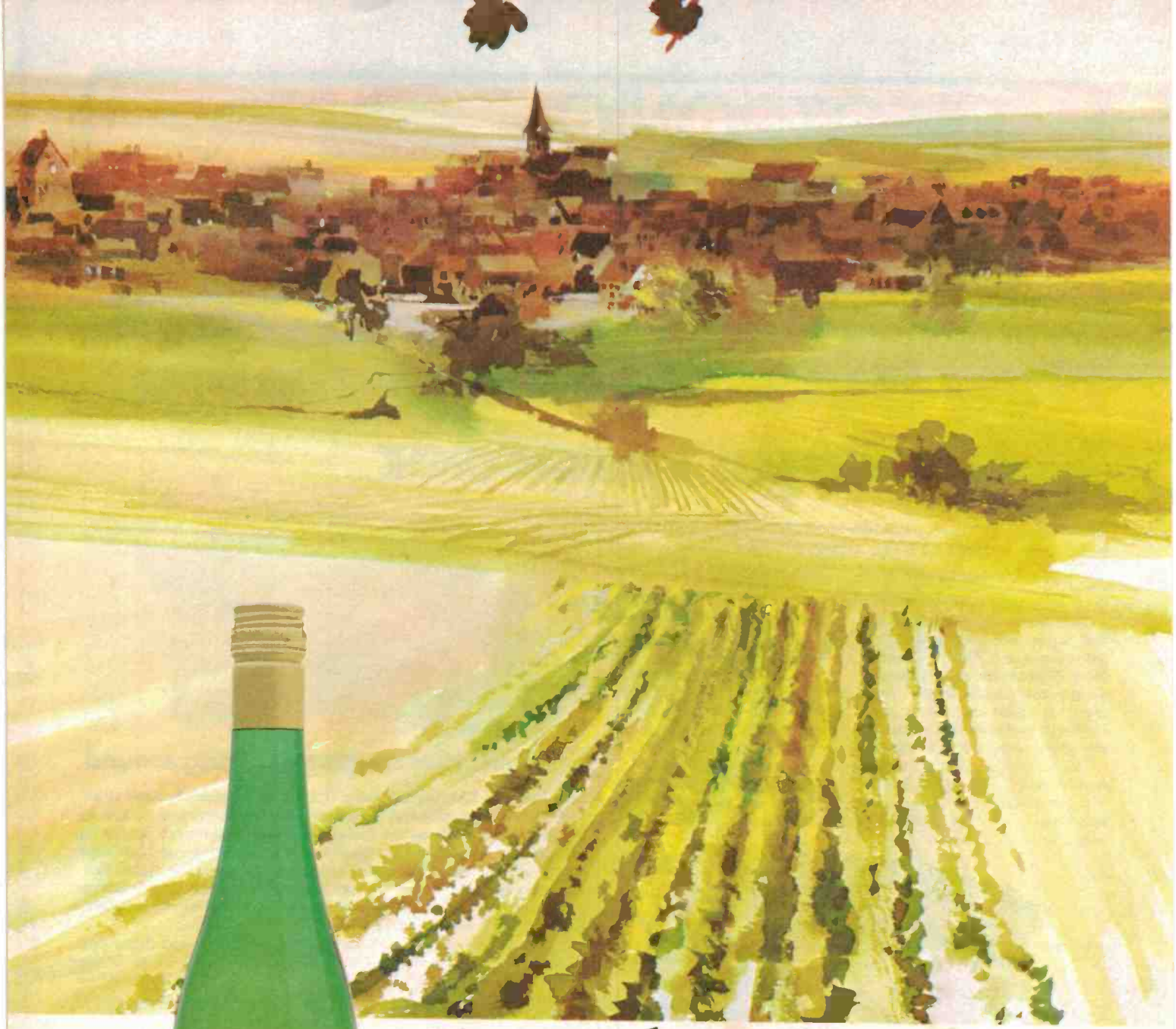
At the Japan Audio Fair in Tokyo at the end of October, more than 30 brands of players using the Philips system were on display, including Sony's CDP-101. Philips Industries have recently announced that they will launch their compact disc system early in 1983.

Interchangeability with video disc systems was not included in the design goals of the CD system. Instead, the system offers a number of advantages that far outweigh this video interchangeability. The small disc has a diameter of 120 mm with about 60 minutes playing time on one side.

Dramatically improved audio characteristics offered by the CD system include a flat frequency over the entire audible range, dynamic range and signal-to-noise ratio over 90 dB, perfect channel separation, undetectable wow and flutter and negligible distortion. These merits have been achieved by adopting PCM direct digital recordings with 16-bit linear digital to analogue conversion, as well as entirely new modulation and error correction systems.

An optical laser pickup system is situated underneath the disc to read the encoded signals on the disc, so there is no physical contact and therefore no wear on the disc or deterioration of sound quality from playing, as with conventional records. The encoded signal is below the disc surface, protected by a transparent plastic coating. Thus the disc is also protected from scratches and dirt. Sony's CDP-101 features fully automatic linear skate front disc loading, three microprocessors, automatic music sensor, repeat function in three modes, dual function digital display and wireless remote control.

Future product applications may well include portable audio products and car audio systems.



For over a thousand years the people of Alsace have been making Traminer Riesling remarkably like ours.

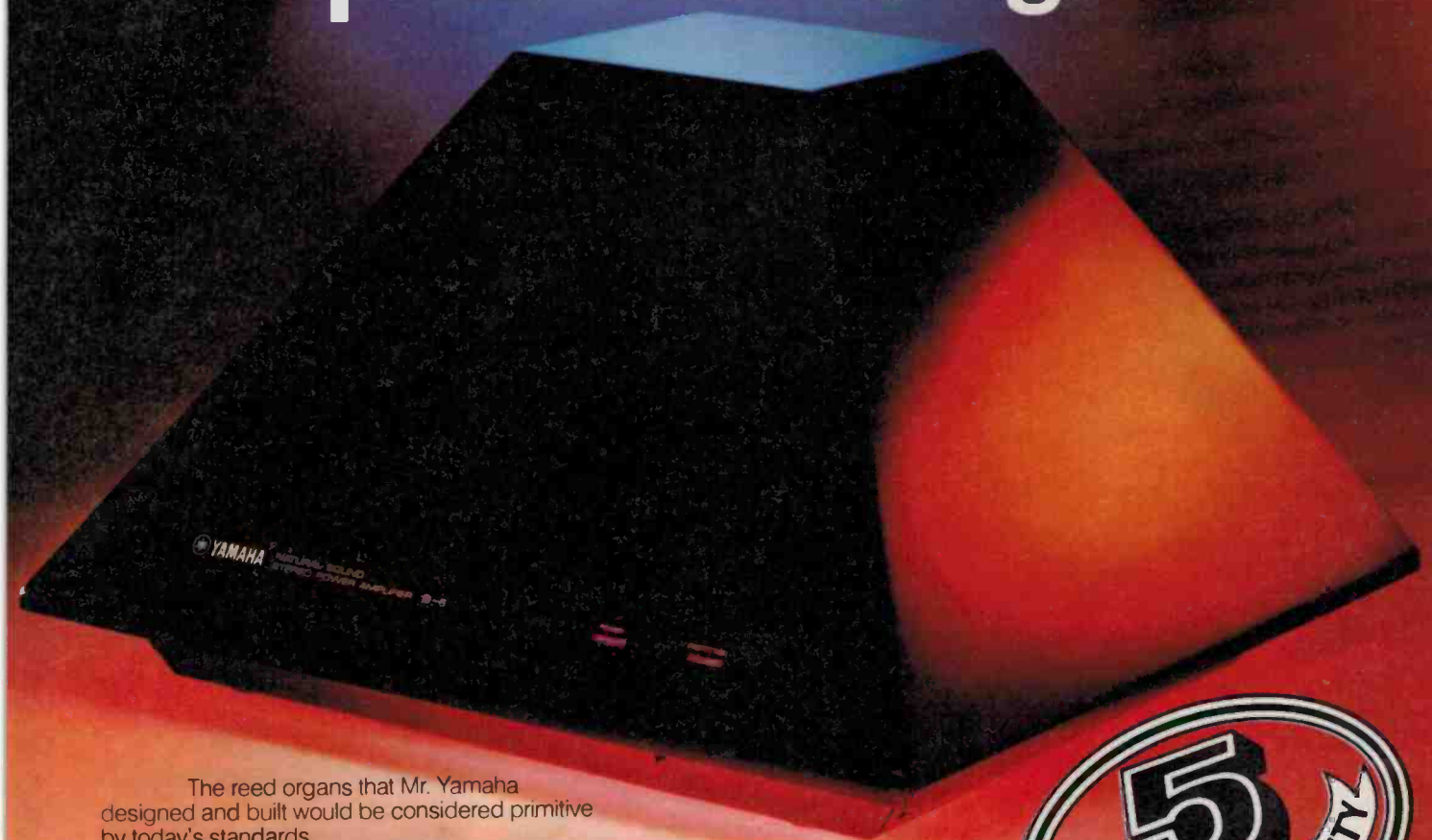
Now we're not suggesting that the good people of Alsace have in any way stolen our idea.

