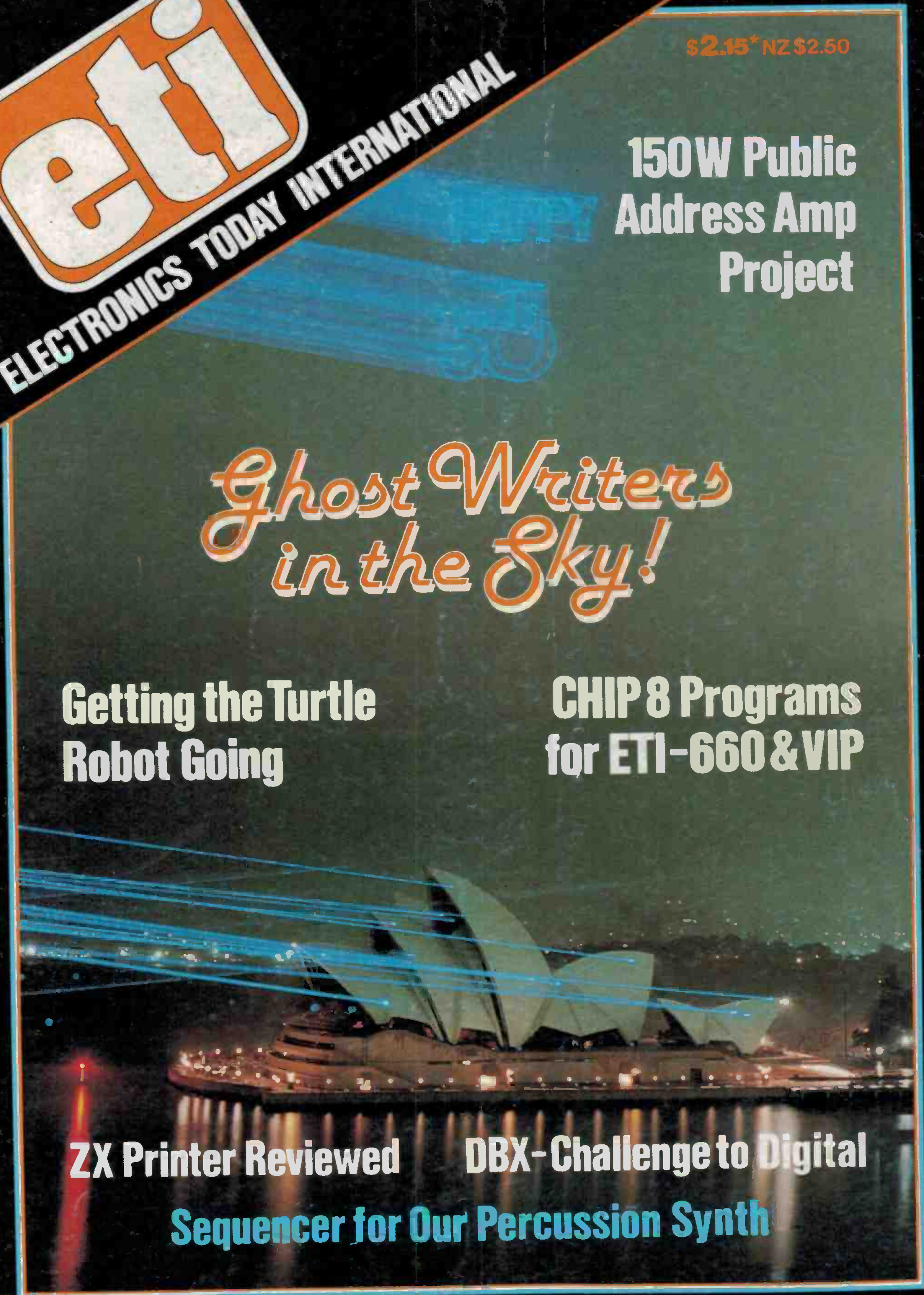
JUNE 1982

eti

ELECTRONICS TODAY INTERNATIONAL

$2.15* NZ $2.50



150W Public Address Amp Project

Ghost Writers in the Sky!

Getting the Turtle Robot Going

CHIP 8 Programs for ETI-660 & VIP

ZX Printer Reviewed

DBX-Challenge to Digital

Sequencer for Our Percussion Synth

Making Things Move Very Fast!

The Sansui XR-Q7 with the Silent Synchrotor System—a direct-drive turntable that doesn't sound like one.

Today's finest direct-drive turntables are marvelous pieces of engineering, providing uncanny speed accuracy, high reliability and great specs. But even the best of them is plagued by cabinet vibration, a phenomenon brought about by the action-reaction torque generated by the motor's servo system. Cabinet vibration, when passed onto the tonearm, lends an unpleasant muddiness to overall sound quality, and also affects stereo imaging. Many spare-no-expense audiophiles are aware of this problem and often opt for belt-drive systems, accepting a little higher wow and flutter in exchange for better overall sound quality.

Sansui has a solution to this problem. It's called the Silent Synchrotor System. And it's found only in the new XR-Q7 turntable. What it does is cancel vibration right at the source by means of a counter-rotating "synchrotor" located directly under the drive motor. Vibration never has a chance to reach the tonearm and affect sound quality.

If you demand exceptionally low wow and flutter (the XR-Q7 is rated at 0.009%) *and* the smoothest, clearest sound around, the new fully automatic XR-Q7 from Sansui is your *only* choice.

Sansui

SANSUI ELECTRIC CO., LTD. 14-1 Izumi 2-chome, Suginami-ku, Tokyo 168 Japan
VANFI (AUST.) PTY. LTD. 297 City Road, South Melbourne, Victoria 3205, Australia Tel: 690-6200
283 Alfred Street, North Sydney, N.S.W. 2060, Australia Tel: 929-0293

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ELECTRONICS TODAY INTERNATIONAL

Roger Harrison

Roger Harrison
Editor

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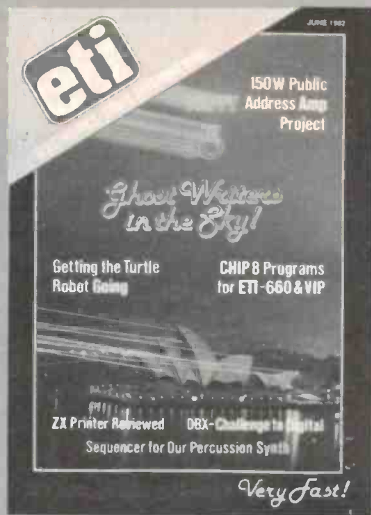
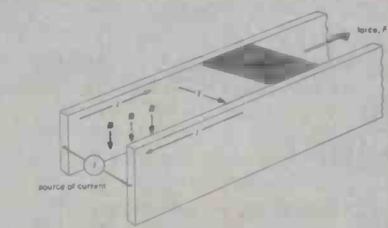


Sydney's 50th Anniversary of the Harbour Bridge opening celebrations saw probably the most spectacular outdoor laser light show yet staged in Australia. It was devised and staged by a new company, Laservision Pty Ltd, using quite sophisticated equipment — read all about it on page 6.

Photography by ON COLOR Pty Ltd, courtesy of Laservision. Cover design by Ali White.

*Recommended retail price only

features



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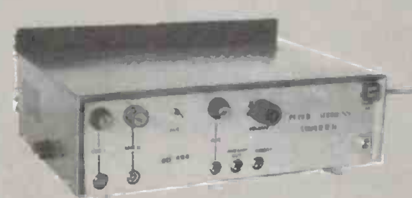

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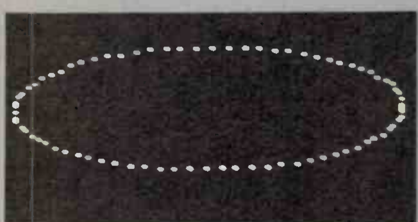
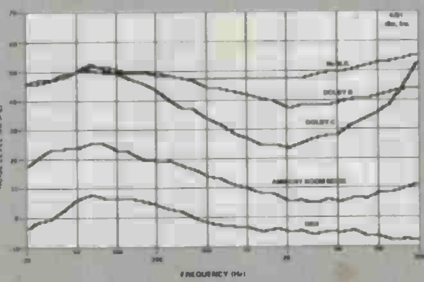


sight & sound



general

next month

13.8 V/10 AMP POWER SUPPLY

"When your battery acts up ornery . . .", as a certain advertisement puts it, this power supply would make an acceptable substitute for many applications! We've received so many requests from readers for a *decent* supply to power 12 Vdc (nominal) operated equipment we just had to do something . . .

12 V FLUORESCENT LIGHT INVERTER

"I hate to see that evenin' sun go down", wrote Will Handy in his famous song, St. Louis Blues. If he'd had our fluorescent light inverter he might not have said that! This project is just the thing for an 'emergency' light at home, for camping trips, etc. It is low-cost and simple to build, uses commonly available parts and will power up to two 20 W tubes from a 12 V battery — silently.

GRAND HI-FI CONTEST!

Over $7000 in prizes, two complete systems to win! PLUS dozens of consolation prizes. First prize is a complete system of **top class** equipment from such famous names as Shure, SME, Pioneer, Rega, Marantz, Technics, Sansui, Audio-Technica and KEF, plus accessories from Convoy, TDK and Allsop. Second prize is a system from Sharp. Consolation prizes include headphones, tapes, and record and tape deck cleaners. You've got to be in it to win it — our grandest contest for years!

SYSTEM 80/TRS-80 GRAPHICS GUIDE

An 'overview' of programming the graphics on these two popular micros. Learn how to SET your screen, PRINT @ and NAME things. PEEKing and POKEing will never be the same after this!

'660 COLOUR PATTERNMAKER

The Patternmaker program (February issue), hailed as one of the most fascinating we've published for the ETI-660 Learner's Microcomputer, can now be run in colour — thanks to a contribution from reader (and ETI-660 owner) Noel Plummer.

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.

'Ghostwriters' in the sky!

The 50th anniversary of the opening of Sydney's world-famous harbour bridge, the 'old coathanger', was the occasion for a spectacular laser light show devised and staged by Laservision Pty Ltd.

Our front cover picture and the picture here show two views of the show, staged several times each evening over three evenings of the event last March.

The Laservision show was financed by the New South Wales Department of Main Roads, who maintain the bridge. A single 20 W argon gas laser was used, which generates predominantly green light. An X-Y deflection system of mirrors under the control of a computer system was employed to move the laser beam under program control.

The Z80-based multiprocessor computer system, designed by Laservision, can drive up to three X-Y mirror deflection scanning systems, enabling patterns, such as that on the front cover, to be 'written' against a background. The system enables the operator to switch programs at the push of a button, thus effecting a change in the display.

Smoke canisters were used for the display so that scattering from the smoke particles would make the beams visible. Rain on one of the nights made for a very effective backdrop, according to Gary Levenberg, even enabling 'writing on the clouds'.

Laservision Pty Ltd, headed by Gary Levenberg, has been formed in association with Soleil-Laser (Australia) to pursue the newly established field of laser productions. Geoffrey Rose of Soleil (Australia) and a team of artists/physicists have staged a number of laser light shows and demonstrations around Australia recently and are currently touring with the Space Light show, a laser and holography 'spectacular' (presently ensconced in the Melbourne Town Hall — a 'not to be missed' event).

Gary Levenberg, an American, has been associated with the US Soleil Company since 1975. They have staged laser spectaculars to as many as four million people, as well as doing light shows at symphony orchestra concerts and rock shows.

Recent work of Soleil-Laser (Australia) includes large outdoor displays such as the opening of the Sydney Tower at Centrepoint, and displays emanating from transmitting towers outside Brisbane and Adelaide for 4MMM-FM and 5AD, in conjunction with Channel 7. They have also done promotional work for Coca-Cola, De Beers Diamonds, BMW, Datsun and many others.

ETI DISTRIBUTION

During the past few years we have received a number of complaints to the effect that ETI has been very late on sale in several areas outside NSW.

While aware of the problem, we have until now been powerless to correct it. However, our parent company (Australian Consolidated Press) has expanded and updated its own distribution system, and as from our June issue we shall be switching over to this system.

On-sale dates in NSW will remain much as they are now, but interstate on-sale dates will be brought forward very substantially.

Please let us know if you experience any difficulties — we will fix the problems immediately.

Infrared airborne observatory

NASA has equipped a Lockheed 300 cargo plane with a 36-inch infrared telescope and computer systems for the detection of infrared radiation from astronomical objects and from inter-stellar space. This is an effective and efficient way to get the telescope above the infrared absorbing water vapour in the atmosphere.

The Lockheed 300 (a commercial version of the C-141 Starlifter) can fly at altitudes of between 41 000 and 45 000 feet, where the telescope is above some 99% of the atmospheric water vapour, so it can provide clearer and more sensitive measurements of the radiation from the planets and stars than are possible from ground-based observatories. It is much more economical than the use of instruments on board space vehicles (such as the Voyager and Pioneer craft), although a special earth-orbiting telescope is scheduled for launching in 1983.

Known as the Kuiper Airborne Observatory (after Gerald P. Kuiper, a pioneer planetary astronomer), the aircraft has taken part in key scientific discoveries, including that of the rings around the planet Uranus. It is considered to be complementary to both the planned infrared space telescope and to the infrared cameras on spacecraft, since its flights are measured in hours rather than years and this provides for much greater flexibility in mission planning. Unlike spacecraft cameras, it is easy to make changes in the equipment of the Kuiper Observatory.

NASA states that the airborne observatory is expected to play a key role in recording the passage of Halley's Comet in 1986 — a passage which is expected to be the least brilliant to the lay public of any passage during the past thousand years, since the comet's approach will be from the other side of the sun. Its approach can only be seen from a spacecraft and, while the space telescope will be in use, only the aircraft observatory will be able to operate in the infrared.

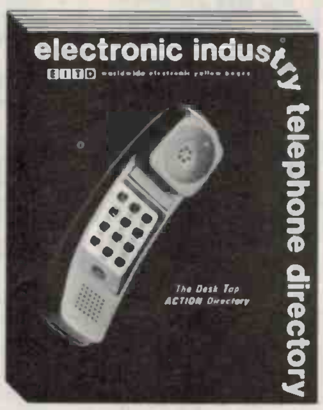
The Kuiper Observatory usually carries a crew of six together with a scientific team of two to five persons. Recently it has been used to detect the presence of carbon monoxide gases in the regions of interstellar space where stars are being formed, while it was previously used to identify the water molecular lines in the radiation from the Orion nebula.

Brian Dance

Electronics Yellow Pages

The Electronic Industry Telephone Directory (EITD) lists nearly 19 000 manufacturers, representatives, and distributors worldwide.

The directory contains two sections: the alphabetical section, which lists electronics firms alphabetically by company name, and the purchasing section, which lists companies under 3500 different product categories. Every listing in EITD's alphabetic section provides the company name, its complete address, including state, and the US direct-dial telephone number.



Because each listing is individually verified each year, EITD is 99% accurate. It has a distribution of 101 000 copies to buyers and engineering specifiers in all phases of the electronics industry in the USA. Due to its intensive distribution to the electronics market and its success in the industry for over 20 years, the USA's largest corporations use EITD to advertise their products and services to the most influential electronic buyers. It costs just $40 per copy, including air freight.

For free brochures and information write to S.D. Chamberlin, Export Manager, Harris Publising Co, 2057-2 Aurora Rd, Twinsburg, OH 44087, USA.

Versatile, low-cost multimeters

If you're looking for a low-cost, highly portable analogue multimeter then Altronics' models Q1001 and Q1002 should attract your attention.

The Q1001 is a 'pocket' multimeter featuring 2000 ohms/volt sensitivity, a mirror-backed scale and overload protection. On dc and ac it covers 10 V, 50 V, 250 V and 1000 V, and it has a 100 mA current scale plus x10 and x100 ohms scales. You get a dB scale too (ac range). It measures just 90 x 60 x 30 mm! Cost? — $12.50! You can obtain a pvc carrying case, with probe pocket, for $2.50, too.

The Q1002 is a portable instrument featuring a 60 mm wide mirror-backed scale and 23 ranges. Sensitivity is quoted as 20 000 ohms/volt on dc, 10 000 ohms/volt ac. It is overload protected and comes with a 'unique' carry handle that doubles as a bench stand.

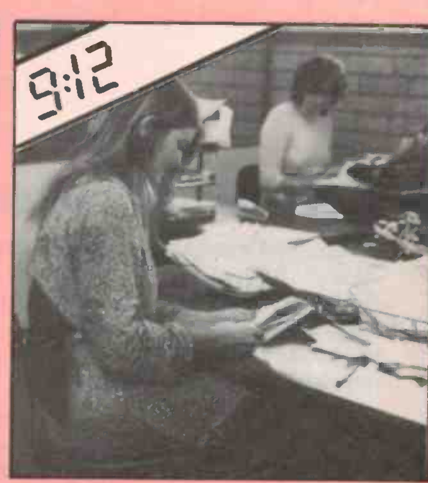
On dc it measures 250 mV to 1 kV in eight ranges and 50 uA to 500 mA in five ranges. A dB scale is included, spanning −20 to +22 dB. On ac it measures 10 V to 1 kV in five ranges. Four resistance ranges are included: x1, x10, x100 and x1k — all for a mere $22.50! A 'leather look' carrying case costs $3.50, but readers mentioning this item when purchasing the Q1002 — or Q1001 — will have a carry case thrown in free of charge (if ordered during June).

Amble out to Altronics or airmail if you're unable to go there personally — they're at 105 Stirling St, Perth or behind P.O. Box 8280, Perth WA 6000.

MEET A MAN WHO KEEPS 74,961 CUSTOMERS HAPPY!

He's got to get that adrenalin flowing — so it's off for a quick jog around the park before work. This is David Broome, our Mail Order Manager. He'll probably never meet our 75,000 mail order customers: but to David, this makes looking after them even more important!

A quick shower, shave and bowl of Kellogs — and David's ready to start another day. First job is to check the computer for overnight orders received via the Electronic Shopping System.



Then it's onto the mail — enough to gladden the heart of even Santa Claus. Up to 10 staff are on hand to open and process each batch of mail.

The good news

"These top quality products are all available by Mail Order at direct import prices."

1% TOLERANCE RESISTORS

WHY SETTLE FOR LESS?

WHY METAL FILM?
High stability — Very low temperature coefficient — High reliability — Ruggedly made — Professional quality

SAVE OVER $5.00

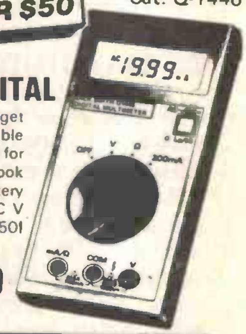
BARGAIN PACK

Cat. R-7015 **$12.90**

300 precision 1% ¼W metal film resistors, $18.00 value!

DIGITAL MULTIMETERS UNDER $50

Cat. Q-1446



AUTORANGING DIGITAL

At last — a fantastic full autoranging budget priced multimeter! This LCD Digital is a portable 3½ digit, compact-sized tester ideally suited for field, lab, shop and home applications. Just look at these features: Overload protection — Battery operated — Low cost — 0.8%, 1.35% DC V reading error. All these features for only $49.50!
Cat. Q-1446

ONLY **$49.50**

Cat. A-1000

NOW MINIATURE HI FI THAT DOESN'T COST A FORTUNE!

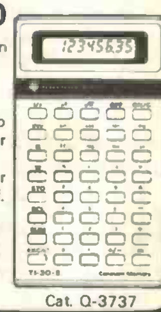
This 3-in-one system offers big performance. It's the ideal system for flats, bedrooms, etc. It features: AM/FM stereo tuner — Integral cassette deck with noise reduction and chrome facilities — 10 watt amplifier with LED VU meters, full switching and 2 phono preamps — Separate 2-way Hi Fi speakers. Small in size, big in sound!

DON'T PAY $500 OR MORE!

ONLY **$249**

TOP QUALITY TEXAS CALCULATOR UNDER $20!

That's the Slimline T130



This calculator is great for any student and well within their reach at this low Dick Smith price!
Just look at these features:

- Easy-to-read Liquid Crystal Display
- AOS Algebraic operating system allows you to enter mathematical sequences in the same order that they are algebraically stated.
- Constant memory feature holds numbers in a user memory even while the calculator is turned off.

ONLY **$19.95**

Cat. Q-3737

FOUR WAY RADIO CONTROL

Cat. Y-1240

4 CHANNEL DIGITAL
HERE AT LAST! A 4 channel radio control for bringing life to your model boats, tanks, cars, etc. This fantastic unit will make every boy the envy of fellow modellers.

$149.50

DON'T PAY FANCY MODEL SHOP PRICES!

FREE POWER!

SOLAR CELL SECTOR
22nd Century technology! Connect these in series or parallel to power your projects. 450mV @ 125mA
Cat. Z-4835

$2.95

CHEAP RESISTANCE!

Resistance Substitution Wheel
Convenient size with large, easy to read value selections from 5 ohms to 1 M ohm in 36 steps. Complete with leads and crocodile clips.
Cat. Q-1410

$7.95

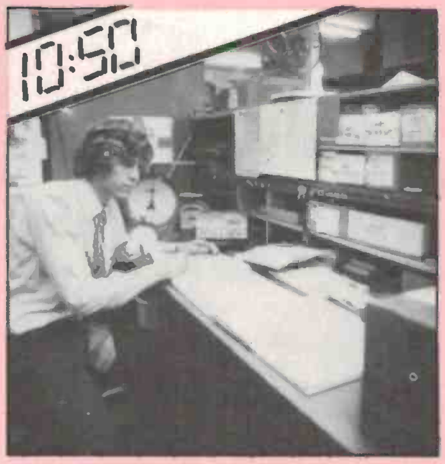
18¢ m

LIGHT DUTY SPEAKER CABLE

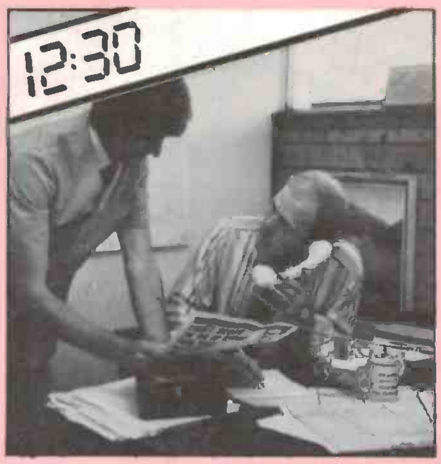
Ideal cable for use with Hi Fi systems for speaker connections or with intercoms. Twin plastic insulated conductors, insulation marked with a trace to keep speakers correctly polarised.
Cat. W-2010

Bulk price 100m or more — 15c/m

Down the conveyor belt to the packing section (sometimes with a pricer hanging on — they're so keen, they sometimes forget to let go: David's working on that one . . .) And your order is carefully packed to make sure you don't receive double the number of pieces you ordered!



Your order is weighed, stamped and entered into a despatch ledger (once again, just in case . . .) And within an hour, it's on its way to the Post Office — one of 5 batches of orders to leave every day! By the end of the day the label lickers have almost run out of lick!



"What do I do about this, David?" Carefully avoiding getting Vegemite on the paperwork (he's not really that tidy — just doesn't want to lose his Vegemite) David answers another query. They don't stop just because it's lunchtime!

$10 CHEAPER THAN WELLER!

The DICK SMITH Solder Station

If you are serious about soldering, there's only one way to do it - with a temperature controlled soldering iron. Dick Smith brings you this brand new temperature controlled station, offering you the best quality at an unbelievably low price. AND it's fully approved by the Energy Authority. The station comes complete with lightweight iron, iron holder and cleaning sponge, with a comprehensive instruction manual with full servicing information.
Cat T-2000

PRO QUALITY AT A HOBBYISTS PRICE

now $59^50

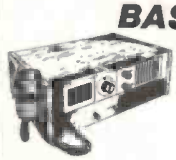
Look at Dick's price for quality! Belt Drive Turntable

Here's top value: a semi automatic belt-drive turntable, with all the 'mod cons' such as variable speed, strobes, anti skate, auto return etc, etc... mounted in a deluxe shock-damped plinth with perspex hinged lid. Cat A-3080

only $169^00 (Inc. Cartridge)

HUGE SCOOP PURCHASE!

Looking for a good BASE STATION?

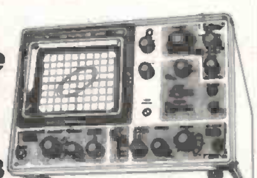


A fantastic base station CB that lets you communicate to others from the comfort of your own home! Has 18 channels available and comes ready to connect to your antenna. Features include a quality loudspeaker with headphone socket, large easy to read power/signal meter, delta tune for receiving stations slightly off frequency, built in power supply - just plugs into mains*, finished in attractive wood grain.
Cat D-1432
*Requires 240V to 110V external stepdown transformer.

value at $169

HITACHI QUALITY - DICK SMITH PRICE!