We do, however, suggest that Oliver de Serres' idea that "the essence of wine lies in the grape" is correct.

And that our Traminer and Riesling grapes produce wine every bit as delicate and heady as those of Alsace. McWILLIAM'S

AB 1730/82 MC 1205

This remarkable amplifier was developed over 95 years from a primitive reed organ.



The reed organs that Mr. Yamaha designed and built would be considered primitive by today's standards.

But in 1887 they were hailed as the world's finest.

Since then, Yamaha has become the world's largest maker of high quality musical instruments; from flutes to flugal horns, from clarinets to concert grands.

But our audio equipment is perhaps our proudest achievement.

The pyramid-shaped B-6 amplifier illustrated above for instance, is just as much 'state-of-the-art' now as Mr. Yamaha's reed organs were 95 years ago. And though technology has changed, the Yamaha principle hasn't.

All of our audio equipment, just like our fine musical instruments, is designed, crafted and ruthlessly tested by musicians. Just like our reed organs almost a century ago.

Indeed, the trained ear rather than a computer will always be the final arbiter of perfection.

And naturally the perfection that our musicians require and that our heritage demands, cannot be achieved by cutting corners or trimming costs.

Which may explain Yamaha's premium pricing and the full five year warranty we give all our audio equipment.

Simply, Yamaha precision audio equipment will reward those whose passion for perfection matches their means with a lifetime of the finest, most natural sound reproduction.

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The Marantz TT1000 (around $2500), with its precision-made high density glass and golden aluminium sandwich structure, is justifiably described as one of the most beautiful turntables ever.

'Playing a series of direct-recorded discs, warped discs, discs with nasty low frequency content and discs requiring unusual trackability performance, showed clearly that this system borders on the superlative in areas where even most good turntables only provide good to above average performance.'

'. . .the resonance characteristics of the TT1000 are the lowest we have yet seen from any turntable irrespective of its selling price.'

'This is top-of-the-line equipment for people who rate hi-fi as their greatest pleasure in life'. — *Louis Challis, Electronics Today International, April 1981.*

Similarly, the Marantz SM1000 Stereo Amplifier (around $5000) is designed to be the ultimate in luxury and performance.

When it was bench-tested by ETI Magazine in an exhaustive lab study, Louis Challis stated 'The Marantz SM1000 Amplifier has the capability to provide superlative performance at home, in a laboratory, in a studio, or in a rock band with the ease and panache of a professional.

'The power output claims are modest for the unit is readily capable of producing 625 watts into an 8 ohm load with both channels driven . . .'.

And when the Marantz ST8 FM/AM Tuner (around $700) was put through its paces so technically surprising was its performance that a second series of tests was devised to check the first results.

'As a result . . . the Marantz ST8 . . . far ahead of any tuner we have ever measured and better than any tuner we have ever seen reviewed in any other magazine, either local or overseas.' — *Paul de Noskowski, Electronics Australia, April 1981.*

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SM1000

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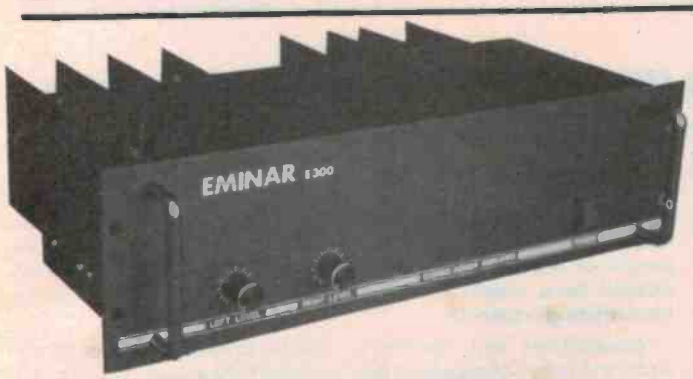
LIFESTYLE NEWS



New Eminar power amplifier

Eminar Amplifiers, well known for their professional range of equipment, has just released the all new Eminar E-300 rack mounted stereo power amplifier, retailing at about $549.

This unit is designed for such applications as medium power two and three-way passive composite bins, mid, upper mid, and top end on three and four-way electronic systems, fold-back wedges, rack mounted instrument amplifiers and studio play-back systems.

It is solidly constructed of heavy gauge aluminium and steel. The electronic componentry is arranged in a completely modular form, allowing easy removal and replacement in a matter of minutes, an important feature for the professional user.

The power output, with both channels driven, is 140 W/ch into eight ohms and 180 W/ch into a four ohms load. With one channel driven the power output is 160 W/ch into eight ohms and 225 W/ch into a four ohms load.

These amps can be obtained from Eminar Amplifiers, 14 Chamfield Court, Thomastown Vic. 3074. (03)465-7144.

Nakamichi ZX-9 cassette deck

Nakamich say that the most significant differences between their ZX-7 and the new ZX-9 are a dramatic improvement in transport precision and performance due to the incorporation of a Nakamichi-designed super linear torque direct drive motor. Nakamichi also claim that the signal transmission accuracy is enhanced in the internal electronics due to direct coupling of the playback head to the playback amplifier.

Up until now Nakamichi have stayed with the traditional belt-drive system but the direct-drive motor that they have developed achieves better flutter performance than the belt-drive system, they claim.

Precise manual calibration of record head azimuth, record/playback level and bias current can be accomplished using a built-in 400/15 000 Hz calibration oscillator and accurate LED level meter. This permits the deck's record/playback characteristics to be precisely matched to those of any particular type of tape for optimum reproduction performance, according to Nakamichi.

The ZX-9 also features a four-bit N-MOS microprocessor, a discrete three head system and Dolby B-C noise reduction.

Nakamichi's BX-1 and BX-2 cassette decks are aimed at a broader cross-section of audio enthusiasts and offer simplified features, functions and operation. A newly-designed two-head reproduction system and precision mechanism result in superior overall sound quality, extended reliability and outstanding cost/performance, claim Nakamichi. Both models are available in either matt black or silver finish.

Infinity loudspeakers

The eight Infinity loudspeaker systems, manufactured in America, share many state-of-the-art technologies. They differ from each other primarily in their power handling capacity, depth of bass response and the size of the musical image they are capable of recreating.

Top of the range is the Reference Standard II which has a five way crossover which blends the seven drivers into an apparent point source. The solid oak wings are curved in a configuration calculated to minimise distortion due to diffraction.

There's a Reference Standard III and then the Reference Studio Monitor which stays cool and smooth regardless of whether it is handling 35 watts or 250 watts, claim Infinity.

Infinity has created speakers for bookshelf use and for low powered receivers or amplifiers.

The top of the range speakers are not what you'd call cheap but they claim that they have a speaker system to suit everyone. Infinity loudspeakers can be obtained from Audio Excellence, 29 Yarrabung Rd, St. Ives NSW 2075. (02)449-7812.

Hand made. Constucting the chassis of the amplifiers in the Perreaux Sound factory

Perreaux Sound, New Zealand

Perreaux Sound is a family company, based in Napier NZ. The company has been operating for about eight and a half years, since Peter first began designing and building amps and speaker cabinets for the NZ market.

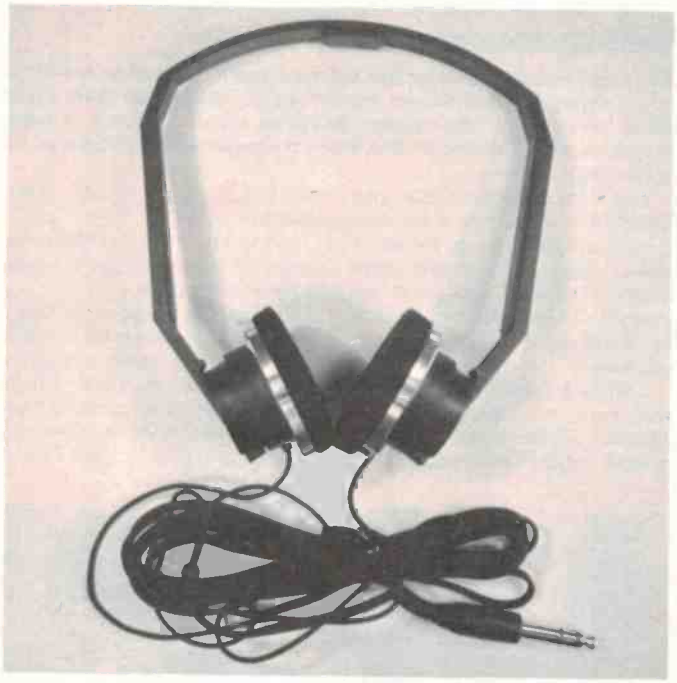
Top of the range of power amps is the PMF 8000B. Output is rated at 500 WRMS/ch minimum into eight ohms, from 20 Hz to 20 kHz, with no more than 0.15% THD from 0.25 W to rated output. Into four ohms the RMS output at the onset of clipping at 1 kHz is 900 W.

The 5000B is also physically very strong and has a rated output of 280 WRMS into eight ohms. There is a budget-priced 2000B model too, designed for the 'up-and-coming' market.

Perreaux Sound is also making a quality hi-fi amp using many of the design features of the professional power amps, including the power MOSFETs. The PMF 2150B Class A amplifier has a rated power of 200 WRMS per channel with both channels driven into eight ohms from 20 Hz to 20 kHz with no greater than 0.009% THD from 0.25 W to rated power. The dynamic headroom is greater than three dB, input sensitivity is 1.5 VRMS for rated output at 1 kHz, whilst input impedence is 10k.

In Australia, Perreaux Sound amps are handled by Eurovox United who can be found at 6 University Pl, Nth Clayton Vic. 3168. (03)561-5244 and 133 Alexander St, Crows Nest NSW 2065. (02)439-5488.

LIFESTYLE NEWS



Little lightweight headphones that sound like the big ones

AWA have released the AKG K1 and K4 lightweight headphones. The 'top' ones, the K4s, weigh 57 gm, have ear cushions with a diameter of 50 mm and incorporate the patented AKG two-way transducers.

The dynamic transducer radiates the bass and middle ranges while the electrostatic transducer responds to the higher frequencies, providing a frequency range from 16 Hz to 25 kHz. AKG claim that the advantages of this system can be heard in the quality of the sound. The recommended retail price is around $112.

The K1 headphones, retailing at $30, consist of a headband that is really a collapsible design which will fit every head perfectly and folds into a box the size of a pack of cigarettes. And there's just no way that it can pull your hair, they say.

For more information contact AWA at 554 Parramatta Rd, Ashfield NSW 2131. (02)797-5757.

dbx 610 autographic computerised room equaliser

Klarion and dbx have announced the release of the dbx model 610. This is a microprocessor controlled room equalisation system suited for professional applications such as recording or broadcast studio monitor equalisation and fixed or portable sound reinforcement system equalisation.

Using its own calibrated microphone, pink noise generator, real-time analyser (RTA), and specially designed, digitally controlled filters, the model 610 can automatically equalise a listening field for a flat or user determined frequency response in less than 15 seconds.

The stereo equaliser section of the model 610 incorporates two tracking sets of ten digitally controlled one-octave filters on ISO centres. The filters are combined in a series/parallel arrangement to optimise the signal-to-noise ratio and avoid excessive control interaction.

The display panel, consisting of more than 300 LEDs, can be switched to display either the selected equalisation curve or the output of the 610's real-time analyser.

For more information contact Klarion Enterprises, 63 Kingsway, South Melbourne Vic. 3205. (03) 61-3541.

US Congress considers home-taping copyright exemption

When the US Court of Appeals for the 9th Circuit ruled, in what is known as the Betamax Case, that off-the-air taping of copyrighted TV programs constituted a copyright infringement, it really caused a stir. It prompted a rush to legislation that has since included proposals to require royalty payments to be allocated to copyright owners as a means of safeguarding their property rights and encouraging creativity.

Manufacturers and retailers of audio and video software have outlined to Congress their support for the pending legislation that would exempt home audio and video taping for private non-commercial viewing from copyright infringement. Senate and House committees are considering the issue which pits those groups against the copyright-conscious, royalty-seeking motion picture entertainment industry.

Contesting sides in the dispute are expending a lot of energy and money in a huge lobbying effort for and against the pending legislation.

New Denon range of cassette decks, amplifiers, tuners and speakers

The new range of Denon products which has just been released includes 40 W per channel and 80 W per channel class-A integrated amplifiers, a digital display synthesised tuning FM/AM tuner, the TU-750, compact two-way 80 W speaker enclosures and two Dolby equipped cassette decks.

One of the decks, the DR-F7, has a three head configuration, using a new M & X combination head and Dolby B and C noise reduction. It also features a flat-twin direct drive motor which drives the capstan while a dc motor powers the take-up reel. This operates in conjunction with a tape tension servo sensor type II transport. A microprocessor based Flat Tuning System automatically tunes the proper amount of bias to match the characteristics of each individual tape to optimise sensitivity and frequency response.

The PMA-750 amplifier has a rated output power of 80 W (both channels driven) with a THD of 0.008% from 20 Hz to 20 kHz. Denon claim that it is a non-negative feedback amplifier with zero dynamic distortion.

Denon is manufactured in Japan and has been marketed by AWA for nearly ten years. More information about these products can be obtained from AWA at 554 Parramatta Rd, Ashfield NSW 2131. (02)797-5757.

LIFESTYLE NEWS

Acoustic Research introduces three new loudspeaker systems

The top of the line floor standing AR9LS (Lambda System) replaces the AR9 as Acoustic Research's reference loudspeaker. The 9LS is a four way acoustic suspension system utilising AR's newly developed Dual-Dome mid-highrange driver. And in addition to an eight inch lower midrange, the 9LS design includes a twin twelve and ten inch woofer bass section with a Bass Contour Chamber to eliminate room imposed aberrations in the bass response down to 28 Hz. The suggested retail price is $2695.

The AR98LS is also a four way system utilising the Dual-Dome mid-highrange driver, an eight inch lower midrange and a front mounted twelve inch woofer in a shallow bookshelf cabinet. A new switching system allows for floor or shelf placement and it has a suggested retail price of $1595.

In the AR Lambda Dual-Dome driver a single massive magnet structure is used to provide the necessary magnetic flux for both an upper midrange dome and a tweeter dome, enabling the domes to be positioned only two inches apart from centre to centre. This results in an almost ideal point source with uniform radiation due to the elimination of crossover region interferences. The system's crossover divides up the frequency range between the 1½ inch upper midrange dome and the ¾ inch tweeter dome at 5.5 kHz.

AR has also entered the mini-speaker market with the AR 1ms which is a two way aluminium system in a deep drawn cabinet. It employs a ¾ inch dome tweeter and a four inch long throw woofer rated at 75 watts of continuous power. It has an optional mounting bracket for automotive applications and retails at about $369.

Vector Research VCX-500 stereo cassette deck

An otherwise excellent performance in terms of frequency response, distortion characteristics and signal-to-noise ratio is downgraded by an unacceptably high hum level. This relatively simple problem puts this machine well below par, says Louis.

Louis Challis

VECTOR RESEARCH is a relatively new name on the Australian market and apparently almost as new on the American market. The VCX-500 cassette deck has all the makings of a first class, top line machine with an outstanding appearance, well made electronics and a solid cabinet structure. According to the claims made regarding the performance of this unit, it should be placed amongst the best of the cassette recorders currently available in this country.