HITACHI 15MHz Dual Trace Cro



Model V-152B

For the service bench, technical college, university or school - or even the serious hobbyist or amateur who simply wants a top-of-the-line CRO without breaking the bank, we have the outstanding Hitachi V-152B 15MHz Dual Trace Oscilloscope.
It costs no more than our previous CRO's which didn't have anywhere near the number of features of the Hitachi V-152B. Features like ★Extra high sensitivity ★TV Sync-separator circuit for rapid video measurement ★5 display modes ★Trace rotation via front panel control ★One touch wave-form shifting ★One touch 10x sweep magnifier AND LOTS MORE! Cat Q-1242

SPECIFICATIONS

Vertical sensitivity: 5mV/div-5V/div
Bandwidth: DC-15MHz, -3dB
Rise time: 24ns
Non-dist.max amplitude: More than 4 div @ 15MHz
Input R and C: Direct 1M ohm, approx. 30pF
Maximum input voltage: 600V P-P (300V AC + DC peak)
Display modes: CH1, CH2, DUAL ADD, DIFF
Sweep time: 0.2us-0.2s/div; 19 calibrated steps
Power requirements: 120-240V, 40W

great value $655

100MHz x 1 x 10 CRO PROBE

This versatile probe set gives you features you would pay $$$ more for and will suit virtually any CRO. You get a Basic probe with inbuilt x1/x10 switch, 1.5 metres of cable with co-ax type CRO connector and wandering earth lead with alligator clip, IC adaptor tip, spring clip, insulating shroud, BNC adaptor, trimming tool, and a plastic wallet for safe keeping.
Cat Q-1245

only $32^50

Compares with $70 Probe Sets!

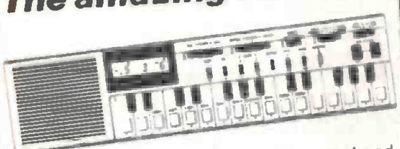
DICK SMITH LOW COST SOLDERING IRON

A general purpose iron that can be plugged into the 240V AC mains and will give 25 watts of heat very quickly. That is more than enough for most jobs around the home or workshop. It has a stainless steel barrel and comes with a copper tip. Complete and ready to use with mains plug and cord attached.
Cat T-1300

10,000 SOLD!

only $9^75

Latest micro technology makes you a musician with The amazing VL TONE



Small enough to fit into the palm of your hand but gives you performance and flexibility that would have been thought impossible a couple of years ago. It gives you ten different background rhthyms, records the melody you've just played, 5 different instrument sounds PLUS the ability to create millions of sounds of it's own. You'll be playing tunes in a couple of minutes. And...

IT DOUBLES AS A CALCULATOR!

Cat Y-1156

only $89^95

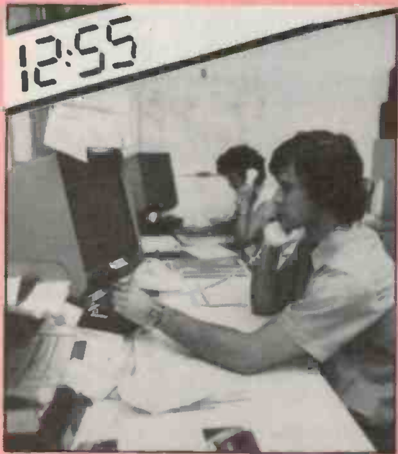
SAVE $8

MINI CASSETTE RECORDER

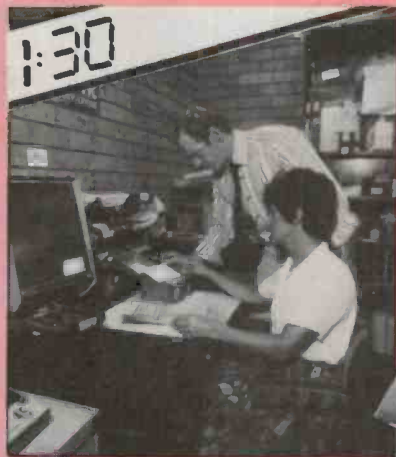
This palm sized recorder is ideal for recording anything that would be ordinarily very difficult with standard sized recorders, such as lectures, interviews and conferences etc.
Uses standard cassette tape, has thumb operated controls, and inbuilt microphone. Can be connected to external power source and has earphone jack. AND it features a review button allowing automatic playing after rewinding a cassette. Cat A-4050.

only $39^50

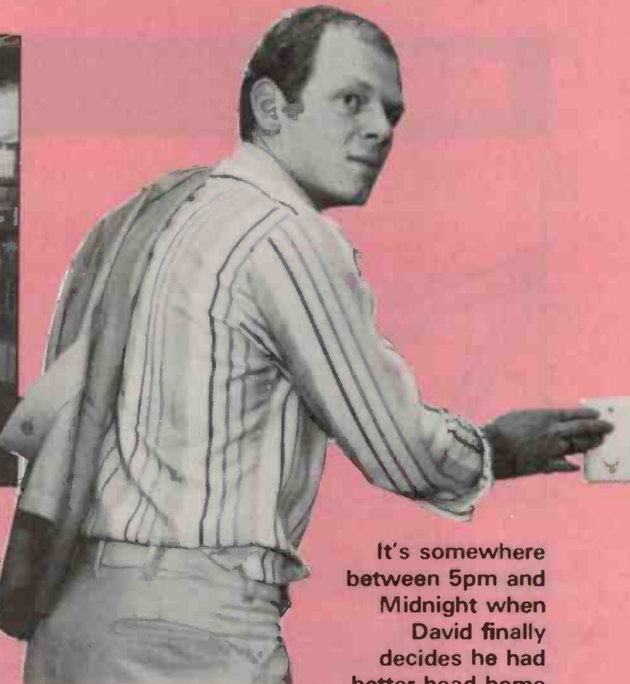
YOU REAP THE BENEFIT!



Calls may come in from Perth to Papua — checking about products, querying orders — or even ordering by 'phone. Our 'phone-in Bankcard ordering system has proven really popular. It is one way to get your order on the way very quickly.



And any goods not in stock (shame!) are 'back-ordered' and sent later at our expense. As soon as we receive it, you'll get it — David and Dorothy make sure of that!



It's somewhere between 5pm and Midnight when David finally decides he had better head home (he's only been married a few months and Penny starts getting anxious after about 8 o'clock). One last check — and he's off. Don't forget the light on the way out, David!

SAVE ON TEAC HI-FI!

Dick Smith offers you this superb TEAC Hi-Fi system at an unbelievable low price.

System Comprises

35 watt RMS amplifier BX-330B
Features LED power meters, low distortion, dual speaker outputs and a frequency response of 10Hz - 100kHz.
Cat A-1301 .... **$249**

AM/FM tuner TX-550B
Unbelievable performance - not just on FM but on AM too!
Cat A-1501 .... **$199**

Metal tape deck V-30
For those with a discerning eye for style and quality. Has Dolby NR switch, peak level display, tape (Bias/EQ) switch, pause key and much much more.
Cat A-3505 .... **$169**

Turntable P-50
Semi-automatic belt driven turntable in modern silver and black finish and with tinted vinyl dust cover. Superb performance.
Cat A-3079 .... **$169**

Two litre speakers
Designed as bookshelf speakers but can be used on the floor also. Each contains a 200mm woofer and a tweeter for top end sound.
Cat A-2460 .... **$95 pr.**

Superb Hi-Fi stand
Store all your Hi-Fi equipment on this quality stand. Separate compartments for amp, cassette deck, tuner and turntable. Great little space saver!
Cat A-0105 .... **$72**

The Affordable CRO!

DICK SMITH 6.5MHz 75mm Laboratory CRO

This oscilloscope is ideal for the laboratory, the classroom, in field service, in bench service in assembly centres and, of course, in hobby applications. Solid state electronics (apart from the tube!) ensures extremely low drift and fast warm up. Features include retrace blanking for a clearer display; fibreglass PCB; lower threshold triggering; sharper focus; and colour coded input terminals.
Cat Q-1280

OVER 2000 SOLD! only **$199**

CRO BNC ADAPTOR

This smart little adaptor plugs into the input terminals on the Dick Smith laboratory oscilloscope, converting the banana socket terminals to a BNC type, as used on more expensive oscilloscopes. Cat Q-1281

$9.90

WANT A DISK BASED COMPUTER SYSTEM?

The SYSTEM 80 Mk II saves you $750 straight away!!

When cassette operation is too slow for business usage, this System 80 is the answer. The normal inbuilt cassette mechanism has been removed (even though we've still allowed for external cassette connection) to allow for connection to a disk drive. Features of this superb computer are flashing cursor; numeric keypad; 12K microsoft BASIC; screen print facility; FULL upper and lower case display plus provision for full expansion to 48K of memory. Cat X-4100

WAS ~~$1495~~ ***SAVE $745!***

NEW LOW PRICE ONLY **$750**

YOU REAP THE BENEFIT!

NO BOAT IS TOO SMALL

DICK SMITH 5 watt 6 ch Hand Held

Now a transceiver offering the maximum legal power on the 27MHz marine band (5 watts) and a choice of up to 6 channels. Operates from 12 volts. A real workhorse.
Cat D-1123

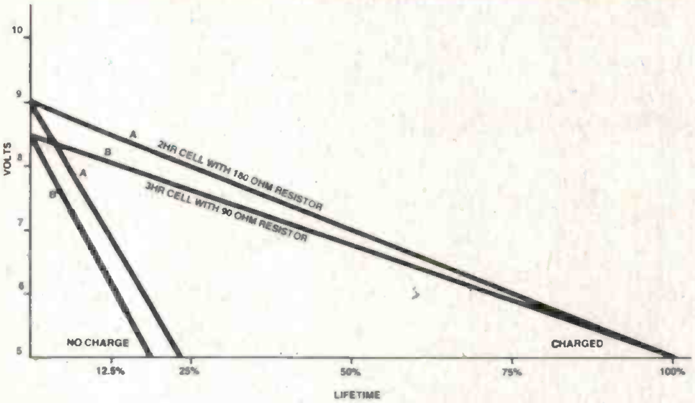
only **$125**

DOC Approval No 242M161

DICK SMITH Electronics

SEE PAGE 34 FOR ADDRESS DETAILS

DSE/A272/PAI



Radio recharges its own batteries

A radio receiver which recharges its own ordinary type of zinc-carbon batteries was recently introduced in Britain by Fidelity Radio Ltd. These batteries are not the expensive nickel-cadmium types, but the ordinary batteries used in radio receivers, which are normally discarded when they are exhausted.

When the 'Battery Saver' receiver is connected to the mains — no matter whether it is operating at the time or not — a mixture of alternating and direct current is passed through the battery so that the zinc is reformed in a polished form on the negative electrode. Unfortunately there is a limit to the extent to which this process can be satisfactorily carried out, but the manufacturers state that the life of a battery can be extended by a factor of at least four times.

Eventually the zinc no longer adheres in an even film to the electrode and the electrolyte becomes devoid of hydroxyl ions. It is important that the batteries are not overcharged, since this can cause loss of the electrolyte, but the circuit incorporated in the Battery Saver receiver is designed to automatically prevent overcharging when the battery reaches its preset voltage of 8.5 V.

It is important that the charging should be quite slow at a low current or the build-up of gases in the cells of the battery can cause a build-up of pressure which may be dangerous.

A red LED provides an indication as to when the battery requires recharging. The receiver should be left connected to the mains supply until this indicator lamp has become completely extinguished, showing that the battery has reached its optimum voltage.

Brian Dance

British telewriting trial for 1983

Telewriting, in which handwritten material (including sketches) is produced at one location and sent over an ordinary telephone line so that it can be reproduced on a visual display unit screen elsewhere, is part of a proposed visual services trial planned by British Telecom for 1983 in the London area.

Research work in the Government's laboratories has resulted in the development of various forms of experimental telewriting equipment. However, the Government has now decided to sponsor a STG£85 000 two-year trial of a 'Cyclops' telewriting system invented by the Open University. Cyclops is a two-way system for both images and speech signals, the two types of data being sent over separate telephone links.

Light pens are employed at both ends of the telephone link to produce written messages and drawings, and the receiving station can use its pen to alter or erase any of the information.

Video material which has been stored on an ordinary audio cassette can also be transmitted, including computer-generated graphic diagrams, charts, tables and black and white pictures.

Brian Dance

Soanar agent for Curtis RFI filters

Soanar Electronics Pty Ltd have been appointed sole Australian Agent for the range of RFI power line filters manufactured by Curtis Industries, USA.

The recent proliferation of computers, peripherals, industrial controls, test equipment and many other devices utilising digital techniques, including electronic games, has highlighted a major suppression problem.

For years, manufacturers and users of interconnected digital devices have recognised the need for RFI power line filters in their equipment. Interference created in one module could adversely affect others, causing them to malfunction unless proper RFI filtering had been incorporated in the system.

Curtis Industries' unique filter design, together with their modern assembly and testing methods, can now provide manufacturers with line filters of extremely high quality which are capable of meeting and surpassing government regulations on noise emission.

The Soanar branch in your state will be pleased to provide you with additional information and literature on Curtis RFI Filters, or contact Soanar Electronics Pty Ltd, 30 Lexton Road, Box Hill Vic. 3128. (03)840-1222.

Prestel retracts

British Telecom have decided to close down 14 of the 20 Prestel computers so as to provide an estimated saving of some £1 million per year.

It appears that the original computer network was based on an assumption that by late 1981 some hundreds of thousands of domestic computers would be using the Prestel service in their homes; however, this has not taken place and neither is there any sign that it will occur.

Prestel customers are almost entirely business users. The total number of Prestel installations in Britain is now about 15 000, and is increasing at about 500 per month.

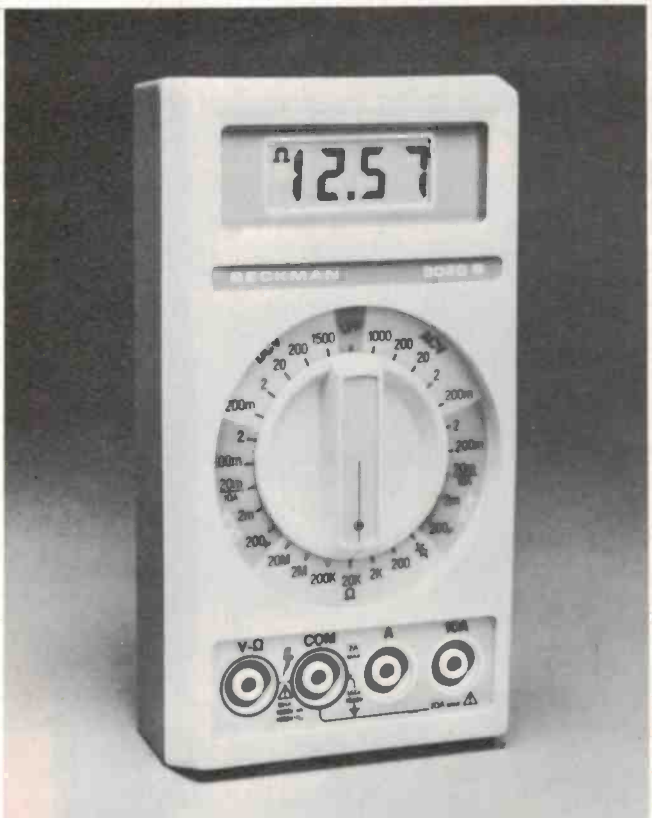
Currently 200 000 pages of information are available and new services are being introduced, including 'Gateway' to provide access to third-party computers and 'Mailbox' to provide an electronic message facility.

Telecom announced the development of Prestel for the blind and for the deaf in October 1981. The first Braille reader for use with Prestel was shown in that month, in which the television screen was replaced by a flat box about the size of a small case. Production models of the prototype demonstrated are expected to become available in 1982.

A telephone communication terminal for the deaf has also been demonstrated, in which a small typewriter and a moving strip display are used with an ordinary telephone fitted with an acoustic coupler. Calls are set up by dialling in the usual way, but coloured flashing lights indicate whether the connection has been established and users communicate by typing the words shown on the display.

This same terminal can be used with Prestel installations, while deaf persons can use it to communicate with hearing people who have Prestel installations and an alphanumeric keyboard.

Brian Dance



Beckman DMM goes beep

Beckman Instruments Inc has expanded its line of digital multimeters for engineers, technicians and service representatives to include a new portable that gets your attention by sound when continuity is detected.

The attention-getting DMM is called the 3020B, and has both audible and visual continuity indication. When it's not possible to see the large-area LCD, the meter will alert the user when continuity is detected by a single loud 'beep' tone. Continuity is also visually signalled (in less than 1/10 of a second after detection) by the appearance of an ohms sign in the upper left corner of the LCD.

Like other Beckman portable DMMs the 3020B features an easy to use single centre selector switch, 0.1% basic Vdc accuracy, has 10 ampere ac/dc current ranges, 2000 hour battery life from a standard 9 volt battery, semiconductor test function and overload protection on all ranges.

Like all Beckman DMMs the 3020B's 27 ranges are protected against overload conditions that result from the measurement of unknown signals or from operator error. Voltage ranges are protected to 1500 volts dc or 1000 volts RMS ac. All resistance ranges are protected by 500 V RMS and current ranges are rated up to 20 amps for 30 seconds.

Resistance ranges are low-power, allowing accurate measurement of in-circuit resistance, without turning 'on' diodes and semiconductors which would affect the measurement. When testing diodes and semiconductors, a separate semiconductor test function provides a 0-2 V, 2 mA constant test current — enough to verify the operation of semiconductor junctions while in circuit with as little as 350 ohms shunt resistance.

For more information and complete specifications, contact your local Warburton Franki office.

'Phone competition

The British Government has announced that Britain is to have an independent telephone network for business users only which will operate in competition with British Telecom.

A consortium (comprising Cable and Wireless Ltd, BP and Barclay's Merchant Bank) has been granted a 25-year licence to operate the competitive network, to be known as Project Mercury. No other networks will be licensed within the forseeable future.

Mercury intends to undercut British Telecom's rates, using optical fibre cables laid alongside British Rail's tracks. It plans to link its first customers in London by the start of 1983, and the first main trunk route between London and Birmingham should be available early in the same year.

An all-digital system will be employed, capable of carrying telephone, data signals and video-conference images. Seven major centres will be linked initially, but British Telecom has agreed in principle that Mercury will be able to interconnect with its own network. Thus a company outside the seven main centres will be able to dial into the Mercury system using Telecom lines.

The consortium has yet to reach a full agreement with Telecom on the interconnection, both as regards the technical requirements and on the financial aspects. It is hoped that the parties will come to a suitable agreement within the next few months. Mercury will be required to pay a royalty to the Government (either directly or possibly through Telecom.)

Telecom will remain the sole international carrier, since there is currently no method available for negotiation between more than one international carrier in any one country and the authorities in other countries. However, Mercury will be able to lease and offer private international circuits by linking directly to international communications satellites from its own independent Earth station, which will be constructed with a large dish antenna in the UK.

The Mercury consortium has struggled for the right to interconnect with the public switched international circuits now used by business and domestic users, but it has not yet been able to obtain any such rights.

British Telecom is currently spending large sums on its international connections, and these connections bring in a large part of its profit; Telecom claim it could therefore suffer considerably if the consortium were allowed to become fully independent in the international communications field.

Britain has had a state monopoly in the telecommunications field for the past 60 years (with the exception of the town of Hull). The consortium's plans to lay 1000 km of optical fibre cable with four cores (each able to carry a 140 Mbit/s data rate signal or 2000 simultaneous telephone calls) will soon change this position for the large industrial companies, but the private telephone user will still have no alternative to the use of Telecom's lines with higher charge rates.

Brian Dance

Pioneer 10 — a space odyssey

A decade in space for Pioner 10! — The first spacecraft (to our knowledge) to closely approach Jupiter completed a decade in space on March 7.

Launched in 1972, Pioneer 10 is now travelling through the space between the orbits of Uranus and Neptune, about 4 billion km from the sun.

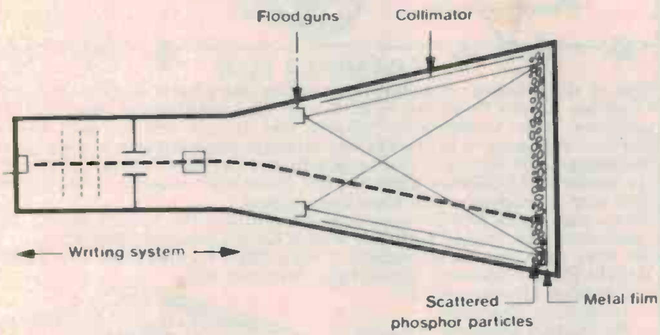
Its next major history-making event will be when it enters interstellar space after passing the orbit of Pluto. In fact, Pioneer 10 will be the first (known) spacecraft to leave our solar system — about 1986. (Thanks to Westlink Report).

No-burn tube provides high light output

A specially-developed, burn-resistant, secondary emission insulator in the storage tube of Philips PM 3219 oscilloscope enables this instrument to provide maximum light output in storage and non-storage operation. Previously, such instruments had to reduce light output by up to 40% in storage operation to avoid damage to the storage layer.

The key to the improvement is the substitution of a magnesium oxide-based layer for more conventional magnesium flouride on the storage mesh. Whilst magnesium flouride provides slightly higher initial writing speeds, it ages rapidly and is liable to irreversible damage or 'burn-in' marking if a high intensity beam stays on too long. The magnesium oxide layer is harder chemically and lasts longer. The after image may persist for a short time but after 24 hours or so it will fade away, leaving an unmarked screen.

Other features of the tube — developed in-house by Philips Electronics Components Division — include a quick start ensured by fast-heating cathodes in writing and flood guns. Warm-up takes around five seconds.



An improved collimation system ensures a full display over the whole screen with no diminution of light output at the edges.

A wide range of electronic and non-electronic applications are simplified by the PM 3219, varying from testing of loudspeakers to the analysis of mechanical operations at very low frequencies using the auto-erase facility.

Whether it is single-shot applications, where a storage scope is the only answer, or a more complex trend-tracking use, such as comparing response curves during sweep measurements, the sophisticated facilities of Philips latest 50 MHz instrument can simplify storage operations.

For further information contact Philips Scientific & Industrial Equipment, 25-27 Paul St, North Ryde NSW 2113. (02) 888-8222.

Silicon Glen

The United Kingdom contains one of the largest manufacturing microelectronics industries in Europe, situated in the lowland region of Scotland between Edinburgh and Glasgow.

Known as 'Silicon Glen', it has the densest concentration of semiconductor manufacturers anywhere in Western Europe. Some 36% of the UK's production of semiconductors comes from this region, but new investments of some STG£150 million by foreign manufacturers in the region will result in half of Britain's semiconductor products coming from this area within the next two years. The annual output of the glen is some STG£100 million, and it accounts for some 7% of the Scottish manufacturing labour force.

The development of this industry during the past four years has been due to the investments of large US and Japanese manufacturers (aided by large grants from the British Government) rather than to the efforts of British manufacturers. A large fraction of the devices produced is exported.

General Instrument commenced work in Scotland some 13 years ago, whilst National Semiconductor, Hughes and Motorola quickly followed. Nippon Electric (NEC) have recently announced a STG£40 million development project in the area.

Other British semiconductor manufacturers are widely distributed throughout the country, and include Ferranti, Plessey and the British General Electric Company. The National Enterprise Board's Inmos Company has a new plant in Colorado producing chips and another under construction at Newport in South Wales; it is the only British company exclusively manufacturing microelectronic devices and no other products.

Why should such a large proportion of Britain's semiconductor industry be collected in a small region of Scotland? Large government grants of the order of STG£2000 million per year for the development of the area is one important reason, but an adequate supply of trained graduates, good communications and a relatively cheap cost of living in this area all played their part.

Most of the research and development work of these Scottish manufacturers is still carried out by their parent companies in the USA or elsewhere, but there is now an increasing tendency for the companies to carry out design work locally. In particular, General Instrument and National Semiconductor have design facilities in Scotland.

Scotland is now especially keen to encourage private sector interests in the region and has announced a scheme to help manufacturers to learn about the applications of microelectronics.

Brian Dance

MORE SPECIALS

HANIMEX

PRINTING CALCULATOR
– MASSIVE PRICE BREAKTHROUGH

- Quality Hanimex Brand Model MC 1500P
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- Seiko Printer
- Uses Standard Plain Paper Rolls (not expensive and hard to get Aluminium coated paper)
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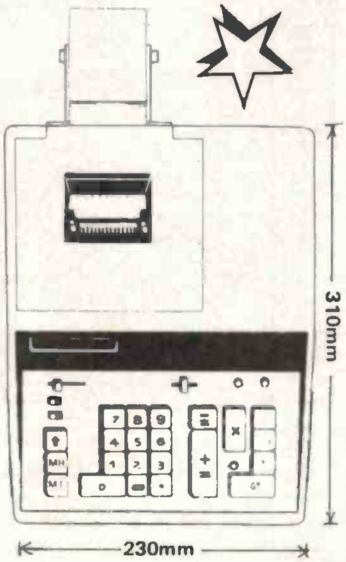
- Selectable % Mode, & most of the usual features found in machines costing well over $100!!
- A Real Accountant's Special
- Weighs over 3Kg!!
- Roll of Paper Supplied – available virtually everywhere.



WE ONLY HAVE A SMALL QUANTITY OF THESE UNITS. STRICTLY ONE PER CUSTOMER

Staggering Value $59.50

* FAMOUS * GENERAL ELECTRIC

BURGLAR ALARM SLASHED!!!
HUGE SCOOP PURCHASE – ONCE SOLD FOR OVER $100

Slashed to $29.50

Amazingly low price for a full-feature ultrasonic proximity/burglar alarm. + Completely self contained + 12 month manufacturer guarantee + Instant or delayed alarm + Handsome imitation woodgrain + Cabinet measures 180Wx85Hx100D + Programmable multi-code disable switch + Single 9V Alkaline battery* lasts one year + Unit beeps when battery gets low + Contains two receiver elements for greater sensitivity without false triggering + Uses State-of-the-art LSI circuitry + Worth the money for parts alone + Comprehensive 24 page manual included + Comes complete with 4 window deterrant stickers + Absolutely no installation needed. * Battery extra

SAVE A FORTUNE – COMPARES WITH UNITS OVER $100
Below cost distress stock – Factory orders to sell.

PCB EDGE CONNECTORS – Lowest in Australia
– Tell us if we're wrong!!!!

0.1" DOUBLE SIDED SPECIALS

2x18 WAY GOLD SOLDER	1-9 $2.50	10+ $1.95
2x36 WAY GOLD WIRE WRAP	1-9 $3.25	10+ $2.50
1x39 WAY GOLD WIRE WRAP	1-9 $2.00	10+ $1.50

* 2x85 WAY GOLD WIRE WRAP PCB MOUNT
* CAN BE CUT TO ANY LENGTH METAL END CLIPS 30c ea.

THIS IS PART OF OUR HUGE BULK PURCHASE. WE ALSO HAVE 0.125" AND OTHER SIZES – CALL IN!!

S-100 0.156" solder tail gold plated pins QUALITY
1-9 $4.95 10+ $4.50

S-44 0.156" solder tail 22 way gold plated QUALITY
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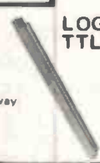


PLESSEY–FOSTER
MORE SLASHINGS!!

We have purchased most of the remaining stock of these high quality units. Grab them now at not-to-be repeated prices.

PA

12" 50WRMS C300K05 — Normally $69.50, This month $39.50
Unbelievable!! Ten pcs or more $29.50

SAVE UP TO 57%!!

15" 240WRMS C380K50 — Normally $245, April Price $175, May $145, THIS MONTH JUNE $140

IS THIS WHAT THEY CALL A DUTCH AUCTION??

HI FI

12" 20WRMS C300L05 — Normally $29.95, This month $19.95, SAVE $10.00

Where else would you get a 12" Hi Fi speaker for this price???

8" 20W C200L19 — Normally $15.00, This month $7.95, SAVE $7.05

5¼" 30W Midrange C130M06 — Normally $11.50, This month $9.50, SAVE $2.00

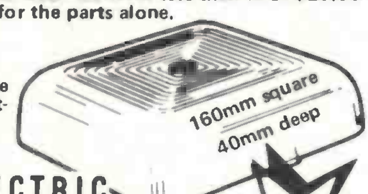
4" 50W Midrange C120K04 — Normally $5.00, This month $2.95, SAVE $2.05

6" 10W Widerange C160K03 — Normally $12.95, This month $6.95, SAVE $6.00

CONSUMER FLOP

One of the greatest consumer flops of the last decade was the Ionization Chamber Smoke Detector. Even though it is a brilliant product (reliable compact, easy installation, fail-safe etc) it just did not sell. Human nature being what it is finds safety-oriented products just not worth the investment. We all know that accidents and fires never happen to US!! As smoke is the greatest killer in a fire, the market research gurus thought that such a product would have wide appeal.
When they were $49.50 no-one wanted them. The price fell to a very reasonable $29.50 and still they stayed on the suppliers shelves.
We have now been in instructed to clear them for less than ½ of $29.50
At $14.50 this device is worth it for the parts alone.

- Contains Americium 241 Ionization Chamber
- 9V Mallory Duracell included
- Contains very loud solid state buzzer and other useful electronic components.
- 12 month factory warranty



GENERAL ELECTRIC

Grab One NOW $14.50

LOGIC PROBES

We have purchased the entire stock of a very well-known supplier. We have probes and pulsers (injectors) made in both the USA & Far East.

MF504 LOGIC PROBE
TTL/CMOS Minimum Pulse Width 20nS
Input imp. 100K
Max Freq 30MHz
Multi-LED readout
Stainless Steel Probe Tip
Normally $49.50, This month $24.50, SAVE $25.00

MF520 SIGNAL GATE
Used to extend the operation range of probes. Will open "time window" to let logic probe signal state in that window . . . .
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LOGIC PULSER MF512
TTL/CMOS Will Generate Pulses (10% High 90% High) at 0.5pps or 400 pps
Output protected
Normally $59.50, This month $29.50, SAVE $30.00

SAVE OVER 50%!!!

READ & REAP

AUTORANGING DIGITAL MULTIMETER
SENSATIONAL NEW PRICE!!

This fantastic meter is apparently exclusive to Dick Smith! Well we have been selling a meter that is identical to his Q-1446 except that ours weighs only 250 grams whereas (if you believe his new catalogue) the Q-1446 weighs 250kg. Perhaps that's why his is exclusive!! It certainly is not as portable as ours!!

We have made a bulk buy of these units as well as the model with the buzzer that gives GO/NO GO short circuit checks.

GRAB ONE NOW WHILE STOCKS LAST

– 2 MODELS –

ME533 (Similar to D.S. Q-1446 except that it does not weigh in at 250kg)

ONLY $45 SAVE $4.95

CLUBS CAN BUY IN LOTS OF 10 (FOR CASH) FOR ONLY $42.50

ME532 with low ohms buzzer **ONLY $54** SAVE $5.95

CLUBS CAN BUY IN LOTS OF 10 (MIXED WITH ME533 IF YOU LIKE) FOR $52.50 (CASH)

(SAVINGS ARE SHOWN OFF OUR NORMAL PRICES)

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PLUG-IN 1% CURRENT SHUNT (TO 30 AMPS) TO SUIT BOTH METERS ONLY $8.50

SOAR BRAND

FEATURES: – 3½ DIGITS LCD
- AUTO RANGING
- AUTO POLARITY
- SAMPLING RATE: 2/sec
- 0-1KV DC +/-1.35% worst case
- 0-600VAC +/-2.3% worst case
- 0-2Mohm
- 0-200mA
- POWER CONSUMPTION 5mW

ME532 ONLY – RANGE CHANGE INDICATION BY ELECTRONIC BEEPER
- SHORT CIRCUIT GO/NO GO BEEPER

AT LAST! REALLY HIGH POWER CAR SPEAKERS AT A LOW PRICE

SCOOP PURCHASE 3–WAY 6x9" 35WRMS 100WIHF MUSIC POWER

We have snapped up a smallish quantity of a South-American made "NOVIK" speakers.

They feature a MASSIVE magnet assembly, (we mean it) weighing 570g, 1¼" diameter voice coil.

These speakers are ideal for high power car installations or Hi Fi.

Available Individually. (Note: Due to their size they may not fit into car door panels – 100mm deep).

THESE UNITS ARE 4 OHMS IMPEDANCE

6x9" Professional grilles to suit $4.50 each.

ONLY $29.50 ea
($59)/pair

"INTERSIL" LCD PANEL METER EVALUATION KIT

BARGAIN OF THE CENTURY!!! ICL7106EV

This kit has featured in numerous construction projects. Until the Jaycar DPM-200 it was the lowest cost LCD DPM around.

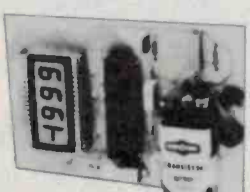
It normally sells for around $45.00

GRAB ONE NOW FOR ONLY $29.50

SAVE 35%!!

KIT INCLUDES:
- High Contrast 3½ digit LCD module
- Intersil 7106 LSI
- PCB and all passives

FEATURES
- +/-1 count over +/-2000 counts
- Guaranteed zero reading for 0 volts
- Differential input



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WB-TH – total 200 holes	$8.95
WB-2N – total 840 holes	$12.95
WB-4N – total 1680 holes	$24.50
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470 OHM THERMISTORS (NTC) DISC TYPE

A MUST IN EVERY JUNK BOX

5 for $1.00

NEED A NEW MUFF??

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Maybe you have never seen a blue muff before but ours are and they come in pairs.

$3.95 set

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ELECTRONIC COMPONENT SUPPLIERS, DESIGNERS & MANUFACTURERS.
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2708	$ 4.50	BU326	$ 1.90
2716	$ 4.90	Z80S10	$18.00
2732	$ 8.00	1771	$18.00
6800	$ 7.90	1791	$59.00
6802	$11.00	1795	$59.00
6809	$19.00	4116	$ 1.95
8085	$ 9.00	2114	$ 1.95
8080	$ 7.00	TA7205	$ 3.30
6821	$ 3.50	100 Red Leds	$ 9.00
Z80P10	$ 5.00	BUX80	$ 3.90
		BU126	$ 1.90

DIP SWITCHES SPST

P/N	No. Switches	Price
SD4	4	1.70
SD5	5	1.90
SD6	6	2.30
SD7	7	2.40
SD8	8	2.50
SD9	9	2.70
SD10	10	3.00

WIRE WRAP 3-LEVEL

	1-9	10-25
8 Pin	1.00	.90
14 Pin	1.10	1.00
16 Pin	1.20	1.10
18 Pin	1.50	1.40
20 Pin	1.80	1.60
22 Pin	1.90	1.70
24 Pin	2.00	1.80
28 Pin	2.20	2.10
36 Pin	2.60	2.40
40 Pin	2.90	2.70

COMPUTER GRADE ELECTRO.

2900uf	40V	6.50
6800uf	16V	6.40
10,000uf	16V	9.00
10,000uf	25V	9.50
10,000uf	40V	11.90
15,000uf	40V	12.00
22,000uf	25V	12.90
22,000uf	40V	23.00
27,000uf	35V	23.50
33,000uf	16V	23.50
68,000uf	16V	21.50
100,000uf	10V	20.50

MULTISTRAND RIBBON CABLE
Price per metre

	1-9	10+
10 Way	1.00	.90
12 Way	1.20	1.10
16 Way	1.60	1.40
20 Way	2.00	1.80
40 Way	4.00	3.50

CMOS

4000	.40
4001A	.40
4001B	.40
4002	.50
4006	1.10
4007	.50
4008	1.00
4009	.80
4010	.50
4011	.40
4012	.50
4013	.80
4014	1.70
4015	.90
4016	.70
4017	1.10
4018	1.50
4019	.60
4020	1.20
4021	1.10
4022	1.05
4023	.70
4024	1.00
4025	.50
4026	2.20
4027	.60
4028	.90
4029	1.20
4030	.60
4031	2.20
4034	3.00
4035	1.30
4039	.70
4040	1.70
4041	1.05
4042	.70
4043	.70
4044	.70
4046	1.20
4047	1.20
4048	.60
4049	.60
4050	.60
4051	1.00
4052	.80
4053	.80
4060	2.00
4066	.80
4068	.60
4069	.70
4070	.50
4071	.60
4072	.50
4073	.60
4075	.60
4076	1.20
4077	.50
4078	.60
4081	.60
4082	.60
4089	1.00
4093	.80
4503	.60
4510	1.50
4511	1.40
4512	1.10
4514	2.50
4516	1.40
4518	1.50
4519	.55
4520	1.60
4522	1.25
4527	1.20
4528	1.25
4529	1.60
4539	1.60
4541	1.60
4543	2.00
4553	5.50
4555	1.00
40097	.95
40098	.95
40175	1.00
74C SERIES	
74C 00	.40
74C02	.40
74C04	.40
74C08	.40
74C10	.40
74C14	.90
74C20	.40
74C30	.40
74C32	.40
74C42	1.10
74C48	1.55
74C73	.75
74C74	.70
74C76	.75
74C83	1.40
74C85	1.20
74C86	.80
74C90	.80
74C93	1.40
74C95	.95
74C107	.70
74C150	3.40
74C151	1.00
74C160	.90
74C192	.90
74C164	1.10
74C173	1.00
74C174	.80
74C175	1.00
74C192	1.20
74C195	1.00
74C221	1.90
74C373	1.80
74C374	2.00
74C901	.90
74C902	.90
74C905	11.20
74C906	.90
74C907	.80
74C915	1.50
74C922	3.80
74C923	5.00
74C925	7.50
74C926	7.50
74C927	5.90
74C932	5.50
80C SERIES	
MM80C95	.90
80C96	.90
MM80297	.90
80C98	.90

LINEAR

LH0002	9.50
LH0022CO	16.60
LH0042CH	8.60
LH0070	12.70
LH0071	12.70
TL071	1.00
TL072	1.50
TL082	1.50
SAK140	2.20
UAA170	3.50
UAA180	3.50
TCA220	2.20
LM301	.50
LM301-H	.50
LM304-H	1.70
LM305-H	.80
LM307-CN	.40
LM307-H	.90
LM308	.70
LM308-H	1.20
LM310-N	2.20
LM310-H	2.60
LM311	.60
LM311-H	1.20
LM318	2.80
LM322	3.90
LM324	1.20
LM325	3.10
LM329-DZ	1.40
LM334-Z	1.30
LM335	12.40
LM336-Z	3.20
LM339	.90
LM348	1.30
LM349	1.80
LF351-N	.70
LF356-AN	1.50
LF357	1.50
LM358	.70
LM373	4.10
LM374	5.40
LM376	.70
LM377	2.90
LM379s	6.70
LM308 8PIN	1.30
LM380 14PIN	1.50
LM318A-N	2.40
LM318N	1.80
LM382N	2.00
LM383	2.70
LM384	2.40
LM386	1.00
LM387	1.30
LM391	1.80
LM393	.80
LF398	5.00
8038	6.00
NE530	1.10
OM350	9.90
555	.40
556	1.10
LM565	1.30
LM565CH	2.00
NE566	2.50
LM567	1.50
NE571	4.50
LM709 14PIN	.70
UA710CA	.60
LM710-CH	.90
711	.80
UA711-H	.85
UA716HC	6.25
723	1.00
LM723CH	1.50
LM725	3.90
LM733	1.20
UA739	2.00
741	.40
LM741-H	1.20
UA747	1.50
UA747HC	2.20
UA748	.50
UA748HC	1.25
UA753	1.80
UA760HC	4.10
UA777	2.40
UA777HC	2.65
9334	1.70
UA743	1.80
UA760HC	4.10
UA796HC	1.70
LM802	1.10
LM1310N	2.40
1408	4.90
LM1458	.60
UA1488	1.50
UA1489	1.50
MC1495	7.30
MC1496L	11.40
LM1558	1.50
LM1596	1.40
LM1380	3.10
LM2902	1.40
LM2917	3.90
8PIN	2.80
LM2917	3.10
CA3028	1.80
LM3039	.90
CA3046	1.70
3065	.45
LM3080	1.20
LM3089	3.90
CA3130T	1.80
CA3130E	1.80
CA3140	1.40
3401	.70
3611	1.10
LM3900	.90
LM3909	1.00
LM3914N	3.90
4136	1.40
LM4250	1.75
UA4558TC	1.40
MM5837	2.50
LM7555	1.80
Mc10116L	.95
LF13741	.60
LF1374-1H	.70
DS75452	.60
76477	4.90
75451	.60
75491	1.40
75492	1.40

TTL (s)

74S00	.80
74S02	.80
74S04	.80
74S10	.75
74S11	.75
74S32	.75
75S51	.75
74S74	1.20
74S86	1.40
74S112	1.20
74S135	2.20
74S138	3.20
74S157	2.95
74S158	2.95
74S182	3.30

7400 SERIES

7400	.40
7401	.40
7402	.40
7403	.40
7404	.40
7405	.50
7406	.50
7407	.50
7408	.40
7409	.40
7410	.40
7411	.40
7412	.40
7413	.50
7414	.70
7416	.50
7417	.60
7420	.40
7421	.40
7423	.50
7425	.45
7426	.40
7427	.40
7430	.40
7432	.40
7437	.40
7438	.50
7440	.50
7441	1.00
7442	.50
7443	1.40
7444	1.20
7445	1.10
7446	1.00
7447	1.00
7448	1.00
7450	.50
7451	.50
7453	.40
8126	2.20
9300	.60
9307	1.80
9308	1.20
7454	.60
7472	.60
7473	.60
7474	.60
7475	.60
7476	.60
7480	.65
7482	1.80
7483	.80
7485	.80
7486	.60
7489	2.60
7490	.70
7491	.55
7492	.60
7493	.60
7494	.90
7495	.45
7496	.80
7497	2.50
74107	.80
74109	.60
74116	2.20
74121	.45
74122	.65
74123	.60
74125	.55
74126	.60
74132	.80
74141	1.10
74145	.85
74147	2.00
74148	1.40
74150	1.20
74151	.60
74152	4.90
74153	.70
74154	1.20
74155	.90
8T28	3.00
9310	.65
9311	1.00
9312	1.35
74156	1.50
74157	.60
74161	1.00
74162	1.00
74163	.85
74164	.60
74165	.60
74174	.50
74175	.90
74176	1.10
74177	1.10
74180	.90
74181	2.30
74182	.90
74184	3.75
74185	1.20
74190	1.00
74191	1.20
74192	1.20
74193	.80
74194	1.10
74195	.65
74196	.85
74197	1.10
74198	1.10
74199	1.30
74221	.90
74290	.90
73293	.90
74365	.80
74366	.80
74367	1.00
74368	1.00
8T96	1.80
9314	1.30
9368	2.50
9370	2.00

74LS SERIES

74LS00	.40
74LS01	.40
74LS02	.40
74LS03	.40
74LS05	.40
74LS08	.40
74LS09	.40
74LS10	.40
74LS11	.40
74LS13	.50
74LS14	.90
74LS15	.40
74LS20	.40
74LS21	.40
74LS22	.40
74LS26	.40
74LS28	.40
74LS30	.40
74LS32	.40
74LS33	.40
74LS37	.50
74LS38	.50
74LS40	.50
74LS42	.75
74LS47	.85
74LS48	1.00
74LS49	1.00
74LS51	.40
74LS54	.50
74LS55	.55
74LS58	.65
74LS73	.55
74LS74	.60
74LS75	.45
74LS76	.50
74LS78	.50
74LS83	1.00
74LS85	1.00
74LS86	.50
74LS90	.70
74LS92	.90
74LS93	.80
74LS95	.65
74LS96	1.55
74LS107	.60
74LS109	.60
74LS112	.60
74LS113	.65
74LS114	.50
74LS122	.50
74LS123	.75
74LS125	.50
74LS126	.70
74LS132	.80
74LS133	.50
74LS136	.50
74LS138	.80
74LS139	.85
74LS151	.75
74LS153	.60
74LS154	1.50
74LS155	1.00
74LS156	1.00
74LS157	.90
74LS158	.70
74LS160	.85
74LS161	.85
74LS162	1.00
74LS163	.85
74LS164	1.30
74LS165	.50
74LS168	1.90
74LS169	1.90
74LS170	2.80
74LS173	.90
74LS174	.90
74LS175	.90
74LS181	2.50
74LS189	3.80
74LS190	1.30
74LS191	1.10
74LS192	.85
74LS193	.85
74LS194	.70
74LS195	.80
74LS196	1.25
74LS197	1.00
74LS221	2.10
74LS245	2.35
74LS247	.90
74LS249	1.30
74LS251	.80
74LS253	.90
74LS257	.65
74LS258	.50
74LS259	2.45
74LS260	.90
74LS266	.90
74LS273	1.60
74LS279	.65
74LS283	1.15
74LS290	1.10
74LS293	1.15
74LS295	1.60
74LS298	1.00
74LS352	1.30
74LS353	1.30
74LS365	.60
74LS366	.70
74LS367	.50
74LS368	.50
74LS373	1.50
74LS374	1.70
74LS386	.50
74LS670	2.70
81LS95	2.10
95H90	15.50
11C90	19.50
81LS96	2.10
81LS97	2.10

TRANSISTORS

2N301	2.20
2N657	.60
2N930	.60
2N1613	1.10
2N1711	.50
2N1893	1.00
2N2219A	.60
PN2222	.30
2N2463	.35
2N2484	.65
2N2646	1.00
2N2647	1.10
2N2894	.80
2N2904	.45
2N2905	.40
2N2906	.45
2N2913	1.20
PN2907	.60
2N3053	.60
2N3054	1.90
2N3055	.90
2N3301	.40
2N3440	1.10
2N3502	.70
2N3503	.70
2N3563	.30
2N3564	.30
2N3569	.30
PN3565	.30
PN3566	.30
PN3567	.30
2N3568	.30
2N3638	.30
2N3639	.30
2N3640	.30
2N3641	.30
2N3645	.30
PN3642	.30
PN3643	.30
PN3644	.30
2N3646	.30
2N3692	.30
2N3693	.35
2N3702	.30
PN3694	.30
2N3704	.30
2N3709	.30
2N3713	2.20
2N3819	.80
2N3866	2.00
2N3904	.30
2N3906	.30
2N4030	1.10
2N4032	.90
2N4033	.90
2N4036	1.00
2N4037	.90
PN4121	.30
2N4233	1.60
2N4235	1.90
2N4236	2.20
2N4248	.30
PN4249	.30
2N4250	.30
2N4258	.30
2N4292	.70
2N4354	.30
2N4355	.30
2N4356	.30
2N4398	5.00
2N4401	.50
2N4402	.50
2N4403	.50
2N4416	1.00
2N4906	2.80
PN4868	.30
2N5088	.30
2N5089	.30
2N5179	1.90
2N5303	3.30
2N5320	.80
2N5401	.70
2N5458	.70
2N5459	.70
2N5461	.70
2N5484	.70
2N5485	.70
2N5486	.70
2N5769	.30
2N5770	.25
2N5830	.25
2N5831	.30
2N5856	.30
2N5873	1.10
2N5874	1.40
2N5961	.30
2N5963	1.10
2N6027	.60
3N201	1.50
AC127	1.00
AC128	1.00
AC187	1.00
AC188	1.00
AD149	3.10
AD161	2.00
AD162	2.00
BC318	.30
BC319	.18
BC327	.15
BC328	.30
BC337	.30
BC338	.30
BC547	.15
BC548	.15
BC549	.15
BC549C	.40
BC557	.16
BC558	.16
BC559	.16
BC637	.60
BC638	.60
BC639	.40
BC640	.40
BCY70	.85
BCY71	.85
BD115	1.50
BD135	.70
BD136	.70
BD137	.70
BD138	.70
BD139	.70
BD140	.70
BD235	.65
BD234	.50
BD237	.50
BD262	1.20
BD301	.75
BD302	.75
BD263	1.25
BD435	.75
BD646	1.70
BD647	1.80
BD675	.80
BDV64B	4.50
BDV65B	4.50
BF115	.50
BF173	.70
BF180	.70
BF195	.30
BF198	.30
BF199	.30
BF336	.80
BF337	.80
BF458	.80
BF494	.40
BFX85	.75
BFY50	.90
BFY90	1.30
BSV17	1.00
BU126	3.00
BU208	3.00
BUX80	7.90
FT2955	1.40
FT3055	.75
MEL12	.90
BU326A	3.40
MJ2955	1.00
MJ4032	7.40
MJ802	3.40
MJ4035	6.90
MJ4502	3.70
MJE340	1.20
MJE350	1.70
MJE295	1.90
MJE8055	1.90
MJE3521	.60
MJ15003	5.00
MJ15004	5.00
QF102	.60
MPF131	1.40
MPSA05	.60
MPSA06	.60
MPSA12	.60
MPSA14	.60
MPSA42	.60
MPSA56	.80
MPSA92	.60
MRF475	4.40
TT31B	.90
TI3PIC	1.00
TIP32B	.90
TIP32C	1.00
TIP33A	1.10
TIP34A	1.20
TIP42B	1.50
TIP42B	1.10
TIP110	1.30
TIP120	.90
TIP2955	1.90
TIP3055	1.90
VN88AF	3.90

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MM5369	2.60
5387	8.50
MM5395	6.50
6502	10.50
6508	5.50
6520	5.50
6522	10.00
6532	17.00
6551	17.00
MC6900P	9.00
MC6802	13.60
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6810A	4.90
6820	5.50
6821	6.00
6850	5.15
6852	6.40
7106	12.60
7107	15.00
7210	13.20
Z80 CPU	14.00
Z80A CPU	16.00
Z80 P10	13.80
Z80A P10	16.50
Z80 CTC	13.80
Z80A CTC	16.50
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Z80A S10/0	63.00
Z80A S10/1	63.00
Z80A S10/2	63.00
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INS8050	15.00
INS8080	8.00
P8085	25.00
8155	22.00
8165	22.00
8205	5.00
P8212	4.00
8214	8.00
8216	5.90
8224N	5.50
8224	7.50
8226	5.90
8228	9.50
8238	8.00
8243	8.00
8251	14.00
INS8251	6.50
8253	19.50
8255A	8.60
8257	19.00
8259	15.00
8275	41.00
8279	11.00
8295	25.00
Ay-5-2376	19.56
8748A	29.00
8755A	45.00
MCT2	.80
MCT6	3.30
MCT275	1.50
MCC671	3.00
4N28	.85
4N33	1.20
4N26	.85
MM80C95	.90
80C96	.90
MM80C97	.90
8098	.90

OPTOCOUPLERS

MCT2	1.00
MCT6	3.30
MC275	1.50
MCC671	3.00
4N28	1.00
4N33	1.20
4N26	1.00

VOLTAGE REGULATORS

78L05	.50
LM341P-5	.80
7805	1.00
7905	1.70
LM309K	1.95
7805K	2.10
LM323-K	6.90
78H05KC	8.50
78L12CP	.50
79L12	.90
LM341P12	.75
7812	1.00
7912	1.90
7812KC	2.15
7912KC	2.60
79H12KC	8.00
78L15	.50
79L15	.90
LM341P15	.80
7815	1.00
7915CT	1.80
7915KC	2.60
78H15KC	6.50
78L18	.50
7818	1.40
78L24	.50
79L24	.90
7824	1.10
LM371T	2.40
LM337T	3.80
LM317K	4.50
LM337K	5.90
LM350K	8.40
78HGKC	10.50
78P05	16.50

BRIDGES

VM48	1.50
W02	.60
W04	.60
KHPC02	2.00
KBP602	2.50
KBP604	2.60
KBP606	2.80
KHPC1002	2.60
KBPC1004	3.20
KBPC1006	3.20
MDA3501	4.20
MDA3502	4.20
MDA3504	4.50

DISPLAYS

MAN2A	6.30
MAN72A	2.20
MAN74A	2.20
MAN52A	3.40
MAN82A	3.40
MAN84A	3.40
MAN6740	3.60
MAN8610	3.30
MAN8640	3.30
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How to make things move very fast

Michael N. Kreisler

The macron accelerator may eventually make energy available for use in a wide range of applications, including controlled thermonuclear fusion.