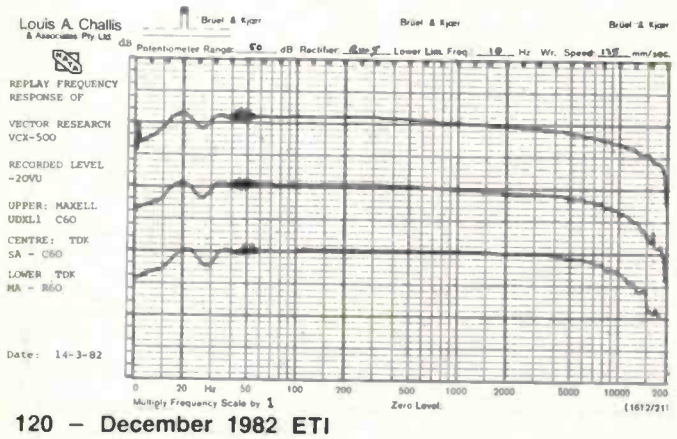
Design and appearance

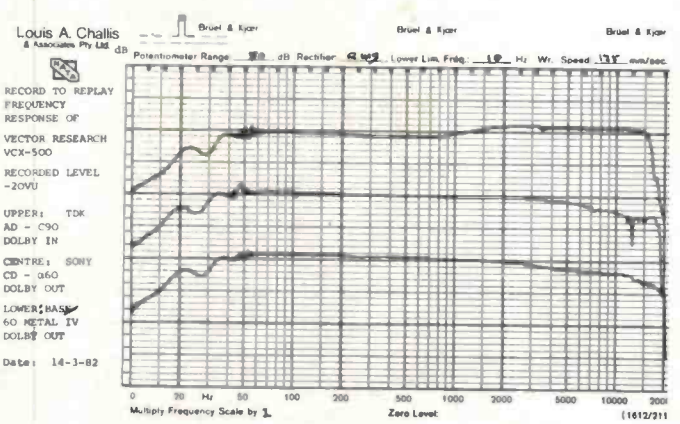
The frontal appearance is neat, business like and with a generally sensible layout. The basic design incorporates a feature which many manufacturers are tending to use now. Components like the cassette deck well, display module and various switching functions are mounted on a series of raised escutcheon sections. This is done to 'improve the appearance' and possibly to facilitate component or switch location (even in the dark).

The front panel appears to be an aluminium extrusion finished in matt black with clear white lettering for the control designations. At the left hand of the deck is the power 'on/off' switch and 'eject' button. Recessed beside them, on the raised section of the escutcheon, is the cassette well featuring a clear acrylic screw-on front cover. This feature helps make servicing easier and gives it a more professional appearance. The eject mechanism utilises a spring loaded mechanically damped flywheel system to slow down the opening of the cover which works effectively with a two second operation time. Below this is a headphone socket which provides an eight ohm output via a small transformer with buffer amplifier which does not provide level adjustment.

On the uppermost raised section of the escutcheon a three digit counter is located together with a Dolby noise reduction LED below. Adjacent to this is a 'reset' button with a 'music search' button below it. And next to these is a memory 'in/out' button and a switch to activate music search. When this switch is activated in conjunction with the 'rewind/review' control, the cassette recorder searches for the nearest five second gap between sections of pre-recorded music or programme content. The recorder then automatically stops and switches into the 'play' mode to replay that section of programme. Its major attribute comes when you wish to replay the section of programme that you have just heard. Without having to note the tape counter number, all you do is activate the two controls in order to cue back to the correct place.

The peak level indicator system features a series of eight green LEDs and four red LEDs. These cover the range from −30 VU to 0 VU and 0 VU to +8 VU respectively. Whilst the indicator system presents gradations and calibration numbers in increments of half a decibel at one end and five decibels at the bottom end, these calibrations are only really indicative as the small number of LEDs provided are incapable of providing that sort of resolution. Notwithstanding, the peak level indicator works very well and





performs its function adequately, as the designers intended.

The central section of the right hand side of the front panel contains an elongated raised section with seven long narrow electronic push buttons. Each of these, with the exception of the 'stop' button, is supplemented by its own indicating light. The functions provided are 'record', 'rewind/review', 'play', 'fast forward' and 'cue' on the top, whilst on the bottom row are a 'record mute' button, the 'pause' button and a double length 'stop' button. The 'record mute' control is the only unusual control and when it is activated at the end of a section of recorded programme and released before the next section of programme, it provides a minimum of four seconds of blank space (or more). This blank section of tape ensures the proper operation of the 'music search' function. Whilst the switch is being activated the programme being recorded may still be monitored through the headphones or the external amplifier and loudspeakers.

On the bottom of the front panel are a series of switches and rotary controls which are noted in order, from left to right. The 'Dolby noise reduction' switch has positions for Dolby B encoding. This switch also provides a 'multiplex' filter switch with the normal 19 kHz notch filter capability required for recording FM transmissions. A particularly useful function is the incorporation of a fine bias adjustment with a ±10% range but for which the handbook provides no usable data. The designers have also provided two separate switches for bias and equalisation providing bias settings for type 1, type 2 and type 4 tapes, and separately, equalisation settings of 120 us and 70 us. This facility does allow alternative settings of equalisation and bias to those normally provided by a single switch control. But such a facility is of little use without guidance from the manufacturer as to the most appropriate settings for currently available tapes. Two rotary controls are provided for line output level and microphone or line input level with coaxial controls for input. The last two facilities are two tip and sleeve sockets which provide for either high impedance (50 k) or low impedance microphones (600 ohm).

The rear of the deck is relatively sparse with only two pairs of line-in and line-output coaxial sockets and a remote control socket. This utilises a conventional valve-type octal socket into which can be plugged the remote control which activates the solenoid operated electronic controls of the tape transport mechanism.

The cabinet is extremely strong, fabricated from heavy-gauge plated steel. The additional bracketry inside the cabinet makes this one of the strongest units we have yet seen from any manufacturer. The top cover of the cabinet is unusual as it is silk screened with a block schematic circuit diagram to assist the technical user in interpreting the control functions contained within the unit.

Inside the VCX-500

The inside of the unit appears to be reasonably well constructed, with a number of separate pc boards rather than using the more typical 'mother board' concept. These boards take up virtually all the available space on the base of the unit (excluding the space required for the main power transformer and cassette drive mechanism). Additional boards take up one side of the chassis for the electronic control of the cassette drive mechanism together with a separate digital control board for the LED peak level indicator circuitry. The circuit boards are clearly marked with circuit designations to assist in maintenance. The drive mechanism features two separate drive motors and a large high inertia flywheel to minimise wow and flutter.

The circuit fuses are mounted off the side of the chassis and are not directly accessible from the rear panel. The main power transformer and power supply feature a separate sub-chassis without provision of any fine adjustment for minimising mains flux leakage. This is a feature we have come to expect from most manufacturers, the majority of whom have learnt the art of finely adjusting the transformer position to minimise mains induction pick-up. The wiring within the unit is more extensive than usual. Although it is neatly harnessed it presents a picture of complexity which may not have been intended by the designers. Circuit access for maintenance could prove to be a little tricky in this unit compared with other units we have recently reviewed.

On test

The objective testing of this unit proved to have a few more problems associated with it than we would have expected at first sight. The record/replay response of the unit is particularly good featuring a basic 13 Hz to 10 kHz replay response with the Maxell UDXL1 reference tape and a similar performance with the TDK SA C60 and TDK MA-R reference replay tapes. These responses are particularly smooth with the metal tape and are ▶

continued on page 123

A revolutionary way to grow younger.

Let's face it, every car interior gets old. But it needn't show. The Kitten System has created Revive All, the facelift that comes in a bottle.

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Otherwise, for your car's good health, use Revive All regularly and help your car grow young.

KIW 311/2

THE KITTEN SYSTEM.

THE CREAM OF CAR CARE.

from page 121

equally good with the other two tapes. The only factor impeding a superlative replay response performance is the time honoured problem resulting from slight differences between our reference tapes and the alignment tapes used by the manufacturer in azimuth alignment in the factory.

We chose to produce the record/replay frequency response with the bias adjustments set to the nominal 100% position rather than attempting fine bias adjustment for optimisation of the performance. Under these conditions, the performance with TDK AD C90, Sony CD60 and BASF60 metal-IV tapes proved to be excellent. These provided frequency responses which were typically 30 Hz to 17 kHz with the type 1 tape, 28 Hz to 19 kHz with the type 2 tape and 28 Hz to 16 kHz with the type 4 tape. The type 2 and type 4 tapes could be extended in frequency response to beyond the specified limits by fine adjustment of the bias control but the frequency responses achieved are nonetheless, excellent. The record/replay frequency response achieved with the BASF LH1 tape is indicative of how smooth a frequency response this machine can produce, which is, as you will see, essentially flat from 30 Hz to beyond 10 kHz (within one decibel) and comparable with the performance achieved by the best professional recorders only a few years ago.

A close look at the results of the one third octave band analysis of background noise, after erasure by the machine, is disconcerting. Whilst the machine achieves, and in fact even exceeds the performance figures quoted by the manufacturer in terms of A-weighted signal-to-noise ratio, with both the Dolby-in and Dolby-out modes, this does not take into account the unusually high hum levels at 50 Hz, 100 Hz and 150 Hz which are produced by this machine.

We actually tested two machines, the first of which produced a 50 Hz component that was only −37 dB relative to 0 VU. The second machine which we requested for evaluation produced a component that was somewhat better at −44 dB but unfortunately had higher levels of second and third harmonic (100 and 150 Hz) than the first machine. These figures fall below our minimum level of acceptability and downgrade what is otherwise a really excellent performance to an unacceptable level.

The channel separation at mid-band is typically in the range −45 to −49 dB rising to −25 dB channel separation at 20 kHz. This is slightly better than claimed by the manufacturer but not outstanding. The 'wow' is 0.2% peak to ▶

MEASURED PERFORMANCE OF VECTOR RESEARCH VCX-500 S.N. 5004503

RECORD TO REPLAY FREQUENCY RESPONSE AT -20VU

Tape	Dolby	Lower -3dB Point	Max. Point and Frequency	Upper -3dB Point
TDK AD-C90	In	32Hz	+1dB @ 3kHz	16kHz
Sony CD - 60	Out	23Hz	-	17kHz
BASF 60 Metal IV	Out	23Hz	+1dB @ 100 Hz	16kHz
BASF LH1	Out	24Hz	-	15kHz

HARMONIC DISTORTION:

Tape: TDK AD - C90		100Hz	1kHz	6.3kHz
OVU:	2nd	-51.0	-56.2	-49.4 dB
	3rd	-42.5	-40.9	-34.9 dB
	4th	-	-	-56.9 dB
	5th	-53.0	056.7	- dB
	T.H.D.	0.83	0.92	1.8 %
-6VU	2nd	-52.4	-	-46.8 dB
	3rd	-58.1	-50.4	-38.9 dB
	4th	-	-	-56.9 dB
	5th	-68.4	-62.7	- dB
	T.H.D.	0.27	0.3	1.2 %

SPEED ACCURACY: +0.125%

WOW AND FLUTTER:

WOW:	Average	0.2 % P-P
FLUTTER:	Unweighted	0.1 % RMS
	Weighted	0.06% RMS

MAXIMUM INPUT LEVEL:

(for 3% third harmonic distortion at 1kHz)

Tape TDK AD - C90 +4.0 VU

DYNAMIC RANGE:

Tape: TDK AD - C90

Dolby Out	40 dB(Lin)	60 dB(A)
Dolby In	39.5 dB(Lin)	65 dB(A)

(High hum level in system)

ERASRE RATION:

(for 1kHz signal recorded at OVU)

Tape: TDK AD - C90	> 80 dB
Tape: BASF 60 Metal IV	75 dB

peak which is reasonable. The 'flutter' A-weighted is 0.06% which is close to the manufactuers's claims and quite acceptable. The distortion characteristics of the machine at low frequencies and at 0 VU are excellent, being 0.83% at 100 Hz, 0.92% at 1 kHz and 1.8% at 6.3 kHz. These figures improve substantially with reduced input level so that at −6 VU the distortions are 0.27%, 0.3% and 1.2% which are first class. The maximum input level for 3% third harmonic distortion with a type 1 tape is +4 VU. The dynamic range in the unweighted mode thus tends to be relatively poor at −45 dB in the second of the machines reviewed by us (Serial No. 5004485). The erasure ratio is excellent, being greater than 80 dB with a type 1 tape and 75 dB with a type 4 tape.

Subjectively

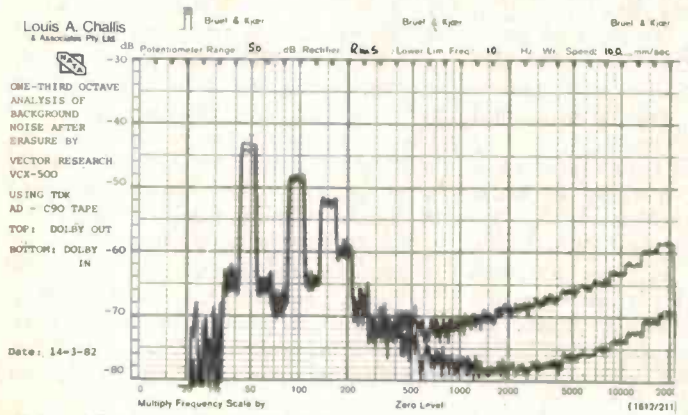
The subjective assessment of this machine had its good points and its bad points. When playing the VCX-500 with an amplifier and loudspeakers offering first class output down to below 50 Hz, the level of hum produced at moderate to high listening levels tended to be disturbing. When played through a loudspeaker system which has a frequency roll-off below 100 Hz, this is less pronounced and tends to be less disturbing.

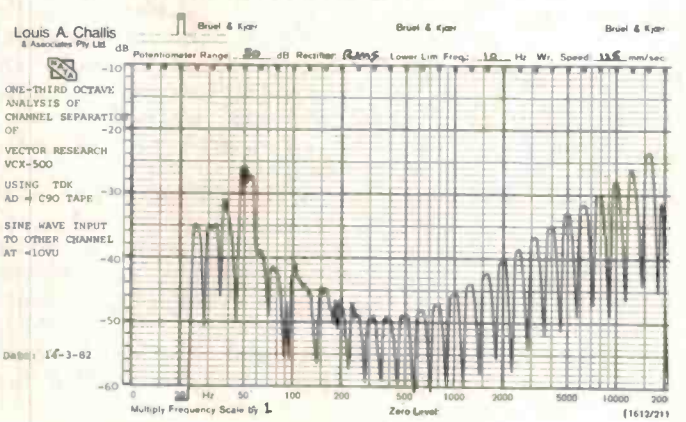
The other characteristics of the machine are in the main, exemplary, and it offers a performance which is comparable with the majority of other top line machines. I played a wide range of prerecorded tapes and made some recordings of material which I replayed through the machine to determine its own basic record/replay characteristics. The VCX-500 performs exceptionally well excluding its hum problem. The control function switches work well, although the size of the switches used to control the tape transport mechanism appear to be slightly thinner and thus a little less ergonomically suitable than comparable switches currently being utilsed by other cassette recorder manufacturers. The electronic controls function smoothly, and the purchase of the remote control for this particular unit could be a worthwhile addition.

It seems a shame to criticise so strongly a machine that has so many other excellent features, but unless the designers are prepared to seriously tackle the question of hum then they are left with a machine that is way below par instead of having a first grade machine. This is one machine that we cannot recommend to the intending purchaser until the manufacturer solves what is obviously a relatively simple problem. ●

VECTOR RESEARCH VCX-500 STEREO CASSETTE DECK

Dimensions:	*440 mm wide x 142 mm high x 375 mm deep*
Weight:	*22 kg*
Price	*Rrp $499*
Manufactured:	*In Japan by Vector Research Inc. of California*
Distributor:	*Keio International Pty Ltd, 198 Normanby Rd, South Melbourne Vic. 3205. (03)64-3546.*





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Illustrated:
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Nakamichi NR-200 noise reduction system

When coupled to a high quality recorder the NR-200 can achieve quite outstanding results. It has an advantage over the High-Com II noise reduction system as it provides compatibility between prerecorded tapes and cassettes recorded on other machines.