Michael N. Kreisler is Professor of Physics at the University of Massachusetts at Amherst. He received his Ph.D. in high-energy physics particle research from Stanford University in 1966 and was on the faculty at Princeton University before going to the University of Massachusetts in 1972. He has done research on a variety of topics ranging from the rare decays of elementary particles to the study of the hadronic production of interesting objects to the hunt for the fastest particles of all — tachyons (*American Scientist, March 1973*). He has recently been involved with colleagues at both Lawrence Livermore National Laboratory (LLNL) and Los Alamos Scientific Laboratory (LASL) in some of the research leading to this paper. Address: Department of Physics and Astronomy, GRC-Tower C, University of Massachusetts, Amherst, MA 01003, USA.

MANY OF US have been fascinated by the challenge of making objects reach extremely high speeds. That fascination is evident in the glamour of high-performance racing cars and in the continuing popularity of the hero who is 'faster than a speeding bullet'. I would like to review here a growing field in which new techniques are being applied to that enticing challenge and to indicate why such efforts are worthwhile (1).

The problem is not simply one of obtaining high speeds — elementary particle accelerators routinely produce electrons or protons with velocities extremely close to the speed of light. Rather the challenge is to achieve high velocities with macrons — macroscopic bits of matter of the order of a fraction of a gram. The name 'macron accelerator' is used to describe any device designed for that purpose.

The attempt to apply technological advances to this type of problem is not new. The catapult of the ancient Romans could be considered a prototype macron accelerator, and as such it demonstrates that although there are many other uses for such devices (some of which are explained below), there is usually an obvious military application.

The level of technology involved is both high and costly, and a legitimate question is why this particular type of research is worth pursuing. Some very interesting problems can be explored with macron accelerators, among them the study of the physical properties of matter. In collisions of stationary targets with matter travelling at very high speeds, it is possible to produce very high-density, high-temperature material momentarily. We can then determine the equation of state of such material to obtain information important to our understanding of material properties, as, for example, in the study of stellar interiors.

Another incentive is the desire to simulate the effect of micrometeoroids on space vehicles. Although the most probable velocity for a micrometeoroid is about 20 km/sec, the velocity distribution extends upward to several times that speed (2). Being able to study in the laboratory the effects of collisions of such objects with space vehicles would clearly aid design procedures.

There is also the hope that macron accelerators will prove useful in the production of energy (1,3). A projectile with a mass of 0.5 g travelling with a speed of 200 km/sec has a kinetic energy of 10^7 J, or roughly 200 eV, per nucleon. If the projectile is small, of the order of a millimetre, the collision time with a stationary target is approximately 10^{-8} sec. The power in that collision is huge — $\sim 10^{15}$ W — and is sufficient, if the projectile and target are properly designed, to initiate a controlled fusion reaction. Once an accelerator capable of producing speeds necessary to initiate such a reaction can be constructed, we will be within sight of power plants using macron accelerators. It is intriguing to realise that in such power plants the machines responsible for the high-velocity projectile could be removed by some reasonable distance from the furnace in which the thermonuclear reaction would occur. Obviously, the energy produced per reaction would have to exceed that necessary to accelerate the macron.

Figure 1 shows the energies involved in the collisions of high-speed particles with stationary targets as the speed is varied from 1 to 1000 km/sec and beyond. In this range, the average energy per nucleon increases from a small fraction of an electron volt to energies approaching a million electron volts. At the high end of this scale, we would not only be able to produce new, exotic forms of matter as well as energy with controlled thermonuclear reactions, but we would also be able to conduct some tests of special relativity.

Thus there are many reasons to strive for high-velocity macrons. This article will concentrate mainly on the status of attempts to produce a macron accelerator. We set as our goal a device that would allow us to enter the region on the right hand side of Figure 1 — by accelerating a macron of at least a fraction of a gram to a velocity between 100 and 1000 km/sec. In addition, we would like a device which is capable of repeated use and which yields a solid projectile. For these reasons, we will not consider the many interesting results produced with shaped charges and with assorted liquid jets (4).

Accelerating macrons to such velocities is quite difficult. To demonstrate the problem in a naive fashion, consider the case of a simple rocket. The well-known relation for the final velocity, v_f, given a rocket with a constant thrust, is expressed in the formula:

$$v_f = v_{exhaust} \ln \frac{m_i}{m_f}$$

where $v_{exhaust}$ is the velocity of the exhaust, and m_i and m_f are the initial and final masses of the rocket-fuel system. It therefore appears that we can achieve any final velocity, given a large enough mass ratio. Some numbers may be instructive. If we assume that $v_{exhaust}$ is 3 km/sec (approximately 10 times the speed of sound), the logarithm of the mass ratio must be 300 in order to have a final velocity of 1000 km/sec. This implies that to have a final projectile of 1 g:

$$m_i = e^{300}\ \mathrm{g}$$

But e^{300} is a huge number — approximately 2×10^{130}! Since the mass of the earth is only 6×10^{27} g, another approach is clearly necessary. In what follows we consider other techniques — some of which might succeed.

Some acceleration techniques

A technique that has been investigated at some length and that still holds the possibility of attaining the goal of extremely high speeds involves the use of an electrostatic field. In the simplest case, one takes a macron, places as large a charge on it as possible, and then allows it to fall through a large potential difference. The expressions for the acceleration a and the final velocity v_f are

$$a = \frac{Q}{M}E \text{ and } v_f^2 = 2L\frac{Q}{M}E$$

where Q/M is the charge-to-mass ratio for the macron, E is the magnitude of the electric field, and L is the length of the accelerator.

Several problems have limited the success of this technique. The first is a natural limit to the magnitude of Q/M. If Q is negative, the magnitude is limited by the onset of field emission. If Q is positive, the limits are set by the tensile strength of the material, which experiences electrostatic forces trying to tear the projectile apart.

Another problem arises from factors such as interactions with residual gas in a long accelerator, which might cause the Q/M of a projectile to vary during the acceleration cycle. A variation of this sort would play havoc with any acceleration scheme using a travelling wave.

Third, the length of the accelerator needed to obtain high velocities seems to be prohibitively long. One calculation indicates that in a travelling-wave accelerator with $E = 10^4$ V/cm, velocities of 1000 km/sec could be obtained for small particles (having radii of 10^{-4} cm) with a 10 km accelerator [3]. Such prodigious lengths have tended to discourage further investigation. However, with current technology we realise that 10 km is big but not outrageous. Indeed, several elementary-particle accelerators now rival that dimension. For example, the Stanford Linear Accelerator is 3.2 km long, the accelerators at the Fermi National Accelerator Laboratory and at the European Centre for Elementary Particle Research (CERN) are approximately 8 km in circumference, and the proposed large electron-positron facility in Europe (LEP) will be 30 km in circumference. Certainly the dimensions of a macron accelerator should not be an overwhelming argument to discourage active effort.

Among other schemes which have been proposed is a very interesting suggestion, first made by Winterberg[5], which uses a travelling magnetic wave to accelerate a magnetic dipole. Although this technique works, the eddy currents set up in the projectile yield Joule heating (I^2R) sufficient to vaporise the projectile. In order to eliminate this annoying side effect, the projectile is made superconducting. As the superconducting projectile approaches a section of the accelerator, energy stored in large capacitor banks is converted into a magnetic field that accelerates the projectile.

In various forms, this proposed technique has received a reasonable amount of attention. Garwin and co-workers have done detailed analyses of the feasibility of such accelerators [6], and Kolm has constructed similar devices concentrating on large masses [7]. At the Lawrence Livermore Laboratory, a brief engineering study of this technique was made [8]. That study concluded that if in the operation of this device no unusual problems with materials properties arose, an accelerator capable of producing a 0.1 g projectile travelling at 150 km/sec could be built for roughly \$60 million. That accelerator would be 3.2 km long. Once again there seems to be no fundamental reason why such a device could not be constructed.

An obvious naive choice for a device to accelerate a projectile is a gun. Unfortunately, even so-called 'high-speed bullets' are barely moving compared with the velocities under discussion here. The limitation on the velocity of ▶

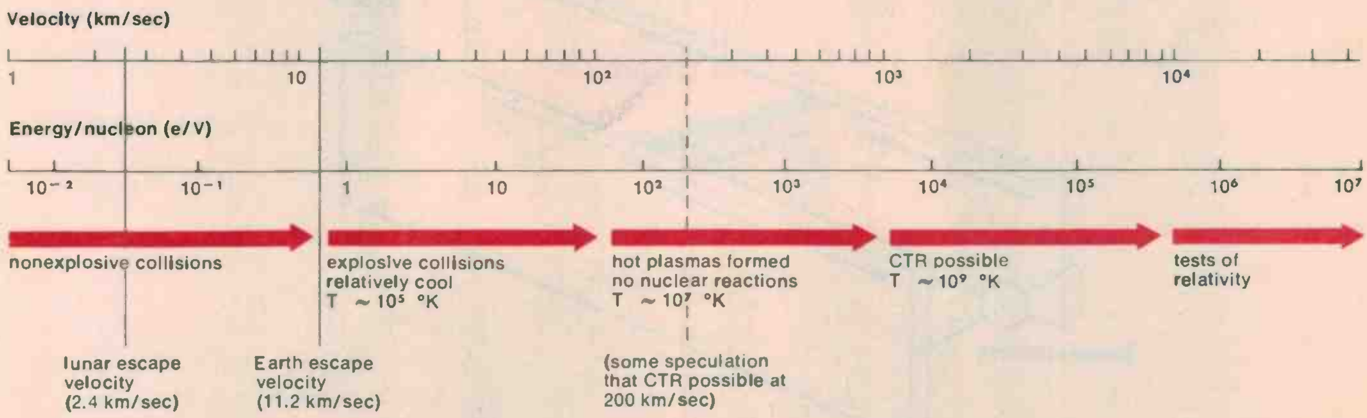

Figure 1. Energies involved in collisions of high-speed particles with stationary targets are shown diagrammatically. As the speed of the projectile increases from 1 to 1000 km/sec and beyond (indicated on the top line), the average energy per nucleon increases from a small fraction of an electron volt to energies approaching a million electron volts (indicated on the second line). Both scales are logarithmic. The phenomena associated with these collision energies and some of the proposed applications are suggested in the descriptions of the collisions at the bottom. Among possibilities at the high end of the scale are controlled thermonuclear reactions and tests of the theory of special relativity.

such bullets can be understood from a simple analysis [9]. In order to get high-velocity projectiles, a very high pressure must be maintained on the projectile for as long a time as possible. The magnitude of the pressure is limited by the strength of the gun barrel itself. The time during which the pressure acts is limited also, regardless of the length of the barrel. As the projectile moves, the driving gas expands to fill the space behind it. This expansion is, of course, limited by the local speed of sound in the gas. When the velocity of the projectile exceeds the local sound velocity, the driving pressure drops rapidly, and any further increases in projectile velocity are very small.

There are many ways to indicate the parameters of this phenomenon, one of the simplest being the following:

$$p/p_0 = e^{-\gamma v/s}$$

where p is the driving pressure, p_0 is the initial pressure, γ is the ratio of specific heats for the driving gas, v is the projectile velocity, and s is the sound velocity. For the case of an ideal gas:

$$s \simeq \left(\frac{kT}{m}\gamma\right)^{1/2}$$

where k is the Boltzmann constant, T is the temperature of the gas, and m is the mass of the gas. Therefore, in order to get the local speed of sound high, it is desirable to go to gases with high temperatures and low atomic numbers. This approach has led to a device known as the two-stage light gas gun.

In the two-stage gun, a first-stage is used to compress and heat a gas in the second stage. This high temperature allows the final velocity of the projectile to reach several times the sonic velocity of the ambient gas. In fact, velocities approaching 5 km/sec have been obtained regularly, allowing accurate equation-of-state measurements [10]. Proposals to improve the performance of these guns include the use of shaped charges to superheat the driving gas and the acceleration of the entire second stage, in addition to the heating and compression. There have even been attempts to modify guns so that additional driving gas is injected at points along the trajectory [4]. Unfortunately, it does not appear that any of these modifications holds the promise of significant increases in projectile velocities. Above 5 km/sec, we have to search for a new method.

The acceleration of small particles using high-power lasers seems to hold great promise. The idea, of course, is quite simple. The end of a target projectile is hit with a high-power laser pulse. A large amount of material is ablated off at supersonic velocities and the remaining mass is accelerated to high velocities.

In order to calculate the velocity, the simple rocket equation suffices (with some problems to be mentioned below). The advantage of this method is that the ablated material is ejected supersonically. Recently, McCann and Degroot performed a calculation that showed the possibility of achieving very high velocities [11]. In their computer simulation, a laser was directed onto a 1 g target. Ninety per cent of the target was ablated in 10^{-3} sec, leaving a projectile of 0.1 g with a kinetic energy of 10^6 J and a velocity of 140 km/sec.

Depending on the power of the incident laser, there are several different types of acceleration mechanisms. These range from simple blasts detonated in the gas above the surface of the projectile to the ablation of the surface to the complete ionisation of the projectile [12]. The laser power required is, of course, quite large (typical efficiencies of conversion of laser power to kinetic energy are about 10%). Great strides have been made in the development of large laser facilities, but limits are set by the material properties of the projectile, primarily the yield strength of its constituent solids.

There is, however, a more serious problem with this technique: the cloud of ablated materials gets in the way of the incident laser light [3,11]. Since we want a target material that will absorb a large fraction of the incident laser energy, it is entirely reasonable that the cloud will absorb the energy as well. At an extreme limit, the incident energy is entirely absorbed by the cloud, and the target vaporises, acquiring little or no velocity in the process.

Two possible solutions suggest themselves. One is to create a pulse along the trajectory. If the laser pulses are directed onto the projectile at widely spaced intervals along its path, the particle can outrun the cloud. Of course, this requires very careful monitoring of the particle position. Such systems should, however, be rather simple to develop.

Multi-layered targets are another possibility. Although the technique is

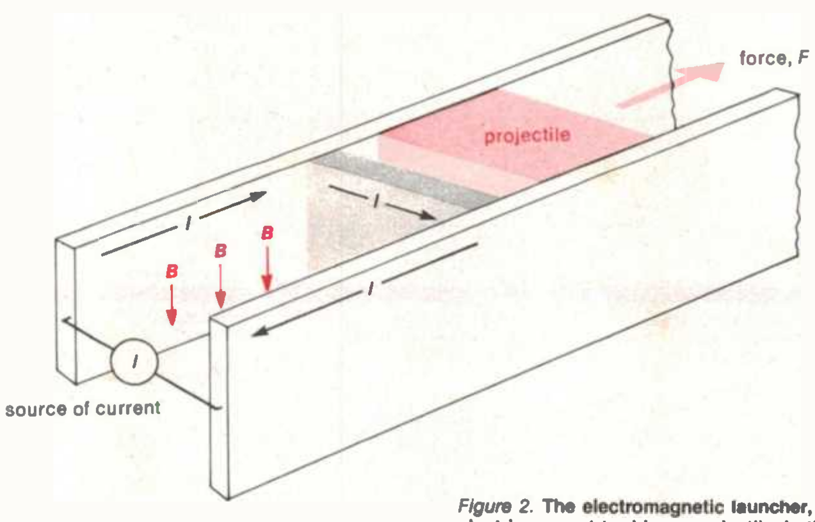

Figure 2. **The electromagnetic launcher, or rail gun, is a device which uses electric current to drive a projectile. In the diagram, the current, *I*, creates a magnetic field, *B*, that in turn acts on the current with an outward force, *F*. The current flows down one of the rails, across a fuselike material on the back of the projectile, and back through the other rail. The large currents are supplied from homopolar generators, capacitor banks, or explosively driven current generators.**

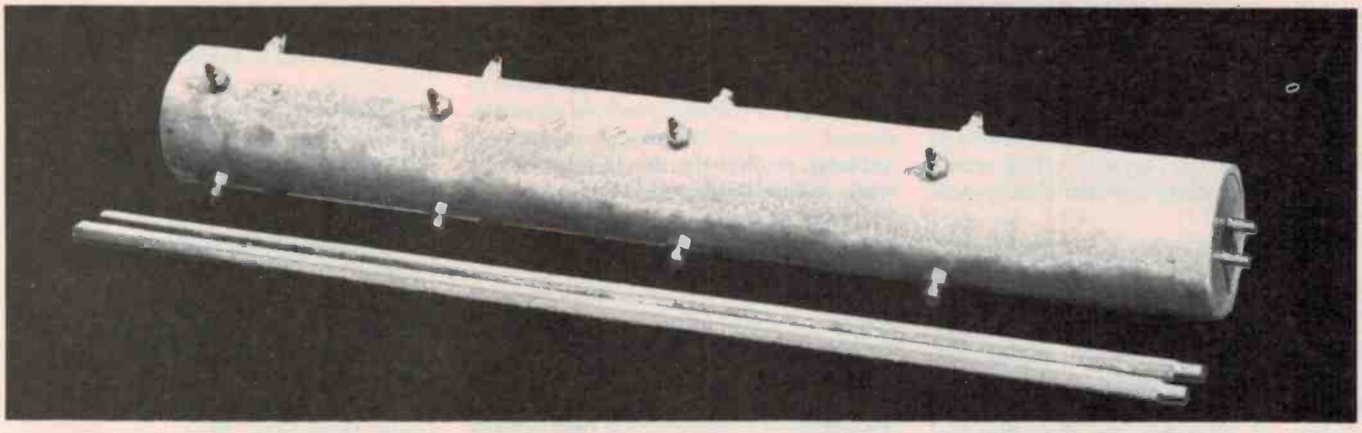

Figure 3. A team of scientists from Lawrence Livermore Laboratory and Los Alamos Scientific Laboratory devised a rail gun with copper rails embedded in a strong casing to reduce the effects of the powerful currents acting on the rails. Input connections to the rails emerge from the right face; alignment and diagnostic ports are visible along the cylinder; rails are shown in the foreground. (Photo courtesy of C.M. Fowler, LASL.)

still speculative, it may prove convenient to use targets constructed of layers of different materials, with driving lasers at different wavelengths. It might be possible for the ablated cloud from the outer layer of the target to be somewhat transparent to the light from the second laser. Obviously, such a scheme is merely a variation on the pulsing technique mentioned above.

Laser ablation acceleration appears promising and is worth a reasonable effort, but it is not easy to obtain time with the large laser facilities. The fact that this method is rather messy makes the situation more difficult, as does the strong competition for the use of high-power lasers, which are in demand for laser implosion studies.

The rail gun

We turn now to an ingenious device — the electromagnetic launcher, or rail gun. This acceleration technique uses the Lorentz force to push a current-carrying element. As can be seen in the diagram in Figure 2, the current, I, that flows in the circuit produces a magnetic field, which in turn acts on the current with an outward force. Since the accelerating force is proportional to the square of the current, obtaining high speeds depends on being able to generate and maintain very large currents. This type of acceleration has been under investigation, with varying degrees of enthusiasm, since 1938 [4]. Interest became quite intense when, in 1978, Rashleigh and Marshall were able to shoot 12.7 mm cubes of LEXAN, a plastic, to velocities of 6 km/sec [13]. The source of energy for their high currents (typically a few hundred thousand amperes) is a homopolar generator, a standard device to convert the mechanical energy of a rotating flywheel into large currents. When the section containing the rails and the projectile is switched into the circuit, the current flows down one of the rails, across a fuse-like material on the back of the projectile, and back through the other rail.

The simplicity of this technique has encouraged a great deal of experimental effort, most notably by a team of scientists from the Lawrence Livermore Laboratory and the Los Alamos Scientific Laboratory [14]. This team has been exploring various aspects of rail-gun technology, ranging from methods of providing high-current pulses to rail manufacture and materials. One of their rail guns is shown in Figure 3. The copper rails are embedded in a strong dielectric container to prevent separation of the rails under the extremely large forces involved.

In the tests done so far, an initial current, provided by a large capacitor bank, yields an initial magnetic field. The region containing the magnetic field is then compressed explosively. In accordance with Lenz's law, this compression causes the current to increase rapidly, thereby greatly increasing the force on the projectile [15]. (An alternative way to understand the operation of this device is to consider it analogous to a gas gun in which the driving gas is the magnetic field. As such, the 'speed of sound' of the driving gas is the speed of light.) In one recent experiment, the rail gun was 1.8 m long, the peak current was nearly 10^6 A, and the peak acceleration was 5×10^6 times the acceleration due to gravity. The LEXAN projectile has a velocity of almost 10 km/sec.

To be sure, this technique, too, is not without difficulties. Problems relating to resistive losses in the rails, rail damage, stresses on the rails, and so forth must be solved before major increases in projectile speed can be obtained. But the technique looks very promising and should certainly provide velocities high enough for new equation-of-state measurements. It may even prove to be a convenient method for launching very small payloads into space. Some people have suggested looking into this technique as the ultimate solution to garbage-disposal problems [19].

New approaches

Several more speculative suggestions have recently been proposed. Before examining them in detail, we mention, in passing, two other techniques. One is acceleration with a charged-particle beam. The projectile is charged, and the beam transfers energy to the projectile. Velocities above 10 km/sec might be possible. The second proposal calls for velocity multiplication. In an elastic collision, a stationary object recoils with a velocity which is the speed of the incident object times an appropriate ratio of masses. This technique is limited by problems related to the strength of materials and the speed of sonic shock waves.

Among the new, speculative approaches which we want to look at in more detail is that involving orbital collisions. Consider an object orbiting Earth in a near-Earth orbit. Elementary physics indicates that the velocity, v, is:

$$v^2 = \frac{GM}{R^2}$$

where G is the gravitational constant, ▶

M is the mass of Earth, and R is the radius of the orbit measured from the centre of Earth — in this case, the radius of Earth. This corresponds to a velocity of 7.9 km/sec. Head-on collisions of two objects in opposite orbits would thus yield a relative velocity on impact of 16 km/sec.

Since the velocity is proportional to $M^{1/2}$, it is appropriate, when trying to improve this technique, to search for larger masses. The obvious choice is the sun. The dependence on radius also indicates that we want to conduct our experiment close to the sun. At the radius of Mercury, we find that the orbital velocity is 47 km/sec, yielding head-on collisions with relative impact velocities of approximately 100 km/sec. In order to get 1000 km/sec, it is necessary to reduce the radius to 1/100 $R_{Mercury}$, which, unfortunately, is inside the sun. Undaunted, we propose finding and using black holes — leaving the problem of finding them to others. But if a black hole with a mass approximately equal to the mass of the sun were discovered, very interesting orbital velocities would exist at radii of 10^6 km. (To be sure, other interesting phenomena would exist as well.)

Tidman and Goldstein have recently suggested a very clever use for imploding plasmas [16]. It is well known that when a hollow annular discharge is initiated, the plasma collapses, or pinches, toward the axis of the discharge. Residual gas is swept ahead of the discharge. If a suitably shaped projectile is squeezed in a succession of such imploding plasmas, there could be a very large acceleration, which is often referred to under the enticing label of 'watermelon pit' acceleration. The effect is similar to the way in which watermelon seeds squirt from wet fingers squeezed together at picnics. Many aspects of this technique would need to be explored, including stability of the projectile, materials and their interaction with the plasmas, and so on. So far, this novel idea looks very promising.

Recently we have been re-examining the use of electrostatic fields as accelerators. It is quite simple to accelerate charged objects. One of the major problems is that the constancy of Q/M is hard to guarantee, and consequently the use of travelling waves may prove difficult. Matching the speed of the travelling wave with that of the particle also presents difficulties, but some of these become less important when we consider the acceleration of the dielectrics. When a dielectric is placed in an electric field, a dipole moment is induced. The particle then feels a force proportional to the square of the magnitude of the electric field.

At first glance, this particular scheme seems very promising, because, for one thing, the acceleration is proportional to the square of the electric-field strength; second, because the dipole moment is induced, so that the use of a travelling wave is facilitated; and, third, because the accelerating force is always pulling the object, so that questions of phase stability are reduced.

However, a few calculations make it apparent that very high fields are necessary to get velocities approaching 1000 km/sec. If the electric field is roughly ϕ/λ, where λ sets the scale of the gradient of the electric field, and ϕ is the electric field, we find that obtaining the required velocities in a 10 km long accelerator implies that ϕ is about 10^7 volts! This approach therefore seems rather hopeless as a way of achieving the maximum velocities.

Some thought is being given to attempts to use the acceleration of dielectrics to obtain intermediate velocities. In such schemes, travelling electric waves provide the acceleration. Even at reduced velocities, serious obstacles remain to be hurdled, including frequency and temperature-dependent dielectric properties.

Finally, Harrison has recently considered the acceleration of needlelike projectiles in strong electric fields [17]. He finds that field emission by the needle provides a self-charging, charge-regulating mechanism. In addition, the charge-to-mass ratio (and therefore the acceleration) is significantly higher than for a spherical projectile. Long projectiles would be ideal test probes when velocities high enough to test special relativity are reached.

Applications

Although I have not presented all the suggestions for macron accelerators, it is clear that meeting the challenge of high speeds is not limited by the availability of ideas. Given the variety of methods being proposed to produce projectiles moving with extremely high speeds, it is appropriate to review some of the possible uses of these devices.

Obviously, any scheme which allows repeated firing of massive objects at very high velocities is of immediate interest to the military. In fact, the railgun principle, or electromagnetic launcher, was used during World War II [4]. Both the Japanese and the Germans are known to have constructed relatively successful electromagnetic weapons. The Japanese device, built to defend a harbour installation in Japan, was reportedly destroyed by the incoming occupation troops. The German weapon, powered by a bank of storage batteries, was capable of firing projectiles weighing about half a kilogram to speeds of 100 m/sec.

The interest by the military in these devices continues today. As the acceleration techniques improve and as the parameters of the system (mass and velocity of projectile, refire rate, ease and accuracy of aiming) surpass those of more conventional weaponary, such interest will, of course, intensify. It should be obvious that extremely high-speed bullets will penetrate almost any shield.

Another possible application is as space launchers. When the projectile speed approaches Earth escape velocity (see Figure 1), it is natural to contemplate using the accelerator to launch objects into orbit or into space. Such thoughts have formed the basis of many science fiction tales, the best known being the Earth-Moon travels described by Jules Verne. Clearly, the ability to launch massive payloads into space without the use of rocketry would benefit the space program. Some macron accelerator workers are concentrating on increasing the size of projectiles once speeds near the escape velocity are reached.

The potential use of such devices as launchers has played an important role in the plans for space colonisation originally put forth by O'Neill [18]. He has proposed using a modification of the travelling magnetic-wave accelerator developed by Kolm [7]. Such devices could be transported to and assembled on celestial bodies such as the Moon or asteroids and used to send huge quantities of rocks and other raw materials to space habitats.

An intriguing, albeit controversial, suggestion involves the use of macron accelerators located near power plants to launch small payloads of radioactive waste into space as a solution to the waste-disposal problem confronting the nuclear power industry. Conventional rocketry is not practical for the purpose, because economic considerations demand a large payload, and a large cargo of radioactive material would present a severe problem in the event of an aborted launch [19].

Meteroid simulation arouses interest, because there is a need for the artificial generation of particles moving at speeds similar to those of meteroids. Although the most probable meteroid velocity is about 20 km/sec, speeds as high as 70 km/sec have been observed [20]. On the basis of this and the mass distribution of meteoroids, researchers are interested in objects up to 1 g in mass with velocities up to 70 km/sec. The availability of such projectiles would allow a better understanding of cratering theories for high-velocity impacts, permit accurate calibration of satellite and rocket-borne cosmic dust detectors, and result in better evaluations of the hazards to manned vehicles in a micrometeoroid environment.[21].

Another extremely useful application involves equation-of-state measurements. When a fast-moving object hits a stationary one, a shock wave, accompanied by very high pressures and temperatures, is generated. Although these conditions exist for only a short time, they are similar to those found in the centres of stars. For example, the collision of two flat plates constructed from tantalum at a relative velocity at impact of 8 km/sec results in a pressure roughly five million times normal atmospheric pressure. Except for underground nuclear explosions, the only hope for studying the behaviour of materials at these pressures in order to learn about stellar interiors is through the use of macron accelerators. Scientists working in this field are anxiously awaiting new developments in high-velocity projectiles. Interest in such high pressures is not limited to the study of material properties. Chemists, for example, want to study reactions and reaction rates at ultra-high pressures.

For many years, various techniques for producing controlled thermonuclear fusion have been suggested and attempted because of the tantalising prospect of an abundant energy source. The process is quite simple. Very small amounts of deuterium and tritium would be fused in a thermonuclear reaction, producing vast quantities of electrical power. It is currently believed that to initiate such a reaction it is necessary to deliver in the order of 10^7 J of energy into a volume of less that 1 cm^3 in a time interval of 10^{-8} sec[8]. In the attempt to produce such conditions, lasers, electron beams, and ion beams have been suggested.

One of the most exciting aspects of macron accelerators is that they provide an alternative approach to this problem. High-velocity projectiles have the requisite energy concentrated into a small volume. If the dimensions of the projectile are kept sufficiently small, the impact with a stationary target implies an exremely rapid energy delivery rate. Current accelerators are still about a factor of ten away from the velocities needed to produce thermonuclear reactions. However, that prospect is extremely inviting and has led to serious consideration of all aspects of impact fusion — the name given to this subfield[1].

Even short of velocities high enough to initiate thermonuclear reactions, macron accelerators might be used as fuel injectors for other fusion devices, such as Tokamaks[9]. Not only could the injector deliver fuel particles at a high rate, but with the proper choice of accelerator, the fuel would not be heated by the injection process.

Clearly the ideas for accelerators are many, and the applications cover just as wide a range. It is an extremely exciting field. ●

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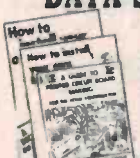

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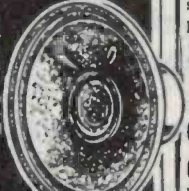

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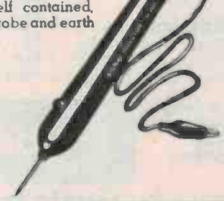

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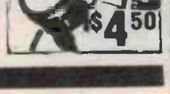

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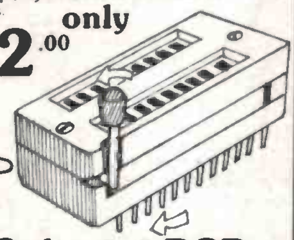

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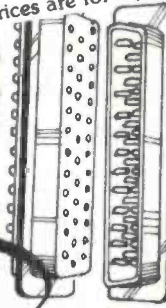

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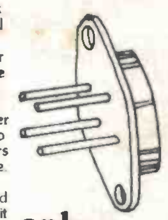

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Light and power from dc supplies

Generating mains-independent light and power from batteries is fraught with many unrealised difficulties. Whether you want dc back-up to operate equipment when the mains goes 'off the air' or a wholly independent 240 Vac supply, you should know the problems up front.

Roger Harrison

THAT'S THE TROUBLE with Electricity Commissions — they've insidiously crept into our lives and made us quite dependent on them. For those occasions when we cannot avail ourselves of their 'services', we have to rely on other sources to provide light and power. The old kerosene pressure lamp has its advantages — and disadvantages — but how on earth do you keep a disk drive running when the ac mains 'browns out'? As storage batteries are ubiquitous, the 12 V car battery in particular, it's natural that we turn to them to provide back-up and mains-independent supplies.

Back-up supplies

For equipment designed to be powered directly from a nominal 12 Vdc source or from either 12 Vdc or 240 Vac, back-up supplies are employed to maintain continuity of supply, the battery being kept charged from the mains, but the battery acts to maintain power supply to the equipment in the event of mains failure. This sort of system is commonly installed with burglar alarms, amateur radio repeaters and geophysical monitoring equipment, for example.

The 'power budget' of such systems is carefully considered to provide maximum service period from the battery supply when mains is unavailable. Hence a single 12 V storage battery — generally a low maintenance type — is employed. Let's learn a bit about lead-acid batteries first.

The fully-charged, no-load terminal voltage of a lead-acid cell is between 2.3-2.4 volts. This drops under load to about 2.0-2.2 volts. When discharged, the cell voltage is typically 1.85 volts. The amp-hour capacity is determined from a 10-hour discharge rate. The current required to discharge the battery to its end-point voltage of 1.85 V/cell is multiplied by this time; e.g: a 40 Ah battery will provide four amps for 10 hours before requiring recharge. Note however that the amp-hour capacity varies with the discharge current. The same battery discharged at a rate of 10 amps will not last four hours; on the other hand if it is discharged at 1 amp it will last somewhat longer than 40 hours. The typical discharge characteristics of a (nominal) 12 V battery are shown in Figure 1.

The ideal initial charging current for the fully discharged battery (cell voltage under 2.0 V) should be about 20 amps per 100 amp-hours of capacity (i.e: 8 amps for a 40 Ah battery). Once the electrolyte begins to gas rapidly, the terminal voltage will be around 13.8 volts and rising rapidly. At this point, the charging current should be reduced to somewhere between 4-8 amps per 100 Ah until charging is complete.

At the end of charging, terminal voltage may rise to about 15.6 volts or more, but this decreases slowly after the charger is removed, the terminal voltage then usually reading around 14.0 to 14.4 volts (see Figure 2).

Back-up supplies are generally of the 'trickle-charge' type or the 'battery condition' sensing type. Two good examples are ETI projects 597 — Emergency Lighting Unit (December 1980) — and 1503 — Intelligent Battery Charger (August 1981). The ETI-597 trickle charges a 12 V battery when the mains is on and provides automatic switchover when the power drops out. It's cheap and simple, but needs to be *used* for the batteries to stay in condition so that they deliver their rated capacity when

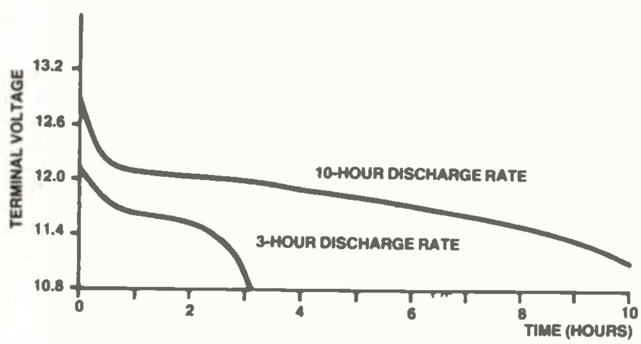


Figure 1. Typical discharge characteristics of a 12 V (nominal) lead-acid battery.

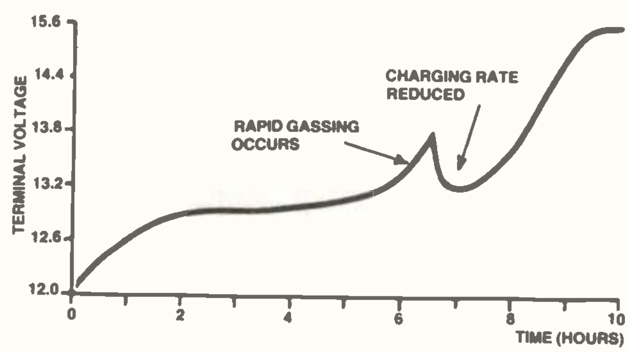


Figure 2. Charging characteristics of a 12 V (nominal) lead-acid battery. The 'kink' in the curve near six hours is explained in the text.

needed. Back-up supplies of this sort are only practical where the load on the supply is not too heavy — generally 20 W or so.

To drive a heavier load, upwards of 50 W for example, it's best to power the equipment from the battery *all the time* and have a charger which senses the battery terminal voltage, charging the battery when the terminal voltage falls to a preset level and turning off when the terminal voltage rises to the desired operating level again. This is what the ETI-1503 does. There is a slight element of luck involved as to how charged the battery will be at any one time, but the lower limit is usually set so that the equipment will operate for a specified period. The ETI-1503 can be used with batteries with a capacity up to 100 Ah. Such a battery can drive a 10 A load at the 10-hour discharge rate — which effectively means it's a good back-up supply for equipment with a power budget of up to 120 W mean consumption. This means that actual consumption can be greater than that from time to time provided that consumption falls below the mean level for an equivalent period. An amateur VHF or UHF repeater is a good example. Whilst 'listening' only — no stations active on the input channel — consumption is quite low. When 'activated' by a station or stations, the repeater spends most of its time transmitting, and consumption can be four to ten times that during inactive periods, depending on the power output of the transmitter employed in the repeater.

As stated earlier, the major consideration with back-up supplies is the power budget of the equipment being supplied. If you anticipate the necessity of operating the equipment for periods exceeding, say, eight hours, then a battery of adequate ampere-hour capacity needs to be used. It is always prudent to choose a battery with 20-50% more capacity than strictly necessary.

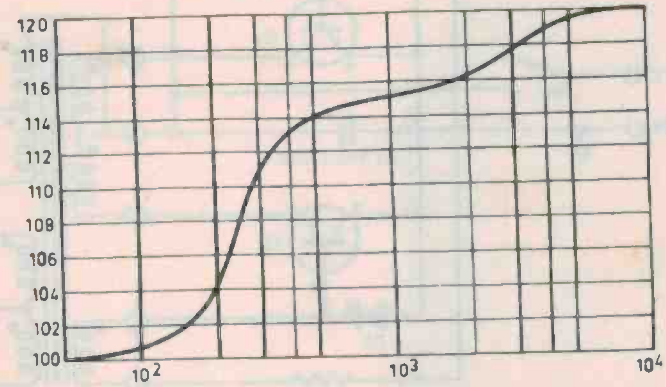


Figure 3. **The light output of a fluorescent tube increases with increasing supply frequency in the manner shown in this graph. The property is exploited in dc-ac square wave inverters for lighting.**

dc-ac inverters

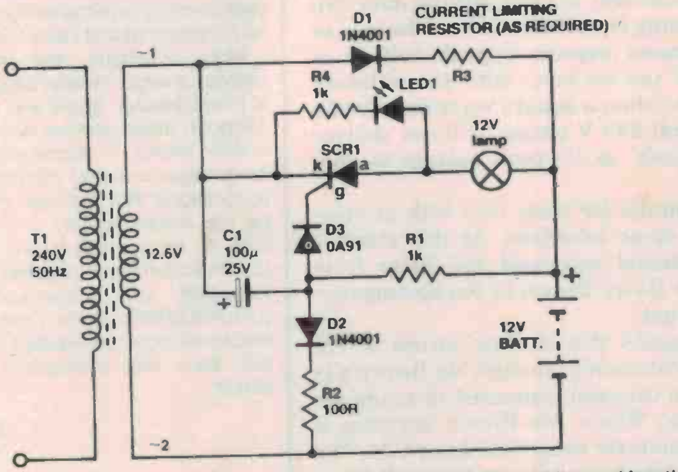
Like storage batteries, 240 Vac mains-operated equipment is ubiquitous! The huge variety of products have been designed to be *convenient*, thus making themselves *necessary*. Or so it seems. Why on earth anyone would want to take an electric razor on a camping expedition and expect to power it from an ersatz 240 Vac supply is beyond this writer — but then I haven't had a shave in more than 15 years except when my appendix was removed and then they didn't shave my face!

There are two common approaches to providing 50 Hz ac power for mains operated appliances: provide square wave drive of the appropriate amplitude, or derive a sinewave (or pseudo sinewave) supply of appropriate amplitude. Both are fraught with hidden difficulties. If you want any substantial amount of power output — like 200 W — you're in hot water — and probably unable to boil a billy, to boot!

A square wave dc-ac inverter has the advantage of simplicity and efficiency — depending somewhat on the design. Inverters generally take two forms: *self-excited*, usually employing a feedback winding on the transformer, and *driven*, where an oscillator drives a switching circuit, generally with transformer output. Where the precise frequency of the ac output is unimportant, self-excited inverters are employed. Where a stable 50 Hz output is required, a driven inverter is necessary.

Lighting is one area where self-excited dc-ac inverters find application. The common tungsten filament incandescent light globe is a poor choice for lighting where a dc supply is employed. They have an efficiency of less than a fifth of that of a fluorescent light of the same power rating — viz: around 12 lumens/watt for the tungsten filament lamp versus better than 60 lumens/watt for a fluorescent tube. A 20 W fluorescent tube would provide as much light output as a 100 W incandescent globe! Those figures are based on 50 Hz ac supply. Fluorescent tubes *actually improve in efficiency* when driven from a higher frequency supply. Figure 3 shows how the light output of a fluorescent tube increases with increasing supply frequency. Driving the tube from a supply frequency of 10 kHz or more will result in a 20% increase in light output.

The circuit of a self-excited inverter driving a fluorescent tube is shown in Figure 4. This is taken from Project ETI-516 of November 1972. It ran at around 2 kHz and employed a ferrite-cored transformer. Consumption was 2.5 amps. An incandescent globe to pro- ▶



Circuit of the ETI-597 'Emergency Lighting Unit', a simple back-up supply that can be used for other than lighting applications.

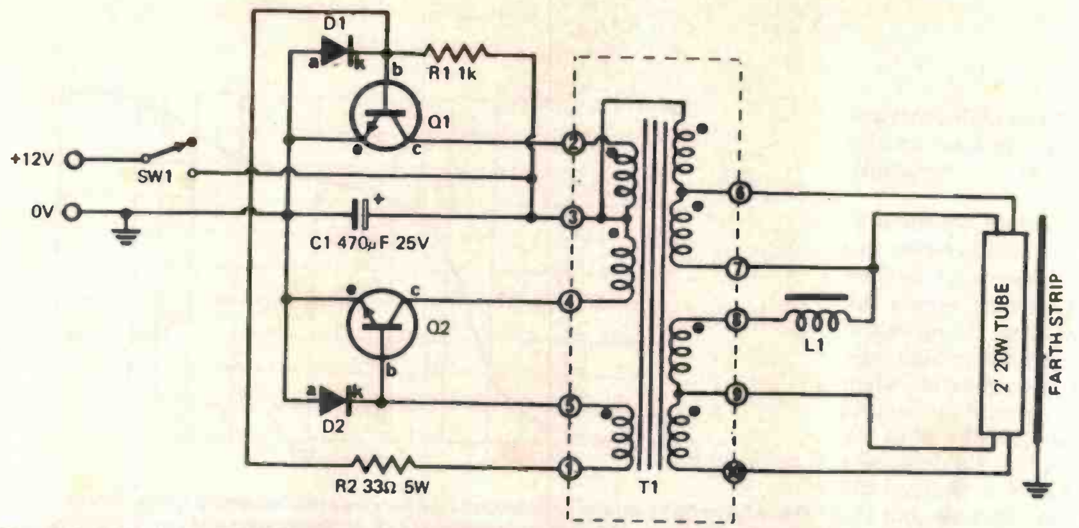


Figure 4. ETI project 516 (Nov. '72!) employed a self-excited dc-ac square wave inverter operating at 2 kHz to drive a 20 W fluorescent tube — an efficient solution to providing light from a dc supply.

vide a similar light output would draw around 10 amps! Such inverters have one drawback — the transformer core 'sings' owing to the magnetostrictive forces on the core pieces (which generally come in two pieces). That can be solved in two ways — put the inverter in a 'soundproof' box or operate the inverter at a frequency above audibility. The first solution was employed with the ETI-516 inverter, but is inevitably only partially successful (though often acceptable). The second solution will be described next month in Project ETI-1505.

When it comes to powering 240 Vac-operated equipment or appliances a number of considerations have to be looked at. First, will the equipment operate from a square wave supply? Many appliances employing an ac or ac/dc motor will operate quite happily from a square wave supply. One of ETI's correspondents employed battery back-up for his computer's disk drives, supplying these with 240 V, 50 Hz square wave ac from a driven inverter. The general arrangement is shown in Figure 5. A 100 Hz oscillator drives a flip-flop, which drives a pair of HEXFETs connected in push-pull across the secondary of a toroidal transformer. Battery supply was 24 V. The transformer is operated 'back-to-front' here, where input is applied to the secondary and the load connected across the primary. Toroidal transformers perform much better in this application than conventional types as core losses are lower and primary-to-secondary coupling is generally better. Some losses are involved, the saturation voltage of the HEXFETs generally being the greatest source. Hence the use of a 20-0-20 V winding and not a 24-0-24 V winding.

The saturation voltage loss in switching devices driving a transformer is an important consideration. One or two volts lost from a 24 V supply represents only about 4% to 8% loss, but at 12 V it's twice that! Any further losses only magnify the problem.

A square wave ac supply is inherently rich in harmonics. These can play havoc with audio and digital equipment and it's often difficult to suppress interference generated by the supply. Then again, some equipment — particularly anything containing a transformer and rectifier, will produce entirely different performance from when it's operated from a sine wave supply. The problem arises because the peak and RMS values of a square wave are the same, whereas the peak/RMS ratio for a sinewave is 1.414. To deliver the same *work value* as a sine wave supply, the peak output voltage of a square wave dc-ac inverter is generally set at 240 V. When driving a motor or resistive load, the square wave supply will deliver the same amount of power as a sine wave supply; i.e: the same amount of *work* will be done (all else being equal). But, where the load or equipment expects a peak voltage of 340 V (as we have with the ordinary mains), then a square wave supply of a nominal 240 V output will not 'deliver the goods' as its peak voltage is only 240 V.

So much for that; let's look at sine-wave dc-ac inverters. At this stage, I recommend you read the letter from reader Barry Brown in the accompanying panel.

Requests of a similar nature arrive quite commonly, though Mr Brown's is a little unusual compared to many we receive. Where Mr Brown suggests a dc-ac inverter to operate from a 24 V or 32 V supply, many readers ask for a

Dear Sir,

Despite the financial burden of component costs for an ever-expanding range of new projects, please find enclosed my cheque for subscription renewal. Would you consider a three-to-six-month moratorium on new projects to enable those of us who are more enthusiastic about starting the new than finishing the old to clear some of the backlog?

No?

Well, to an area with possibly more appeal — that of small domestic power supplies. With most homesteads using 32 Vdc power for lighting and almost all travellers using 24 or 12 Vdc power, a stable inverter producing 240 Vac at 50 Hz in the 500 W-1 kW range could be of enormous benefit to many people. With an increasing range of domestic electronic equipment becoming available, the only way for many people to enjoy these products is to crank over the, if available, 240 V diesel generator. This is great stuff during the day, especially with auto-start, but can be a bit distressing when you discover that your evening music selection is really a duo for harpsichord and Lister Diesel.

More ambitious, and probably a lot heavier: a larger inverter capable of starting a fridge/freezer would win many friends. Although these devices may have considerable losses in conversion, there are advantages in using converters for many applications. Not the least of these would be the lifetime supply of European carp likely to be donated by the Darling River United Naturalists Kangaroo Appreciation, Research and Development Society (DRUNKARDS). Such a society, although unformed, could be initiated at the drop of a cold tinny after publication of a suitable circuit.

Barry Brown,
Young NSW.