Louis Challis

NAKAMICHI NR-200
NOISE REDUCTION SYSTEM

Dimensions:	*482 mm wide x 71.5 mm high x 268 mm deep*
Weight:	*5.5 kg*
Manufactured:	*by Nakamichi Corporation, Tokyo, Japan*
Price:	*Recommended retail $299*
Distributor:	*Convoy International, 400 Botany Rd, Alexandria NSW 2015. (02)698-7300.*

WITH ALL THE recent talk in technical magazines, newspapers and even on television concerning the introduction of the compact laser discs, one could be forgiven for asking "why all this talk and involvement in alternative noise reduction systems?".

Obviously with a little thought you start to realise that while a 90 dB dynamic range is a basic design feature of those wonderous new laser discs, it is most certainly not a feature of the ubiquitous tape recorder. Those of you who own one, irrespective of its type, age or attributes, know only too well the problems of background noise level and restricted dynamic range which constitute one of the most serious limitations of tape recorders.

The past ten years have seen a remarkable number of attempts by various researchers and manufacturers to develop a solution to this problem, with each one producing his own solution, the majority of which are completely incompatible. The only serious and generally accepted solutions, in order of importance, have been the Dolby B system, the dbx system, the DNL system and most recently the Dolby C system. The only two systems which are in any way compatible with one another are the Dolby B and the Dolby C systems. The only reason for compatibility is their development by Ray Dolby and his staff who realised that unless there was a degree of compatibility, both the new and the old systems would suffer severe penalties in the marketplace.

We have already spoken at length concerning at least three cassette recorders incorporating Dolby C processors, the Nakamichi 480Z, the Sony TC-FX 6C and the NAD 6150C. All three of these machines provided us with the opportunity to describe the technical attributes of the Dolby C processor, which when well executed converts a good cassette recorder into a better one, or better still an excellent machine into an exceptional one. That's all very good, but you may already own a good machine, and a small number of you may already own machines which you believe (even if your are wrong) to be excellent.

The NR-200 is designed to provide you with that extra little boost in technical performance. It provides you with the Dolby B and C signal processor performance in the form of an add-on unit designed for mating with any brand or type of tape format. Even as I write these lines it occurs to me that the NR-200 could even be used with a wire recorder or any other museum piece which you may happen to own.

Design and appearance

The NR-200 is a sleek and if I might use the word slick, rack-mounting module in the typical neat Nakamichi style, which is a satin black aluminium fascia. This features, in the format in which it is delivered, a pair of screw-on brackets with miniature handles to facilitate the mounting of the unit into a normal 19" rack (Editor NB: I'm getting more perplexed every time I have to describe this as to its correct metricated description).

The controls provided are modest being respectively a power switch at the extreme left-hand end and a peak signal meter next to this utilising LEDs covering the range −40 VU to +10 VU, together with four indicator lights inset to show the selection of Dolby B, Dolby C, tape or source. In the centre of the fascia are two rows of switches with three switches in each. The top row features the Dolby B and Dolby C selector switches and a central 'off'

switch which cancels and resets the other two. The bottom row features a monitor switch which provides the ability to select and monitor the signal either before or after it has been encoded by the unit, a multiplex switch which notches out any residual 19 kHz pilot tone signals from FM stereo broadcast transmissions and a test tone switch. The test tone switch produces a standard 400 Hz Dolby reference signal for correctly aligning the recording signal range within the upper and lower limits specified by both Dolby Laboratories and the Nakamichi Laboratories.

The only remaining controls on the front panel are the left and right channel record level controls mounted one above the other. I am pleased to see this as I have previously criticised other Nakamichi units for failing to follow this logical sequence. Adjacent to these is the master level control which provides the same function as the two previous controls and a separate output level control which is used to set the listening level during playback or when monitoring the output.

The rear of the unit features four sets of normal RCA type coaxial sockets which are colour coded and two sets of miniature record and playback potentiometers for adjusting the separate encoding (record) signal level, and the decoding (playback) signal level from the tape recorder's output. The unit is constructed with a strong steel cabinet without normal ventilation facilities (which appear to be unnecessary in this situation) finished in the now famous 'black is beautiful' look.

Inside the NR-200

Inside the unit the circuitry is constructed on one large mother board, with a reasonable amount of coaxial wire interconnections above the board, a number of which have obviously been carefully routed to minimise the screening problems. The circuitry has a separate display logic board, screened linear potentiometer boards and a power transformer. This has necessitated a change in the bottom panel of the unit to facilitate its incorporation in the obviously limited space allocated at the design phase. All the components are clearly designated on the top of the board. The sixteen pin dual in-line Dolby chips are all mounted in plug-in sockets, whilst the remaining components are all directly soldered in the normal manner. The internal circuit fuses are only accessible by removal of the cover. The bottom plate of the chassis features a protective insulation cover to remove the possibility of short circuiting the circuitry to the bare metal plate which is spaced only 4 mm away.

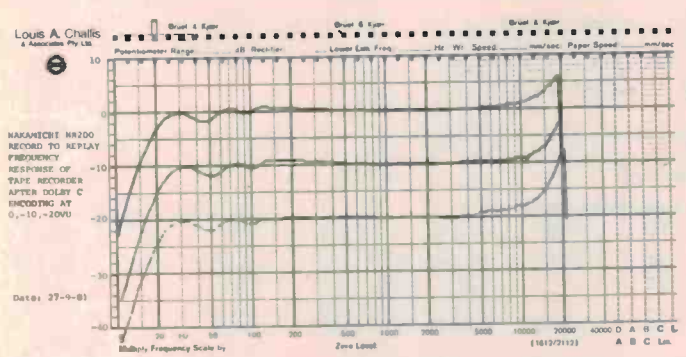
On test

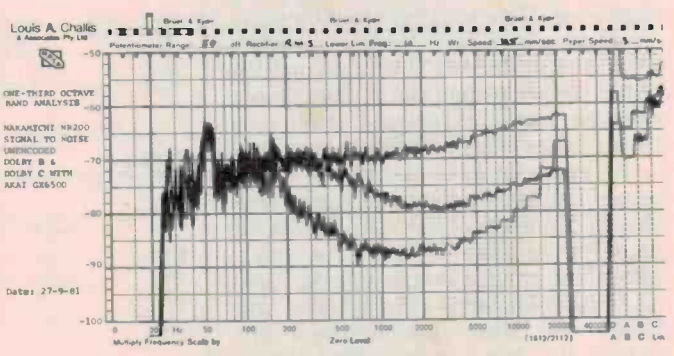
In evaluating the performance we once again elected to deviate from what other reviewers may consider normal practice by measuring the performance on our reel-to-reel recorder, which features neither Dolby B nor Dolby C. This unit, whilst very convenient because of its wide frequency response, excellent spooling characteristics and faultless electronic controls, nonetheless suffers markedly in terms of its basic limitation of 'conventional tape recorder signal-to-noise capabilities'. This is most probably the major area and most significant market for the NR-200 unit. Obviously if one had previously purchased a $200 or $300 tape recorder a few years ago you could be forgiven for being reluctant to spend $299 on this unit. However, if you had spent $600 to $1000 three or four years ago on a two-channel (or four-channel) reel-to-reel recorder you would most probably think very seriously about upgrading it to circa '82 performance with the simple addition of the NR-200 unit.

This was the philosophy underlying our evaluation of the unit with our AKAI GX-650D reel-to-reel recorder. This machine is typical of the best reel-to-reel recorders developed in the mid-seventies for amateur use. It is designed for both 250 mm (10 inch) as well as 175 mm (7 inch) spools and has a frequency response that extends from 20 Hz to beyond 35 kHz at 37.5 mm/s (15 inches/sec). More significantly the A-weighted signal-to-noise ratio is 55 dB relative to 0 VU. Such a performance is just not good enough in the current scene where 'run-of-the-mill' cassette recorders with an internal noise reduction capability produce signal-to-noise ratios 10-20 dB better.

Our first step was to evaluate the record to replay frequency response of the tape recorder with BASF SP54R tape without the Dolby unit and then with Dolby B and Dolby C. The results in practical terms showed no significant difference between Dolby out and Dolby B but showed a significant increase in the high frequency response at frequencies about 10 kHz with Dolby C activated. What surprised me was the extent of the high frequency rise which was typically +10 dB at 20 kHz at −20 VU. This unwanted rise could obviously be removed by adjusting the bias level and although we didn't actually do it, a better overall performance would have been achieved with a small reduction in distortion as well.