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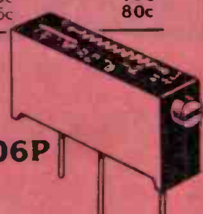

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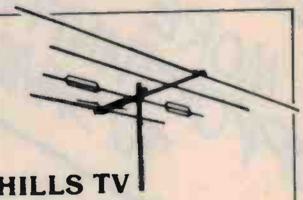

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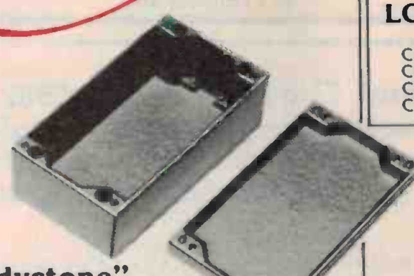

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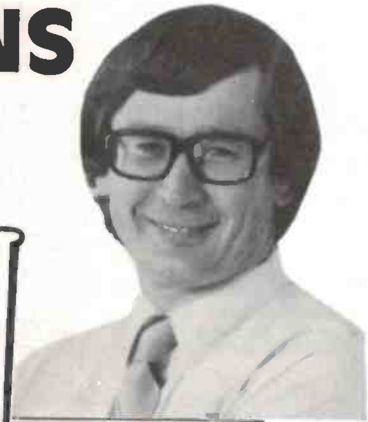

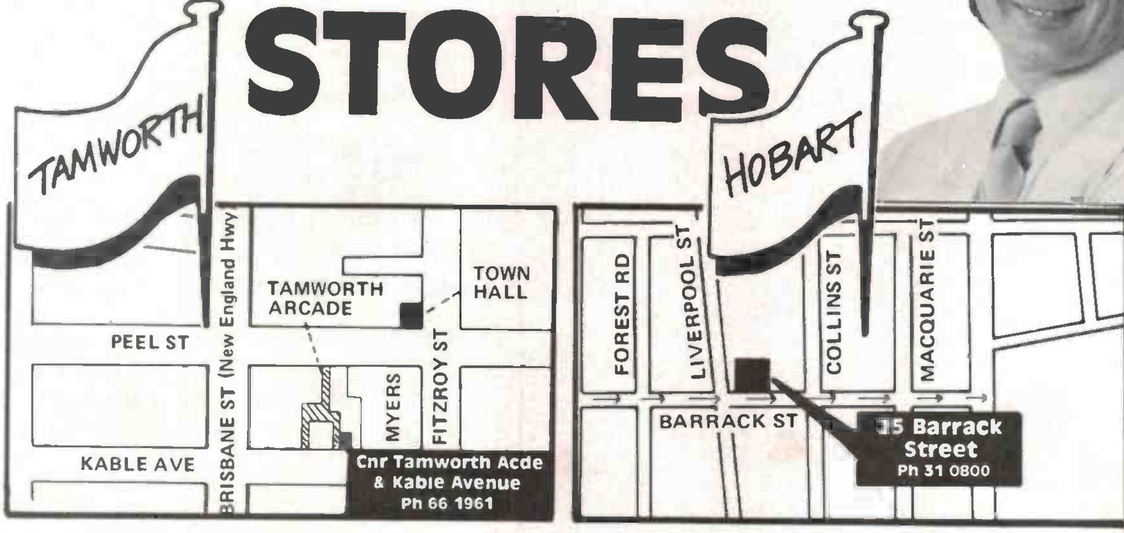

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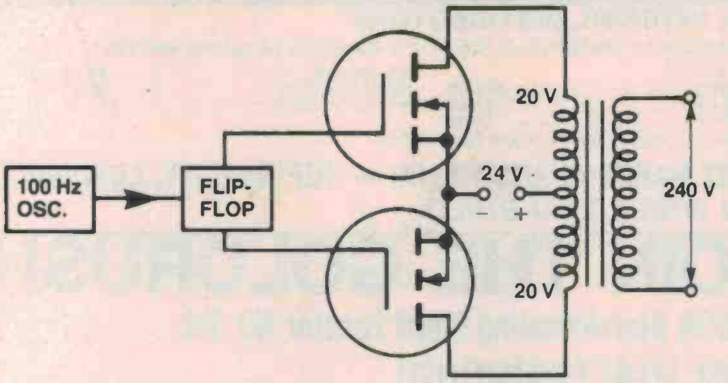


Figure 5. **Example of a 'driven' dc-ac square wave inverter with nominal 240 Vac output. This technique has been employed by one of our correspondents as a computer back-up supply.**

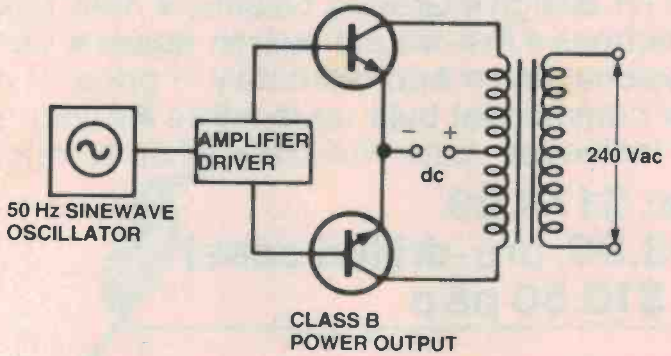


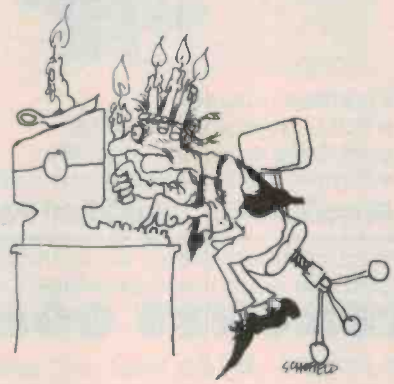
Figure 6. **Class B driven sinewave inverter technique for providing 240 Vac from a dc supply.**

1 kW or similarly rated inverter to run from a 12 V battery. The latter is impractical, for the following reasons.

Consider this: a sinewave dc-ac inverter needs to be of the driven type. Hence it generally consists of an oscillator driving a class B power amplifier — usually a push-pull type. The theoretical maximum efficiency obtainable with a class B power amplifier is 78%. With losses and power consumption of drive circuitry taken into account the dc power input to ac power output efficiency of an inverter of this type is generally around 65-70%. Thus a 1 kW dc-ac inverter to run from a 12 V battery *would draw in excess of 120 amps* at full load! Few batteries available would supply that sort of current for long. With currents of that magnitude, special arrangements have to be made for primary circuit conductors. A resistance of 5 milliohms (0.005 ohms) will result in a power loss of more than 70 watts. Then again, special consideration has to be given to heat dissipation in the power output stage. The devices used would dissipate something over 400 W at peak load. No load dissipation would probably be in the vicinity of 40-50 W, which is no mean amount to get rid of.

Apart from the weight of a heatsink, consider the weight of a 1 kVA (or 1000 W) transformer (assuming a single transformer is used). We'll leave the expense to your imagination.

The problems are reduced somewhat when a much higher dc supply voltage is available. However, in the latter case other techniques of dc to ac conversion present themselves — but that should be the subject of another article as it's a whole new ballgame.



Where a 12 V battery supply only is available, there is a practical limit to the maximum power of a dc-ac inverter, and that's probably around 300 W output. At typical efficiencies, the dc input power is around 450 W, or close to 35-40 amps current from the battery.

As you would already appreciate, this brings its own special problems. A battery to supply that sort of power for any appreciable or worthwhile period would need to have a considerable ampere-hour capacity. Your typical 40-60 Ah car battery would barely deliver an hour's worth of power. If the inverter is installed within the vehicle, or close by, and you are willing to keep the engine running during operation, then the battery will deliver the goods for quite a period, provided you can 'set' the throttle to suit so that battery charge is maintained. At this stage, I might point out that an alternator coupled to the motor would provide a more efficient energy conversion.

To gain, say, four to six hours of operation for a 300 W inverter, you would need a battery system of more than 200 Ah capacity.

A more practicable power level for a sinewave dc-ac inverter would be around 120 W. Such an inverter would pull 12 to 15 amps from the battery, a much more manageable figure.

Having seen the primary side of the problem, let's consider the secondary side — the load. How many appliances do you have rated at less than 300 watts? Very few. The humble electric kettle is rated from 1 kW to 2.4 kW. Monochrome TV sets, particularly portables, may only consume 100 W, but a colour TV may draw three times that or more. A 'low power' (say, 30 W/ch.) domestic hi-fi will draw around 100 W, depending on how much equipment is in use and how loud you like it. Anything more ambitious has a proportionately larger consumption. A 300 W dc-ac inverter is best considered where the full output is only required intermittently.

Conclusion

As can be seen, many factors have to be taken into account when considering obtaining light and power from a battery supply — whether it be in a back-up application, for lighting or 240 Vac substitution. The ubiquitous 12 V battery is not up to the job in some instances — in which case higher voltage dc systems are better considered.●

Lab Notes

"For members only . . ." — the exclusive OR gate

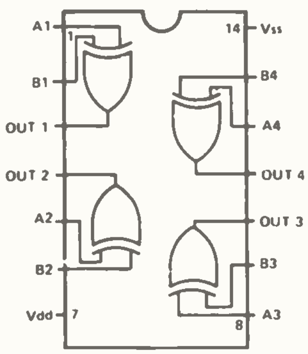
The 4070B quad EX-OR gate is one of the least known but most useful members of the commonly available family of CMOS quad two-input gate ICs. The device's gates can readily be used as programmable (inverting or non-inverting) pulse amplifiers, phase comparators, free-running or gated astables, or multi-bit magnitude checkers, etc. Pretty good for a cheap chip!

Ray Marston

THE OUTLINE and pin notations of the 4070B are shown in Figure 1, together with the truth table for each of the EX-OR gates in the package. The most important point to note here is that the output goes high only (EXclusively) if a logic 1 is applied to only one of the inputs (A OR B). The output takes a logic 0 state if identical inputs are applied to both inputs.

Figure 2 shows how individual gates can be used as programmable pulse amplifiers. With the connections shown in Figure 2a, the circuit functions as an inverting amplifier. In Figure 2b the amplifier acts in the non-inverting mode, while the Figure 2c circuit shows the connections for making a switch-programmable amplifier.

The EX-OR programmable amplifier can be used as the basis of a so-called scrambler system of the type used on security telephones, etc, by using the basic circuit shown in Figure 3. Here, in



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

1 OF 4 GATES

Figure 1. **Pin notations, outline and truth table of the 4070B quad two-input EX-OR gate.**

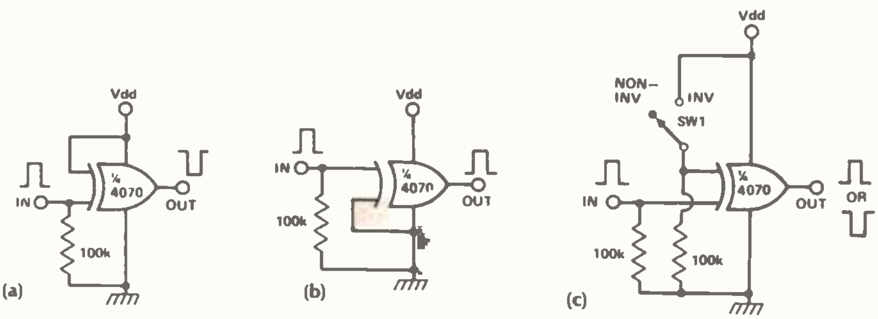


Figure 2. **The EX-OR gate can be used as an a) inverting, b) non-inverting, or c) switch programmable pulse amplifier.**

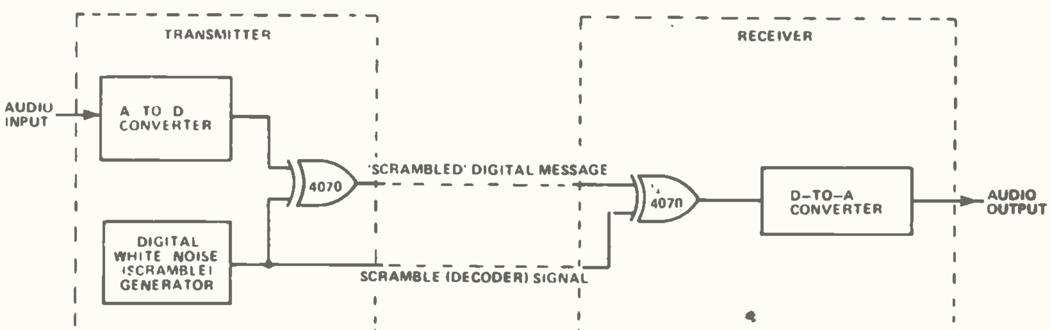


Figure 3. **Basic circuit of an audio (telephone, etc.) scrambler system.**

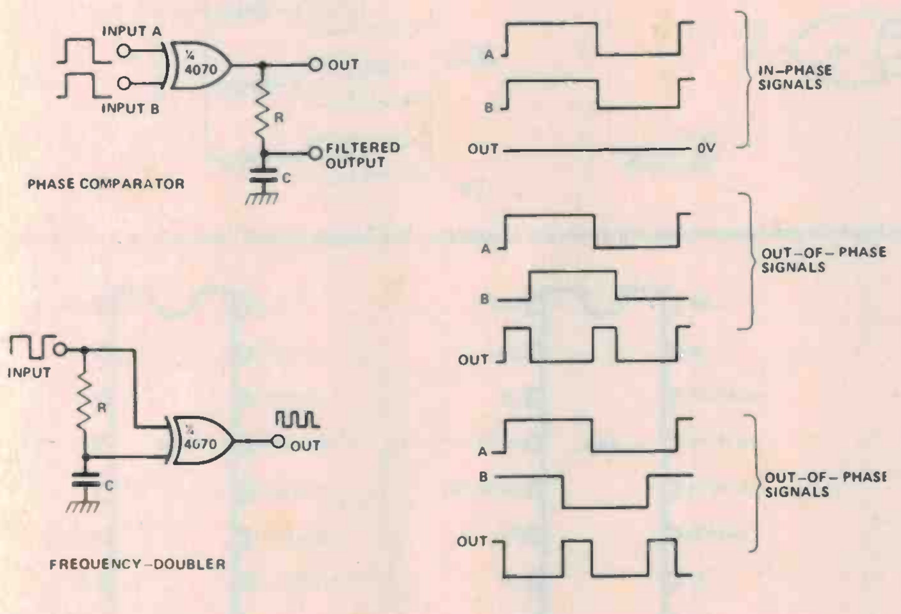


Figure 4. **An EX-OR gate can be used as both a phase comparator and a frequency doubler. Typical waveforms for the phase comparator circuit are shown on the right.**

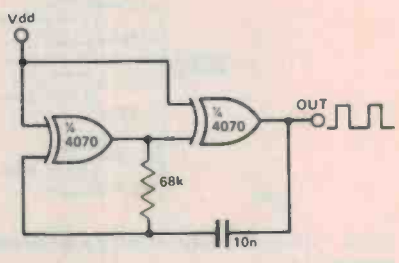


Figure 5. **A 1kHz EX-OR astable.**

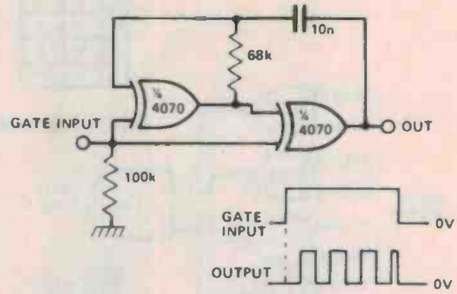


Figure 6. **A gated 1 kHz EX-OR astable.**

the transmitter, the audio signal is converted to digital form by an A-to-D converter and fed to one input of the EX-OR gate, while the other input is fed from a digital white noise or 'scramble' signal. The output of the EX-OR gate is thus inverted or non-inverted in a random manner and cannot readily be deciphered.

Both the scrambled message and the scramble signal are sent out (on separate lines) from the transmitter. At the receiver, the two signals are picked up and fed to the two inputs of a second EX-OR gate, where the digital analogue signal is restored (unscrambled) to its original form (the simple principle here is that if both gates are either inverted or non-inverted, the net effect will be an overall non-inversion of the signal). The restored digital signal is then converted back to analogue form by a D-to-A converter. Neat.

More circuits

Figure 4 shows ways of using an EX-OR gate as a digital phase comparator and as a frequency doubler. The two circuits use the same basic principle of operation, so let's look at the phase comparator first. The comparator is meant to be fed with digital (ideally, square wave) signals that are identical in form and frequency but which may differ in relative phase. A digital signal is available directly at the output of the gate, or a dc signal may be available from an R-C low-pass output filter.

From the circuit waveforms, you can see that if both input signals are precisely in phase the two inputs will always be identical and the output will be zero. If, on the other hand, the two signals are not in phase, the output switches high at those points in the waveform where the two inputs are in opposite logic states. This situation occurs twice in each input cycle, so the output signal is frequency doubled. The pulse width of the output signal and thus the mean dc output levels of both the gate and the low-pass filter are directly proportional to the magnitude of the phase difference between the two input signals. The level is low with a small phase difference, rises to a maximum at 180° difference and then reduces again as the phase difference is shifted from 180° towards 360°.

From the above, it is easy to see how the Figure 4 frequency doubling circuit works. The digital input signal is fed directly to the 'A' input terminal of the EX-OR gate but is fed to the 'B' terminal through the phase-shifting network formed by R-C; the resulting phase-shift implements the frequency doubler action.

Figure 5 shows how a pair of EX-OR gates can be used to make a 1 kHz astable multivibrator or square wave generator. The circuit operates as a standard CMOS astable, the two gates being made to function as pulse inverters by taking one of their two inputs high.

Figure 6 shows how to modify the above circuit so that it functions as a gated 1 kHz astable circuit. Useful features of this design are that it uses a logic 1 (high) gate signal and its output goes to the logic 0 (zero) state when the astable is gated off.

Magnitude comparators

We've already seen that the output of an EX-OR gate goes low if its two inputs are identical, or high if the inputs differ. The device can thus be used to compare a pair of digital bits, or a number of gates can be used to compare the magnitudes of a pair of multi-bit digital words. Figure 7 shows how a 4070B can be used to compare two four-bit words and give a high output if the two words are not identical. In Figure 7a, the ▶

Lab Notes

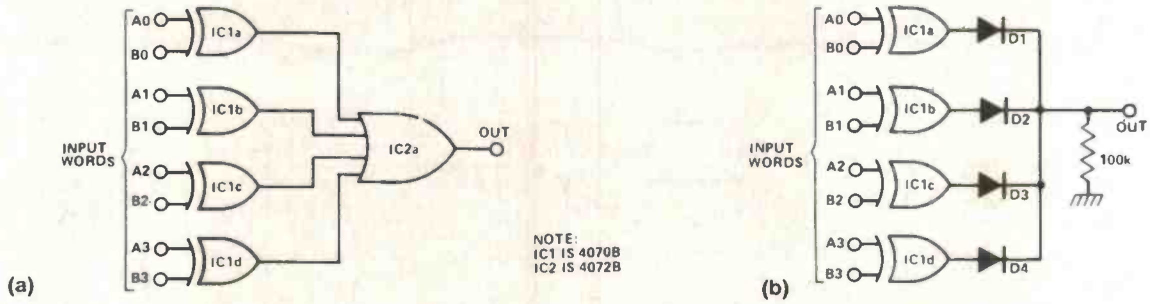


Figure 7. **Alternative ways of using a 4070B and a four-input OR gate to make a four-bit two-word comparator. The outputs go high if the two input words are not identical.**

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

4077B TRUTH TABLE

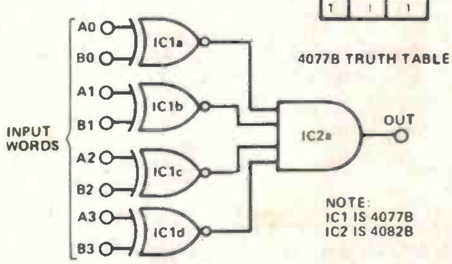


Figure 8. **Method of using 4077B EX-NOR gates to make a four-bit two-word comparator that gives a high output if the two input words are identical.**

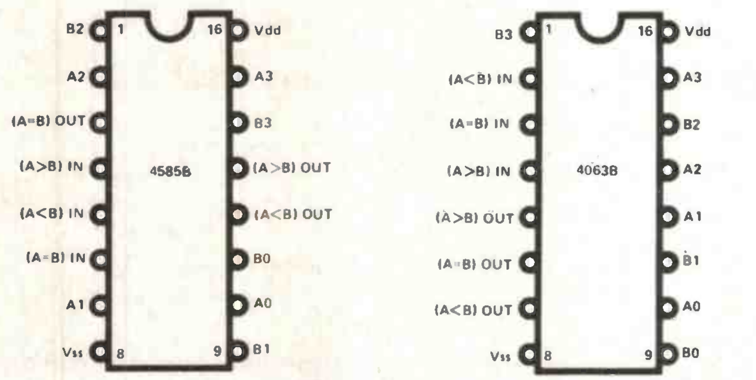


Figure 9. **The 4585B and the 4063B are four-bit magnitude comparator ICs.**

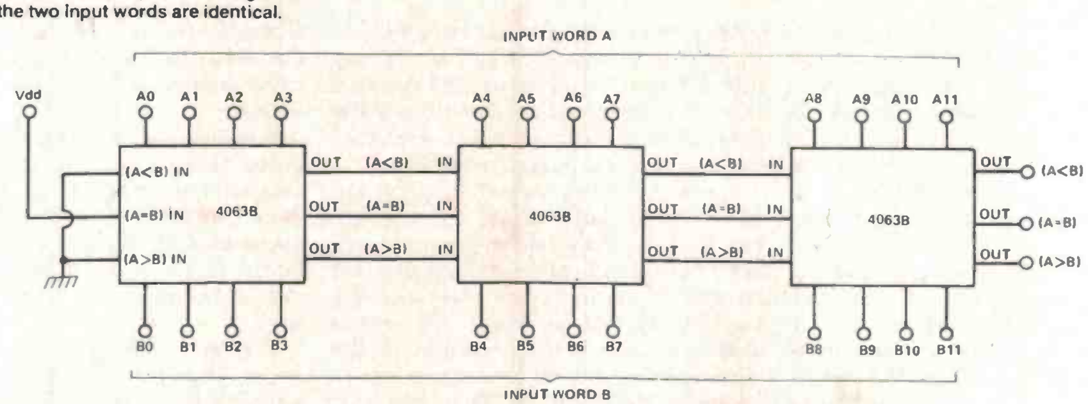


Figure 10. **Method of cascading three 4063Bs to make a 12-bit two-word comparator.**

outputs of the four EX-OR gates are ORed by one half of a 4072 dual four-input OR gate. In the Figure 7b circuit the outputs are ORed by a four-input diode gate.

An opposite action, in which the output goes high if the two words are identical, can be obtained by replacing the 4070B with a 4077B EX-NOR IC and ANDing the outputs by one half of 4082B, as shown in Figure 8. The 4077B has the same outline and pin notations as the 4070B.

The two magnitude comparator circuits described above are quite inexpensive and, clearly, are not particularly sophisticated. If a more sophisticated magnitude comparator performance is required, special chips such as the 4063B or 4585B four-bit magnitude comparators can be used. Figure 9 shows the outlines and pin notations of these two CMOS devices. Note that these chips have three outputs, one going high if the two words are identical, one if the 'A' word is greater than the 'B' word, and the remaining output going high if the 'A' word is less than the 'B' word. Obviously, only the one output can be high at any given time.

A useful feature of the 4063B and 4585B comparators is that they can readily be cascaded to compare words of any desired 'bit' length. Figure 10, for example, shows the basic connections for making a 12-bit comparator, using three cascaded ICs. When using these comparators, either singly or in cascade, note that the cascading inputs of the least significant comparator are connected as follows: (A<B) and (A>B) are biased low, and (A=B) is biased high. ●

How to get into robotics without boiling your brain cells or breaking the bank

In this third part of the Turtle robot project, we give final instructions on getting the beast up and running, plus some hints on programming and interfacing.

Allan Branch

Flexible Systems, Hobart, Tasmania

Part 3

HAVING completed the construction, you're ready for an initial test. At this stage you will need to buy, beg, borrow or build a suitable 12 V power supply capable of delivering up to about 2 A. The panel on page 48 describes a power supply you can build. Many of the parts can be found in the average hobbyist's or workshop's 'junkbox'.

If you don't wish to go to the trouble of building a supply, a mains CB rig supply makes an excellent alternative. The vast majority of these deliver about 12.5 V or 13.8 V at up to 2 A and cost between $40 and $50.