There were no other visible effects on either the mid-band or low frequency response, which are a function of the tape recorder rather than the NR-200 unit. The more significant results related to the improvement in signal-to-noise ratio which were far more dramatic and of unquestionably greater interest. In the Dolby B mode there was a 9.5 dB improvement in the A-weighted signal-to-noise ratio, but only a 6 dB improvement in the unweighted signal- ▶





to-noise ratio. In the Dolby C mode there was a 15 dB improvement in the A-weighted signal-to-noise ratio but only a 7 dB improvement in the unweighted signal-to-noise ratio. A 15 dB improvement in signal-to-noise is dramatic for this provides a 70.5 dB signal-to-noise ratio relative to 0 VU and a 76.5 dB ratio relative to 3%, third harmonic distortion, the normal reference point for relating total dynamic range. The improvement in the signal-to-noise ratio in the Dolby C mode is maximised in the region 500 Hz to 5 kHz providing approximately 15-18 dB of weighted improvement over that particular range.

This is, in fact, the frequency range of maximum subjective sensitivity so that the perceived signal-to-noise enhancement is greater than the A-weighted figure indicates by approximately 0-3 dB, depending on your own 'real ear' transfer characteristics. A recorder achieving this performance is only one order below the performance achieved by the next generation of digital recorders. But they cost approximately three times the price of a conventional reel-to-reel recorder supplemented by the NR-200 noise reduction unit.

Subjectively

To evaluate the performance of the NR-200 noise reduction unit I took it home and utilised it with an excellent cassette recorder, an AIWA AD6900, which incorporates Dolby B but not Dolby C. The process of alignment was very simple and straightforward and once set-up can be almost forgotten. By playing a series of prerecorded Dolby C encoded tapes, produced by the Nakamichi Corporation, I was able to achieve a quality of replay which was in all respects indistinguishable from the best Dolby C machines currently being marketed. This was important for there are large numbers of expensive cassette recorders in various homes around the world whose owners could understandably be loathe to discard them only because they lack the Dolby C capability.

My major 'piece de resistance' was to record and replay some live music with the combination of the AKAI GX650G recorder coupled to the Nakamichi NR-200 unit with two Bruel and Kjaer 12 mm laboratory microphones and Bruel and Kjaer preamplifiers providing the input signal. This set up provided signals with a dynamic range exceeding 100 dB which was more than suitable for this application. The quality of reproduction was positively outstanding. By utilising the replay facilities that we have in our monitoring room we produced a sound which was unquestionably superior to the best records or tapes that I have ever had the pleasure of listening to.

The Nakamichi Dolby B-C noise reduction unit is not a panacea. When coupled to a high quality recorder it can achieve outstanding results. It has to be correctly adjusted to track properly between the encoded and decoded states, otherwise the results may be disconcerting. If the recorder has a poor frequency response so too does the resulting signal. If the recorder has poor wow and flutter or drop-out problems because of poor tape spooling dynamics or dirty heads so too does the resulting signal.

The ability of the NR-200 to provide compatibility between prerecorded tapes and cassettes recorded on other machines is a tremendous advantage. Although the unit will obviously never be sold in large numbers, it is unquestionably just as attractive as the Nakamichi Hi-Com II offering a different set of advantages and in my mind a smaller set of constraints in its usage. As for the difference between this system and the Hi-Com II. Well, the Hi-Com II is slightly superior, but it is not compatible with other peoples' prerecorded tapes the way the NR-200's results are, right now. ●

MEASURED PERFORMANCE OF NAKAMICHI NR-200

Serial No. F103.01211

FREQUENCY RESPONSE: 0Hz - 20kHz

	Left	Right
INPUT IMPEDANCE:		
Line	50Kohms	50Kohms
Playback	50Kohms	50Kohms
OUTPUT IMPEDANCE:		
Line	2.2Kohms	2.2Kohms
Record	2.2Kohms	2.2Kohms

HARMONIC DISTORTION:

PLAYBACK MODE

Dolby B
(with output control at maximum)

	Indicated level 0dB 63Hz	1kHz	6.3kHz	10kHz
2nd	-82.3	-67.4	-76.3dB	-70.5
3rd	-69.1	-	-	-
4th	-	-	-	-
5th	-	-	-	-
THD.	.035%	.043%	.015%	.03%

	Indicated level +6dB 63Hz	1kHz	6.3kHz	10kHz
2nd	-84.8	-72.2	-70.1dB	-67.2
3rd	-70.9	-86.6	-	-
4th	-	-94.6	-	-
5th	-	-	-	-
THD	0.036%	0.023%	0.031%	0.044%

INTERMODULATION DISTORTION (Dolby B)

f_1 = 330Hz and f_2 = 8.0kHz mixed 4:1
Distortion components measured near 8kHz

Combined level as indicated on V.U. meter

Level	f_2-2f_1	f_2-f_1	f_2+f_1	f_2+2f_1
+5	-	-49.6	-52.4	-
0	-	-60.5	-61.7	-
-5	-	-	-	-
-10	-	-	-	-

INTERMODULATION DISTORTION (Dolby C)

Level	f_2-2f_1	f_2-f_1	f_2-f_1	f_2+2f_1
+5	-	-50.0	-51.2	-
0	-	-58.5	-59.0	-
-5	-	-	-	-
-10	-	-	-	-

Signal to Noise Improvement (see curves)

Dolby B	6dB(Lin)	9.5dB(A)
Dolby C	7dB(Lin)	15dB(A)

Dolby C
(with output control at maximum)

	Indicated level 0dB 63Hz	1kHz	6.3kHz	10kHz		Indicated level +6dB 63Hz	1kHz	6.3kHz	10kHz
2nd	-55.2	-72.9	-72.6	-59.9dB	2nd	-56.6	-75.5	-65.6	-58.3dB
3rd	-73.4	-81.8	-	-dB	3rd	-54.6	-86.5	-	-dB
4th	-79.8	-87.7	-	-dB	4th	-77.1	-	-	-dB
5th	-	-	-	-dB	5th	-76.0	-91.6	-	-dB
THD	0.17%	0.024%	0.023%	0.1%	THD	0.24%	0.012%	0.05%	0.12%

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The CT 930 cassette deck has 3 motors that are computer co-ordinated for superb musical accuracy. It also features auto reverse, music search and Dolby* B&C noise reduction circuitry.
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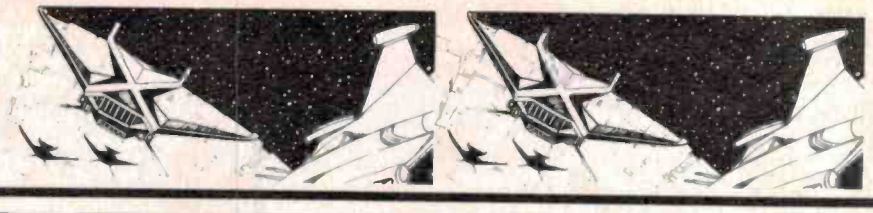
*Dolby is the registered trademark of Dolby Laboratories.

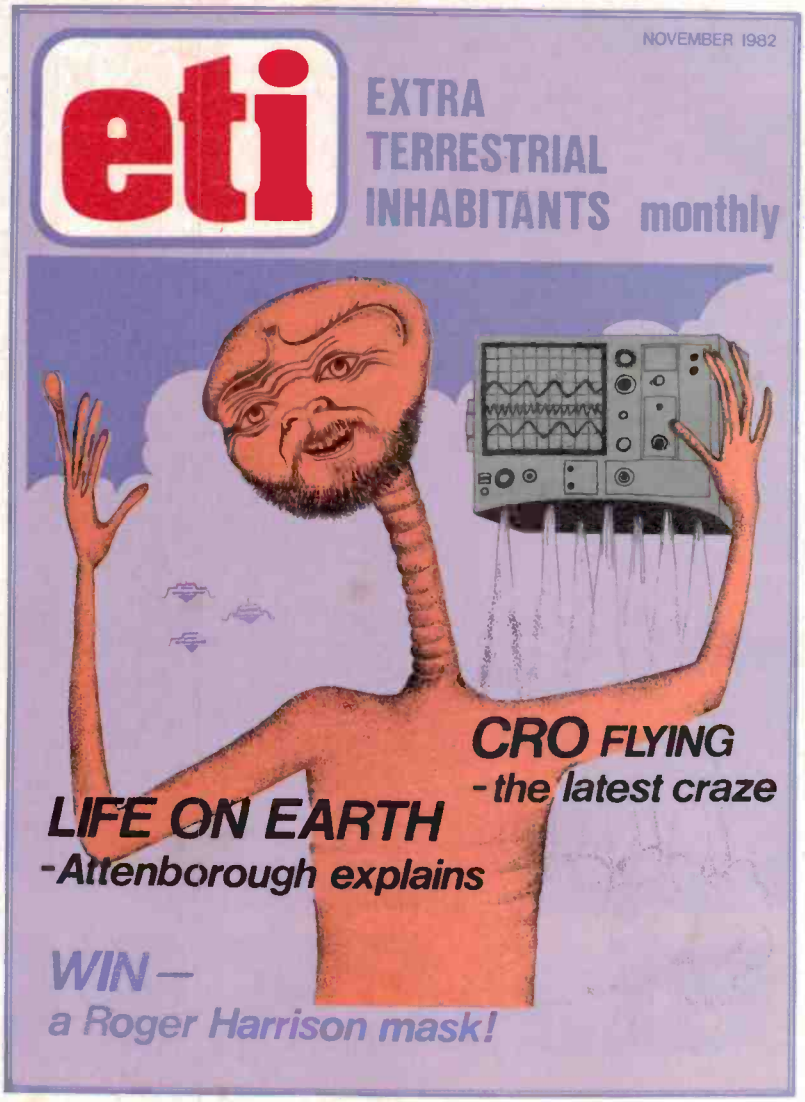
PIO 0238

DREGS



PRESS RELEASE: November 31, Hollywood. Following the phenomenal overseas success of David Spielberg's latest and greatest sci-fi movie spectacular, "E.T.", Flurry Publishers announced today that they would launch a magazine here aimed at sci-fi enthusiasts and fans of the film E.T. To be titled 'Extra Terrestrial Inhabitant', or ETI for short, the magazine will include features on building and flying your own CRO (a type of flying saucer that is rectangular rather than circular), dealing with life on earth (the strangest planet of them all) and popular competitions. The first issue's cover is reproduced herewith.

Flurry Publishers is located in Hollywood on the Outer Barcoo (where men of religion are scanty). The magazine will be printed by The Outer South Western Riverina and Barcoo Nut Gatherers and Paper Recyclers Cooperative Press at Gulargambone.**



Love thy robot

Robots behaving as surrogate humans may well exist within two decades, claims Arthur Harkins, director of the graduate programme in futures research at the University of Minnesota.

Most human relationships are basically ritualistic, according to Harkins; even relationships between lovers involve expected behaviour and expected response.

Harkins believes it is entirely feasible for computer-based 'primitives', as he calls them, to act as companions for the elderly, the extremely lonely, people in prison, or those suffering from massively disfiguring injuries.

Furthermore says Harkins, "It seems imminently possible to program software accordingly. When you add voice recognition and synthesis and at least limited mobility, you don't even need artificial intelligence to reach a plateau of performance acceptable for a lot of human beings."

In reply to the obvious question, Harkins says, "The Japanese have already developed all kind of mechanical substitutes for human sexual organs, which are implanted in robots and embellished with heat and other types of human-like characteristics."

When queried about the possibility of 'marriage' between robot and human, Harkins was guarded. He sees 'legal bonding' perhaps for limited periods but, in what must be the understatement of the year, Harkins says, "The theologians are basically... unwilling to deal with any of this."

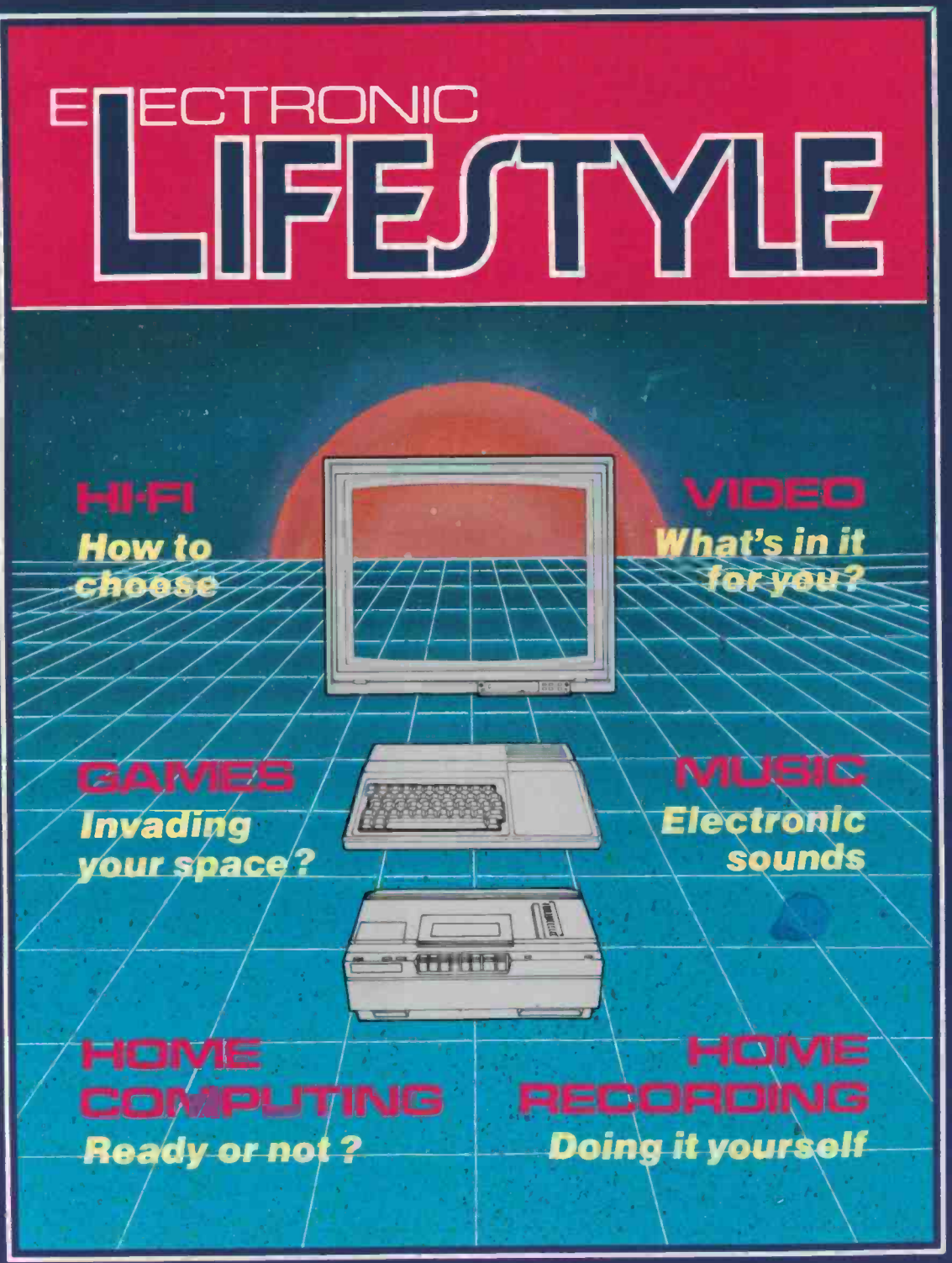
Ultimately Harkins sees the human race dying out and being replaced by non-biological cyborgs "... in which the best artificial intelligence and artificial organs will be implanted and buttressed by genetic engineering."

"We gradually move in thousands upon thousands of directions as a modified species," says Harkins, "But what will give us our enhanced longevity and our greater protection against environmental glitching — including radiation, water contamination or the absence of food and water — will be the movement from a biological species into an ecology of non-biological species."

Harkins sees a non-biological species as 'living' if it reproduces itself. The mind boggles as to how it proposes to do it!

**The Marginal Finking Department and ETI's other editorial staff would like readers to know that this is one of Roger Harrison's stranger twists of humour. i.e: a joke. Laugh now and have a happy Christmas.

ELECTRONIC LIFESTYLE



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