Turtle test

For this initial test you will need a 25-pin socket, the above-mentioned power supply, a length of figure-eight flex with one lead marked, a 'jumper' lead and a multimeter. Solder one end of the figure-eight flex to the 25-pin socket — the marked lead designates the 0 V line and it should be soldered to pins 12-13 of the 25-pin socket; the other lead is the +12 V line — solder it to pins 1-2 of the 25-pin socket. Having done that, plug the 25-pin socket into the plug on the dome of the Turtle and connect the free end of the figure-eight flex to the power supply — watch the polarity: *marked lead to 0 V, unmarked lead to positive.*

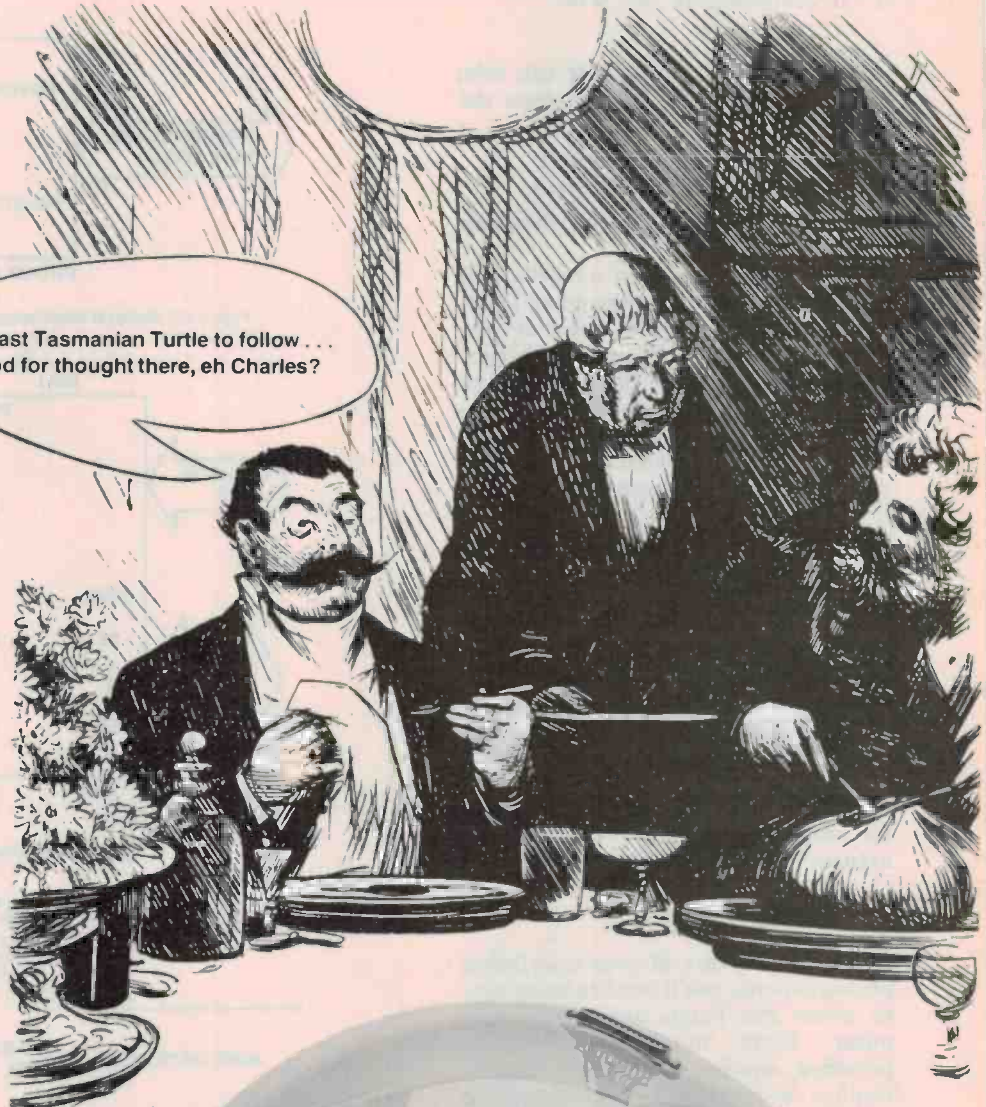
Hold your breath . . . and switch on. The pen solenoid should operate immediately and the LED on the control board should light. If the LED lights but the solenoid does not operate, give the pen clamp a tap as the plunger in the solenoid may be a little stiff at first. If you don't get the expected results at this stage, switch off and go over your wiring.

If all is well, try operating the microswitch bump sensors in turn. The corresponding LED on the inner disc should light up when you operate each microswitch. If not, switch off and check your wiring. If the wrong LED lights up when you actuate a microswitch, then you have either the LED or the micro-switch wiring incorrect.

Next, take a jumper lead. Connect one end to +12 V and touch the other end on pin 18. This is the LAMP INPUT and the two green lamps should light. If they don't, a wiring check is necessary. If, or when, all is OK, next connect the free end of the jumper lead to pin 19, the PEN INPUT. The solenoid should release immediately and retract when you take the jumper off the pin. When the solenoid is operated, the current drawn from the supply should be about 1.4 A, dropping to about 0.8 A when it is not operated. OK? Next connect the free end of the jumper lead to pin 20. This will turn on the HORN. Bridge pins 20 and 21 with the free end of the jumper

ETI-645 SPECIFICATIONS TASMAN TURTLE ROBOT (minimum version)

Dimensions	385 mm diameter 180 mm height	Input functions	Left motor direction Left motor toggle (drive) Right motor direction Right motor toggle (drive) Lamps (on/off) Pen (draw/not draw) Horn (on/off) Horn (low pitch/high pitch)
Weight	2.5 kg		
Drive	Left and right stepper motors		
Power requirement	12 Vdc (nominal) 1.5 A (max.)		
Load capacity	4.5 kg	Output functions	Left bump sensor Right bump sensor Front bump sensor Rear bump sensor
Pulling force	500 grams (max.)		
Negotiable incline	15°		



lead and the horn pitch should go up in frequency.

You can test the motor drives by momentarily touching the free end of the jumper lead first to pin 14, when the left motor should 'jump', then to pin 16, when the right motor should jump.

Last of all, you can check the SENSOR outputs. Using your multimeter switched to a convenient range to read 12 V, connect the negative lead to 0 V and the positive lead to each sensor output pin on the 25-pin socket in turn. You should read 12 V on each pin. Operate the appropriate microswitch and the voltage should drop to zero. Make sure the appropriate microswitch corresponds with each of the sensor pins tested. If not, or if you don't obtain the required indications, check your wiring.

That's about all you can do for an initial test; the final performance comes when you have interfaced the Turtle to your computer and get some software up and running.

INTERFACING — general details

As computers vary widely in the manner they can be arranged to communicate with 'the outside world', we can only give general interfacing information at this stage and we will have to leave you to sort out the individual details of how you interface your Turtle to your particular computer. ▶

An input/output controller can take on many forms, but it *must have* the following two characteristics:

(a) the output must be latched;
(b) the input must be tri-stated.

The general arrangement is shown in Figure 24.

There are a number of methods that can be employed to implement an interface and there are quite a few devices available to assist. One of the better-known devices is the 6821 peripheral interface adaptor. This has two completely separate 8-bit I/O ports — PA and PB — and four control lines, two per port. Figure 25 shows general details of how a 6821 could be employed as an interface between a computer and the Turtle.

Another method is to employ a pair of tri-state buffers, as illustrated in Figure 26. This employs a 74LS367 hex buffer/driver for the four Turtle output bits and a 74LS244 octal buffer for the eight Turtle input bits, plus a little extra logic for address and read/write decoding.

We'll get down to some specific circuits for particular computers in follow-up articles*.

Drivers' manual

Having taken care of your interfacing arrangements, you'll need to know how to 'drive' the Turtle using your computer. Eight input functions are provided, and four output functions — that's a lot more than the average car! At the moment, you're at a standstill.

The first thing that is important to know is how to move the Turtle. This is very easy to accomplish, even for beginners in programming, and surprisingly requires very little memory space. In conventional programming the largest part of the software is more often than not dedicated to producing the screen display. Making graphics uses lots of RAM. With the Turtle none of this is needed because there is now a real-world or physical representation of what you need. There is no point setting up a simulated robot on the screen and a complex obstacle course when you have a Tasman Turtle and a kitchen (office/garage/workshop). Very interesting programs will use only about 20 lines of BASIC.

**Flexible Systems can provide ready-built interface boards and details on interfacing to particular computers. Turtle owners and potential Turtle owners should write to them for further details — Ed.*

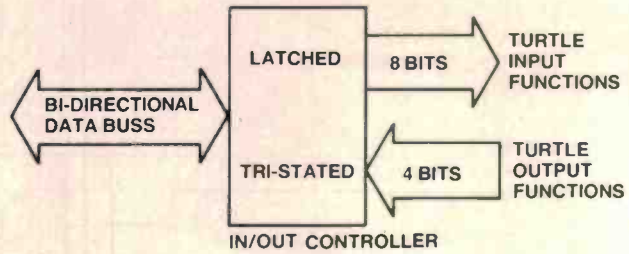


Figure 24. General Interfacing arrangements for the Turtle.

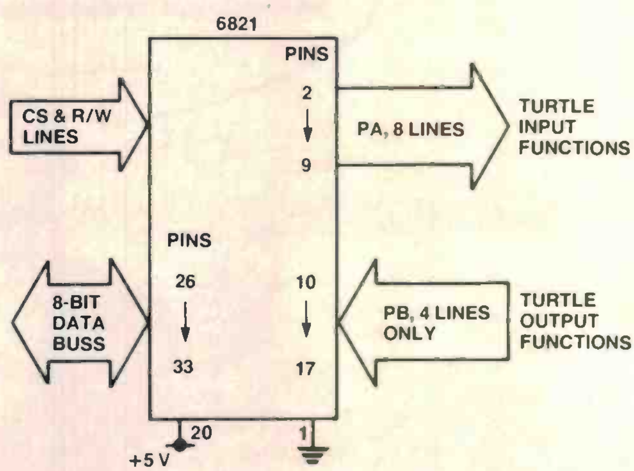


Figure 25. Interfacing via a 6821 PIA.

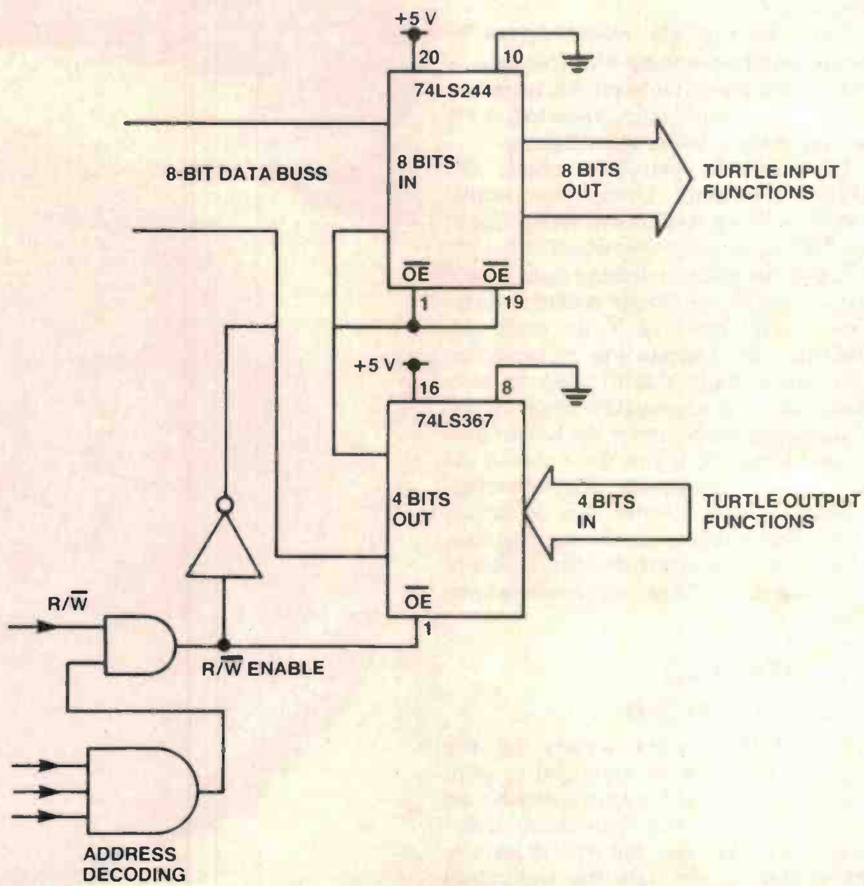


Figure 26. Interfacing using buffer/drivers.

Understanding how to control the Turtle requires an understanding of the robot's 'control line' — that is, its control cable from the computer. If the minimum Turtle is thought of as the skeleton and the muscles or body, and the computer as the brain, then it is easy to see that the pair become an exceedingly powerful combination, limited only by your imagination.

The Turtle's control cable has eight separate control functions, or 'nerves' if the anthropomorphism is maintained. These are dedicated to the following uses:

Table 1

1	Motors
2	Motors
3	Motors
4	Motors
5	Lamps
6	Pen
7	Horn
8	Tone

We will discuss the motors soon, but the last four functions are the easiest to start with. The eight Turtle functions are each controlled by one of the eight data buss lines.

Table 2

Function	Name	Data Line	Binary Value
1	LMT	D0	1
2	LMS	D1	2
3	RMT	D2	4
4	RMS	D3	8
5	LAMP	D4	16
6	PEN	D5	32
7	HORN	D6	64
8	TONE	D7	128

Suppose your Turtle occupies part of the computer memory space at address W. More will be discussed about this when we get to specifics on interfacing, but it is sufficient to say here that W will have a value between 0 and 65 536. On some computers W may be negative numbers in the same range.

To operate the Lamp simply requires that the binary value for the Lamp function, which is 16, be sent to the Turtle (at address W). This will be either POKE W, 16 or OUT W, 16, depending on the type of computer. For those of you lucky enough to have the language LOGO, the instruction to turn on the lamp is simply 'LAMP ON'.

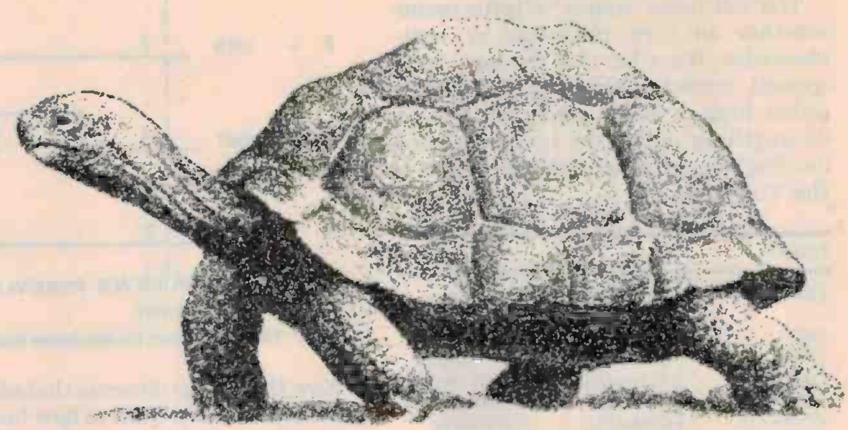
Similarly, the Pen or Horn can be turned on by:

POKE W, 32 or POKE W, 64

respectively.

To turn them off again simply requires:

POKE W, 0



The Horn Tone control is operated by:

POKE W, 192

This is not a mistake, as the tables below show.

Table 3

Function No.	Name	Action
7	HORN	ON/OFF
8	TONE	HIGH/LOW

Table 3a

TRUTH TABLE

7	8	Result	Binary
Off	Off	Nil	0
Off	On	Nil	128
On	Off	Low	64
On	On	High	192 (128+64)

The Horn function simply turns the horn on or off. Whether it is high or low in pitch when it is turned on depends on the value of the Tone function *at the same time*. That is, the horn has to be turned on (binary value 64) and at the same time, if you want the pitch to be high, the Tone function must be turned on (binary value 128), hence:

POKE W, 192 puts the horn on high pitch, and

POKE W, 64 puts the horn on low pitch.

Some of you will have already seen what to do if, for instance, the Lamp and the Pen were required to be on together. The instruction would be POKE W, 48, since the value for the PEN is 32 and the value for the LAMP is 16. In fact for any combination of functions, the instruction must use the sum of the binary values for each function.

Motor control

The motors used in the Tasman Turtle are stepper motors. This gives the robot great precision, but requires that certain programming requirements are taken into account before the robot can be made to move.

Stepper motors require pulses to be sent to them. In the Turtle these pulses are generated by software for two special reasons:

1. The speed can be controlled;
2. The program can do other tasks between pulses, such as sense the microswitches.

Luckily, all the difficult tasks, such as phasing and rotating the pulses, are done by electronics in the Turtle, so the programmer has a relatively simple job left to do.

If the list of motor functions is looked at again it will be seen that there are four motor commands:

LMT, LMS, RMT, RMS.

Table 4

Function No.	Command	Meaning
1	LMT	Left Motor Toggle (pulses)
2	LMS	Left Motor Set (direction)
3	RMT	Right Motor Toggle
4	RMS	Right Motor Set.

Those of you familiar with information theory will see that with four bits of the data line, there should be 16 ($2^4 = 16$) possible combinations of motor movements. In fact there are only nine. There are two motors and each motor can have three conditions ($3^2 = 9$). This is perhaps a waste of bits! Where are the other combinations? We shall see shortly. ▶

Project 645

The 'Set Input' simply tells the motor whether to turn clockwise or anti-clockwise. It's a bit like the horn tone control, since the horn tone can be set either high or low in pitch, but doesn't do anything unless the horn is turned on. The thing that turns the motors on is the 'Toggle Input'.

Table 5

Left motor	Right motor	Action
OFF	OFF	OFF
OFF	FORWARD	LEFT WHEEL
OFF	BACKWARD	RIGHT WHEEL
FORWARD	OFF	RIGHT WHEEL
FORWARD	FORWARD	FORWARD
FORWARD	BACKWARD	RIGHT
BACKWARD	OFF	LEFT WHEEL
BACKWARD	FORWARD	LEFT

The next thing to consider before actually seeing the programming is the effect of each motor. For the Turtle to move forward (for example), it can be seen from looking at the beast that the right motor must move clockwise and the left motor must move anti-clockwise. If both motors turn in the same direction, say *clockwise,* then the Turtle will turn *left*.

Now, to generate pulses from the software for the stepper motors is quite simple. For the left motor we determine LMS to be high or low for whatever direction we want the motor to turn in and we then set up a loop where LMT is made alternatively high then low:

```
10 POKE W, 1          10 POKE W, 3
20 POKE W, 0    or    20 POKE W, 2
30 GOTO 10            30 GOTO 10
```

To move the right motor:

```
POKE W, 4        POKE W, 12
POKE W, C   or   POKE W, 8
```

To move both motors:

```
POKE W, 5
POKE W, 0    etc.
```

To see what is happening, let us look at a timing diagram of the first four data lines (Figure 27). The list below shows what combinations of numbers give what directions of movement.

Table 6

MOTION		A	B
FORWARD		8	13
BACK		2	7
LEFT		10	15
RIGHT		0	5
RIGHT WHEEL		0	1
	or	0	4
LEFT WHEEL		2	3
	or	8	12

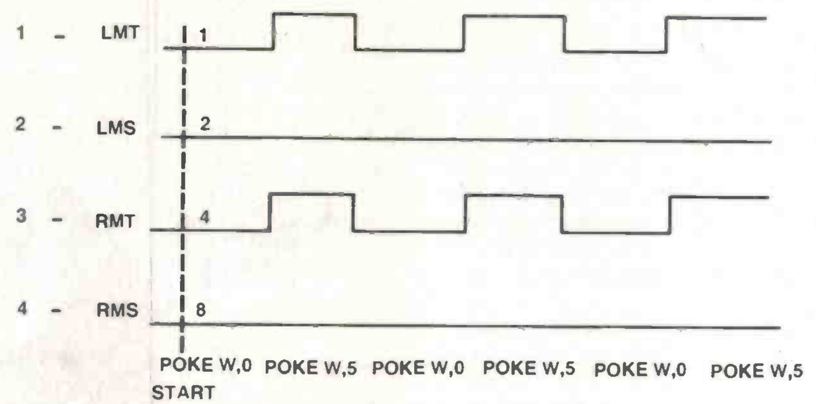
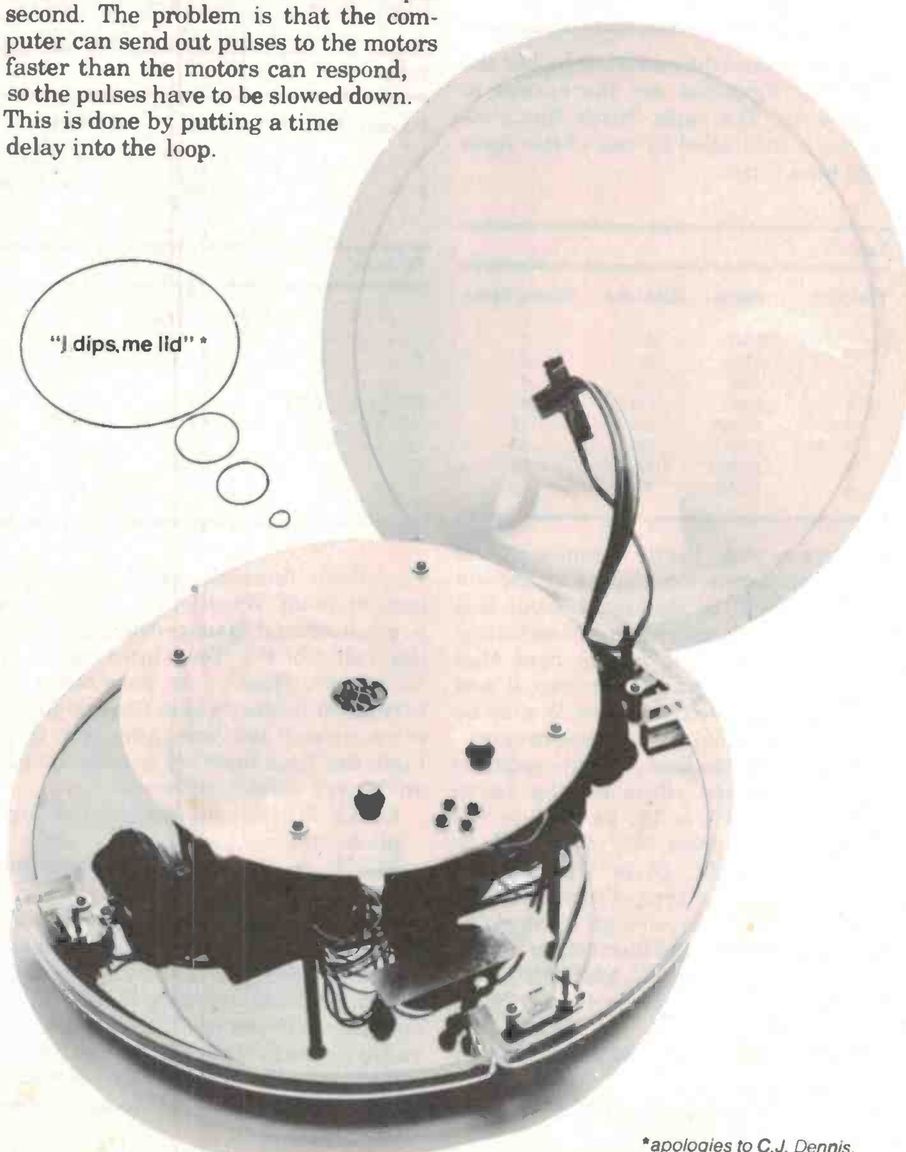


Figure 27. Timing diagram for the motor lines.

Now the next problem is that all stepper motors have a limit to how fast they can rotate, which is much less than for ordinary dc motors. For the Tasman Turtle it is about 100 pulses per second. Since the motors have a step angle of 7.5° (48 steps per revolution) this amounts to about two revolutions per second. The problem is that the computer can send out pulses to the motors faster than the motors can respond, so the pulses have to be slowed down. This is done by putting a time delay into the loop.

```
10  POKE W, A
20  GOSUB 100
30  POKE W, B
40  GOSUB 100
50  GOTO 10
100 FOR T = 1 TO TT
110 NEXT T
120 RETURN
```

▶



*apologies to C.J. Dennis, from 'The Sentimental Bloke'.

SPECIAL OFFER

TASMAN TURTLE ROBOT KIT

EXCLUSIVE TO ETI READERS

Special Offer Price:
$349.00
(tax exempt: $297.00)
plus $6 post and handling (inc. registration).

This product has never previously been offered as a kit and would normally retail for around $600.

OFFER CLOSES 30 JULY 1982

Here is a not-to-be-missed opportunity to get started in robotics. For minimum cost this kit will provide you with the basic equipment to construct a robot which can be driven by remote control, electronic hand control or under computer control. Called the 'Minimum Turtle Kit', it has been put together by Flexible Systems of Hobart, Tasmania, manufacturers of the Tasman Turtle (see Printout, page 82, February ETI). Using this kit as a start you can develop a sophisticated robot capable of a huge variety of tasks.

The complete Minimum Turtle Kit comes ready for assembly according to the construction description published in ETI, packed in a box which has been designed so that the Turtle may be housed or stored in it after assembly.

HOW TO PURCHASE A MINIMUM TURTLE KIT

Fill out the coupon here and include a cheque or money order for a total of $355. Make out the cheque or money order to 'Flexible Systems, Turtle Kit Offer', and post it, together with the coupon, to:

ETI/Turtle Robot Kit Offer
ETI Magazine
15 Boundary St
Rushcutters Bay NSW 2011

The orders will be processed by ETI and, on clearance of the cheque or money order by Flexible Systems, the kit will be despatched directly to you by ETI via registered post.

Alternatively: You may call in to ETI's Sydney or Melbourne offices at the addresses given below and purchase a Minimum Turtle Kit for $349. A demonstration kit and/or model will be available for inspection during this offer.

Sydney: ETI, 4th Floor
15 Boundary St
Rushcutters Bay

Melbourne: Murray Publishers, 22nd Floor
150 Lonsdale St
Melbourne

Tax exemption: For schools, TAFEs, etc. this kit can be purchased at the tax exempt price only if the coupon is accompanied by a signed order and a tax exemption declaration.

NOTE: This offer is made by Flexible Systems in co-operation with ETI Magazine. ETI is acting as a clearing and despatch agent for orders. All mail orders will be despatched by registered post. Please allow four to six weeks for delivery.
Note that the offer expires 30 July 1982.

DEMONSTRATIONS: see the Turtle — live!

Sydney: at ETI's office, 4:30 — 6:00 pm, Monday to Thursday.
Apple II computer supplied for demonstrations courtesy Imagineering Pty Ltd.

Melbourne: at city office, by appointment.
Apple II computer supplied for demonstrations courtesy Computer Country Pty Ltd.

WHAT YOU CAN DO WITH IT

You can use your Minimum Turtle to experiment with many aspects of robotics by interfacing it with a computer: draw figures under program command, solve mazes, make measurements, identify objects, etc, etc. It can be driven via a cable or a remote control. The Minimum Turtle has been designed so that a wide variety of add-on projects may be included to increase the sophistication as you desire.

THE MINIMUM TURTLE KIT CONTAINS:

- **All hardware (base, nuts and bolts, perspex dome, 'touch' ring, pen solenoid, speaker, etc)**
- **All mechanical parts (wheels, gears, axles, two stepper motors, etc)**
- **'Standard Turtle' electronic control pc board and components**
- **All wire and cable for internal wiring**
- **A 25-pin plug for bidirectional data buss, control lines and power supply connections**
- **Comprehensive instruction manual**

*Tasman Turtle is a registered trademark of Flexible Systems.

COUPON

Please supply .... Minimum Turtle Kit(s)
I enclose $ .... plus $6 each postage (inc. registration).
TOTAL $ ....
Name ....
Address ....
.... Postcode ....
Cheque or Money Order No ....
Signature ....
(please allow four to six weeks for delivery)

By varying the value of TT, the speed can be controlled.

To move a certain number of steps (each step is about a millimetre), a FOR-NEXT loop is used. N determines the distance the Turtle will move:

```
For I = 1 to N
POKE W, A
GOSUB 100
POKE W, B
GOSUB 100
NEXT I
```

If any other function is required while the Turtle is moving, simply add its value to A and B.

Output (sensor) functions

The Turtle sends back information from its touch sensors when the PEEK statement is used (on INP). If the Turtle is not touching something then PEEK (R) = 255, where R is the Turtle's address for reading. Otherwise, PEEK (R) will have one of the following values:

Table 7

	L	R	F	B
L	254			
R	252	253		
F	250	249	251	
B	246	245	243	247

LFB	—	242
RFB	—	241
LFR	—	248
LBR	—	244
LBFR	—	240

It is easy to make the Turtle decide which direction to move using IF-THEN statements, e.g:

```
If PEEK (R) = 255 then RETURN
If PEEK (R) = 254 then A = 5 : B = 0
etc.
```

Note that the time delays required for the stepper motor pulses can be achieved by using PEEK instructions, e.g:

```
10 FOR I = 1 TO N
20 POKE W, A
30 IF PEEK (R) <> 255 THEN GOTO
   100
40 POKE W, B
50 IF PEEK (R) <> 255 THEN GOTO
   100
60 NEXT I
100 S = PEEK (R)
110 IF S = 254 THEN A =      :
    B =      : RETURN
120 IF S = 253 THEN A =      :
    B =      : RETURN
130 IF S = 251 THEN A =      :
    B =      : RETURN
140 IF S = 247 THEN A =      :
    B =      : RETURN
150 RETURN
```

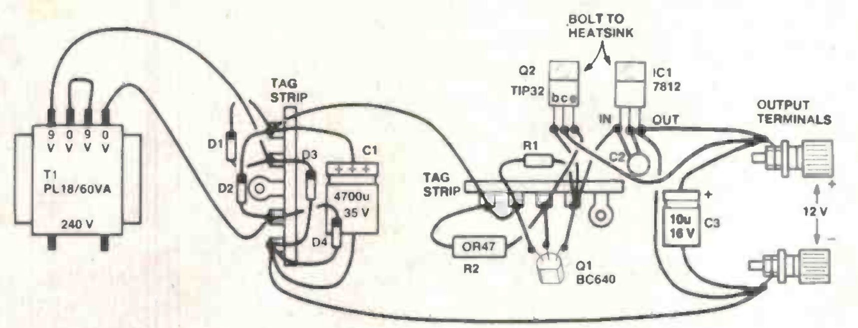
Don't forget the PRINT statement:

```
If PEEK (R) = 254 THEN PRINT
"BACKSWITCH"
```

Also, A can equal B:

```
IF PEEK (R) < 255
THEN A = 192:B = 192: RETURN
```

▶



POWER FOR THE TURTLE

The Tasman Turtle requires a supply of nominally 12 V at up to 2 A, which leaves plenty of current 'headroom' for later additions, as the 'minimum' Turtle only draws about 1.2 A.

PROTECTED SUPPLY

If you're a dyed-in-the-wool experimenter and plan to attach accessories of your own to the minimum Turtle, then this supply will provide over-current protection in the event you do something foolish during installation or in the course of an experiment.

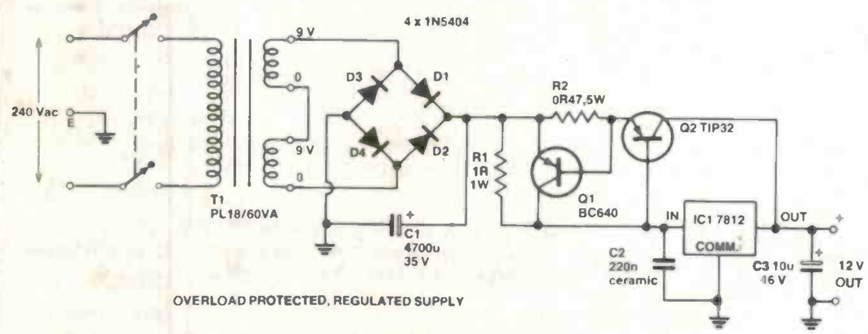
The diagrams show the circuit and suggested construction. A capacitor-input bridge rectifier is used, delivering about 25 V across C1. Output at the terminals is regulated 12 V. IC1 provides up to 1 A of the output current, and the series-pass transistor, Q2, provides a further 1 A or so of the output current. Fold-back over-current protection is provided by means of Q1. When the load current exceeds about 2.3 A, the voltage drop across R2 rises to about 0.6 V, turning Q1 on. The collector of Q1 then 'robs' Q2 of base current, turning Q2 off, and as IC1 cannot supply any further current it drops the output voltage. The output drops to near zero at a load current of about 2.5 A. Thus if you get a short circuit in the Turtle or some circuit attempts to draw too much current, your supply protects the wiring and circuitry from possible damage.

It is suggested the supply be built in a sturdy plastic case such as the Arlec PC1. The rear panel of this case is metal, which allows IC1 and Q2 to be mounted to it, providing some heatsinking. A suitable heatsink should be secured to the panel rear. Both devices should be insulated from the panel by suitable insulating washers. Smear the washers both sides with heatsink compound before installation. Don't forget to insulate the bolts securing the tags of IC1 and Q2.

PROTECTED SUPPLY — PARTS LIST

T1 — PL18/60VA
D1-D4 — 1N5404, 1N5408, 1N5625, A14P or similar
C1 — 4700u/35 V electrolytic
C2 — 220n ceramic
C3 — 10u/16 V electrolytic
R1 — 1R,1 W
R2 — 0R47,5 W wirewound
IC1 — 7812
Q1 — BC640
Q2 — TIP32

Two terminals (one red, one black); 240 Vac rated toggle switch; mains cable and clamp grommet; sturdy case (e.g: Arlec PC1); two tagstrips; wire etc. Estimated cost — $38 — $42



OVERLOAD PROTECTED, REGULATED SUPPLY

DEMONSTRATIONS!

See the Turtle strut its stuff!

Yes folks, it's an amazing sight. A Tasman Turtle toddling along, beeping, bumping and flashing, obeying the every whim of a devious computer program.

You can see the Turtle in live action at our Sydney and Melbourne offices — a not-to-be-repeated exhibition. If you're interested in purchasing a Turtle kit (or kits) and would like to *caveat emptor* (roughly translated: 'don't go into a cave unless it's empty'), then we'd only be too happy to show the beast in action. You can purchase kits on the spot if you wish.

The demonstrations have been arranged with the kind co-operation of Imagineering in Sydney and Computer Country in Melbourne, who have supplied Apple II computers, and Machine Dynamics of Victoria, who supplied interface cards.

HOW, WHO, WHERE?

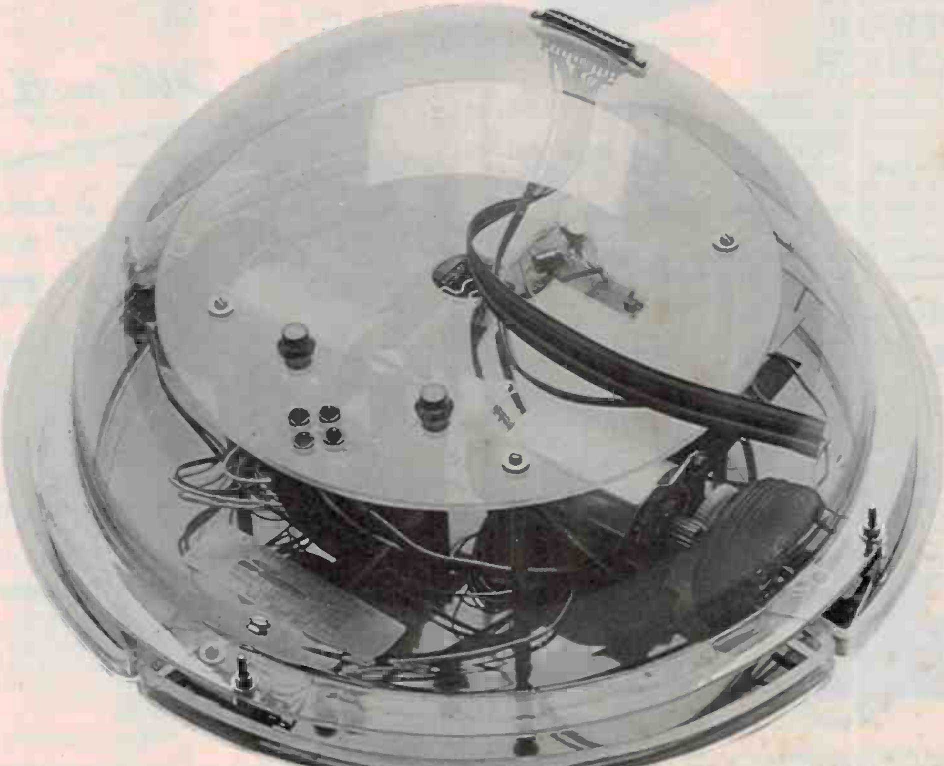
In Sydney: ETI, 4th Floor, 15 Boundary St, Rushcutters Bay. (02)268-9015.
Monday to Thursday each week, 4:30 to 6:00 pm

Apple II computer used for demonstration kindly supplied by Imagineering Pty Ltd, 22 Sir John Young Crescent, Woolloomooloo.

In Melbourne: Murray Publishers, 22nd Floor, 150 Lonsdale St, Melbourne.
By appointment, phone Virginia Salmon (02)662-1222.

Apple II computer used for demonstration kindly supplied by Computer Country Pty Ltd, 338 Queen St, Melbourne.

Interface cards for Apple computers supplied by Machine Dynamics, Mitcham, Vic.



AMATEURS read this, avoid an expensive mistake

Dear Amateur,
Consider these two recent reports of amateurs who purchased Yaesu equipment from 'backyard' importers: both these cases were told by the purchasers to our store staff in trying to get some help.

Case History No. 1:
Mr X from Adelaide bought a transceiver by mail order. After waiting some time for delivery, the unit arrived but shortly after the digital display failed. Mr X rang the supplier to be told the repair would take 6 to 8 weeks, and he would have to pay freight charges both ways. Mr X ended up having the unit repaired in Adelaide at his own cost.

Case History No. 2
Mr Y from Sydney bought a 'new' transceiver from the same source. On opening the carton, Mr Y strongly suspected the unit was not new, but had been 'refurbished'. It failed to operate at all - the PA stage was inoperative. Mr Y rang the supplier to be told that parts were unavailable and the repair would take at least three months. As it was supposed to be a brand new unit, Mr Y asked for a replacement. This was refused.

Other problems:
We have often heard of transceivers supplied without instruction manuals, or with Japanese language instruction manuals ... Obviously these units were intended for the Japanese domestic market, and never intended to be exported. The warranty is not valid in Australia on these units.*

Many 'backyard' importers do not have any service facilities whatsoever - let alone spare parts. They are not authorised by Yaesu, (or usually anyone else!) and often have little expertise.

Is it worth the risk?

*Dick Smith is the only authorised Yaesu dealer offering full 12 month warranty!

Dick Smith
VK2ZIP

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SELLING IN USA FOR $2995!

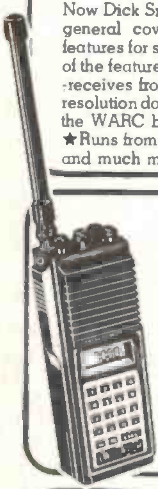
THE FANTASTIC **FT-ONE** GENERAL COVERAGE TRANSCEIVER

Cat D-2852

Now Dick Smith and Yaesu bring you this superb general coverage transceiver with outstanding features for such a low, low price. Just look at some of the features: ★ All mode - even FM*; ★ All band - receives from 150kHz to 30MHz continuous, with resolution down to 10Hz; ★ Transmitter includes all the WARC bands; ★ All microprocessor controlled ★ Runs from 100-120 or 200-240V AC or 13.5 DC, and much more! And the price?

An unbelievably low **$1795**

*FM board optional extra



HAND HELD FM
The FT 208R

2.5W/.25W

The FT 208R transceiver brings a new flexibility to today's active 2M operator. An easy to read LCD display is coupled with a 4-bit microprocessor, bringing 10 memories and a scanning function. Only with Yaesu can you get these features at such an economical price. Cat D-2889

Complete with battery & charger

ONLY **$368**

25 watt

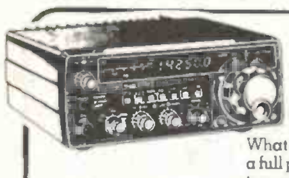
NEW!

FM 2 metre FT 230R and it's only

$375

It's here! The brand new Yaesu FT 230R with features you'd pay $$$$ more for. 3W/25W output, full 144-148MHz band coverage, fully synthesised, 12V operation. Plus two VFO's, LCD readout, 10 memories, scanning, hi/lo power switch, and much, much more. Check it out now!
Cat D-2893

SUPER COMPACT!



SUPERB MOBILE/BASE FT 707

100 WATT

ONLY **$795**

What a performer packed into such a tiny package! It's a full power all HF band (including WARC) multi-mode transceiver not much bigger than the average 2 metre mobile! And you get digital display as well. LED S/power meter, push button operation etc, etc. Team it up with and FP-707 supply and you have a superb base station too! What more could you ask for?
Cat D-2869

2 metre SSB-FM-CW with scanning
FT 290R

ALL-MODE

only **$395**

The brilliant Yaesu FT290R. For the person who can't quite decide whether they want a portable or a mobile set. This one is both! And what's more, it's fully microprocessor controlled offering up to 10 memory channels, scanning, LCD display, high or low power operation, all modes plus full 144-148MHz band coverage. All this in a transceiver which can be operated both portable (from internal batteries and whip antenna) or mobile (ext. antenna and power sockets fitted). Complete with carry strap, scanning microphone and whip antenna. Cat D-2885.

DEMO CLOSEOUT SALE

Ex-demo and store stock, some slightly marked.

Full 12 month warranty

FT 207R	2 mtr hand held with charger SAVE $60!	(D-2888)	$235.00
PA 2	Mobile charger supply for FT 207R SAVE $10!	(D-2894)	$19.95
	SPECIAL PACKAGE - BOTH UNITS FOR $246.50!!		
FT 107M	Solid state HF transceiver (power supply built-in)	(D-2863)	$850.00
FT 7B	Solid state portable HF transceiver SAVE $50!	(D-2868)	$549.00
FT 901D	Transceiver 160 - 10 mtrs (built-in power supply) SAVE OVER $70!	(D-2854)	$999.00
FT 901/902 memory	Memory unit for 901/902 series SAVE $40!	(D-2858)	$99.00
FT 901/902 DC-DC converter.	DC power supply for 901/902 seriesSAVE $20!	(D-2856)	$49.00
FT 720RVH	2 mtr mobile transceiver SAVE $80!!	(D-2890)	$369.95
FT 101ZD	101 digital HF transceiver with WARC bands (built-in power supply) SAVE $60!!	(D-2859)	$850.00
FT 227RB	2 mtr FM mobile with scanning SAVE $60!!	(D-2891)	$319.00
FV 707DM	Digital VFO for FT 707 SAVE OVER $30!	(D-2896)	$265.00
MMB2	Mounting bracket for FT 707 SAVE $9!	(D-2897)	$25.95
	Galbraith paddle morse key SAVE $2.55!	(D-7103)	$14.95
YM-34	Desk Mic for FT 707 SAVE $14.55!	(C-1114)	$29.95

Some stores have limited or no stock available. Ring Jim Powell at Head Office (02) 888 3200 for details on where to find these bargains.

DICK SMITH Electronics

HFC

See Page 34 for address details

DSE/A240/PAI

For a *real life* example of all the foregoing, one of ETI's correspondents, Phil Cohen, has written a 'Random Walk' program for the Minimum Turtle interfaced to an Apple II via a PIA card which plugs into Slot 2. For this interface, the Turtle input functions 'reside' at address −16224, and the Turtle output functions at address −16222. The program effectively 'exercises' all the Turtle's functions, both input and output. The randomness of its 'walk' comes from the function at line 200 — you never know how far the Turtle's going to turn after it meets an obstacle and backs off!

The Turtle commences moving forward, and if it doesn't meet an obstacle after a short period it will execute a turn and continue in another direction, etc. If it meets an obstacle (other than running out of 'umbilical cord'!) it will flash its lamps, sound its horn, back off and continue in another direction. It's a fascination to watch!

Conclusion

Well, it's not a conclusion, really — more like 'until next time'. Now you have your Turtle 'up and running' — even if you haven't organised interfacing to a/your computer, the limits are bounded by physics and your imagination (the Turtle won't transport you around, but the family's new kitten might enjoy a ride!). At present, we're working on a number of accessories, e.g: a manual controller (drive it yourself); a line follower (draw a line and the Turtle will follow you anywhere); interfacing to popular micro/personal computers, etc. We hope to present these in forthcoming issues, very soon. In the meantime, ETI would appreciate feedback from Turtle owners/constructors with their own ideas/hints/tips/circuits/programs. ●

RANDOM TURTLE WALK

```
10  DIM ARR(8)
20 W =  - 16224
30 R =  - 16222
40  POKE W + 1,0
50  POKE W,255
60  POKE W + 1,52
70  POKE R + 1,0
80  POKE R,0
90  POKE R + 1,60
100  POKE W,0
110 ARR(1) = 0
120 ARR(3) = 1
130 A = 4: GOSUB 230
140 ARR(7) = 0:A = 6: GOSUB 230
150 A = 10: GOSUB 390
160 ARR(7) = 1:A = 6: GOSUB 230
170 ARR(1) = 1:ARR(3) = 0:A = .5:
     GOSUB 390
180 ARR(1) = 0:ARR(3) = 0
190  IF  RND (1) > .5 THEN ARR(1)
     = 1:ARR(3) = 1
200 A =  ABS ( RND (1) * 3) + 1
210  GOSUB 390
220  GOTO 110
230  REM  *********** FLASH BIT A

240 ARR(A) = 1
250  GOSUB 320
260  POKE W,OUT
270  FOR I = 1 TO 100: NEXT I
280 ARR(A) = 0
290  GOSUB 320
300  POKE W,OUT
310  RETURN
320  REM  ************* GENERATE
     OUT
330 ARR(0) = 0:ARR(2) = 0: REM  M
     AKE SURE MOTORS ARE OFF
340 OUT = 0
350  FOR I = 1 TO 8
360 OUT = OUT + (2 ^ I) * ARR(I)
370  NEXT I
380  RETURN
390  REM  ************** TURN MOT
     ORS FOR A SECS UNTIL STOPPED
      AFTER 1/2 SEC
400  GOSUB 320
410 O5 = OUT + 5
420  POKE W,OUT
430  FOR I = 1 TO 50
440  POKE W,OUT
450  FOR T = 1 TO 3: NEXT T
460  POKE W,O5
470  NEXT I
480  IF ARR(1) <  > ARR(3) THEN
      GOTO 550
490  FOR I = 1 TO A * 110
500  POKE W,OUT
510  FOR T = 1 TO 3: NEXT T
520  POKE W,O5
530  NEXT I
540  RETURN
550  FOR I = 1 TO A * 110
560  IF  PEEK (R) <  > 15 THEN
     RETURN
570  POKE W,OUT
580  POKE W,O5
590  NEXT I
600  RETURN
```

CORRECTIONS

In the May issue, Figure 11 on page 25 — the pc board component overlay — shows the LAMP INPUT going to the track joining the collectors of Q5 and Q6. This is incorrect, as the circuit (and common sense) shows. The LAMP INPUT goes to the free end of R10, and the LAMPS connect between the pad joined to the collectors of Q5 and Q6 and the +12 V line, where one lead of R13 protrudes through the top side of the board (as per original). In other words, swap the two leads going to the pads over Q6 and R10.

The printers failed to effect a number of alterations to Figure 13 on page 28. The principal problem is with the length of the leads to the lamps and MSW2 (right). The leads to the lamps should be 260 mm long, the leads to MSW2, 500 mm long.

THE DICK SMITH SUPER 80 THE DICK SMITH SUPER 80 THE DICK SMITH SUPER 80

Electronics Australia/ DICK SMITH SUPER 80 Computer Kit

Production costs have now been absorbed due to fantastic response — YOU REAP THE BENEFIT!!

NEW SUPER LOW PRICES

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Photo shows the basic board with the following options: S-100 expansion, IC sockets and a full 48K of memory.

Yes, this makes the full 16K computer, with 9K BASIC on tape, transformer and IC sockets — only

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SHORT FORM KIT: Designed for computer applications where 'BASIC' programming is not required. Kit supplied with EPROM monitor and 16K RAM. (Cat. K-3600)
WAS $289.50 — SAVE $50.00 .... **$239.50**
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WAS $12.50 — SAVE $3.00 .... **$9.50**
BASIC manual (Cat. B-3602)
WAS $14.50 — SAVE $5.00 .... **$9.50**
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EX-STOCK Available NOW! OVER 2000 SOLD!

The SUPER 80 is the proven computer kit with over 2000 sold and it is available ex-stock! Why wait for others – check out our prices with the competition and whilst you are doing that, check out the features too! Dick Smith Electronics have reduced the price of the SUPER 80 as the enormous design costs have now been absorbed by the superb sales of this superlative kit computer – read on . . .

Check the Super 80 against all others

	SUPER 80	OTHER
* IS IT S-100 EXPANDABLE	☑	☐
* DOES IT EXPAND TO 48K ON BOARD	☑	☐
* DOES IT HAVE RF OUTPUT FOR TV CONNECTION	☑	☐
* WAS IT FEATURED IN ELECTRONICS AUSTRALIA – AUSTRALIA'S LEADING ELECTRONICS MAGAZINE	☑	☐
* IS IT AVAILABLE EX-STOCK	☑	☐
* HAS IT SOLD OVER 2000 AND BEEN PROVEN AGAINST TEETHING TROUBLES	☑	☐

CHECK OUT THESE FEATURES: * Relay operates cassette unit automatically * 2K Monitor program supplied * Character generator giving full 64 characters, 32 characters x 14 line screen * Spare IC positions for prototyping and user customising * RF modulator inbuilt, connects to your TV set * Optional S-100 provision * Keyboard can be remotely mounted if required * 12MHz quartz crystal * Optional 9K SUPER BASIC in ROM plug in facility * Full size professional 60 key keyboard * Inbuilt power supply * 16K RAM on board plus provision for on board expansion to 48K * Inbuilt cassette interface

'Sorry Dick, It Doesn't Work'

This service is specifically intended for constructors who have completed their Super 80 kit, but have difficulty in getting it to work correctly. We will not complete half-built kits, then get them to work: your kit must be complete before taking advantage of this service.

Your kit must have been constructed using IC sockets.

Our Service Centre will check and repair your Super 80 for the cost of $100. This fee includes necessary replacement of components, etc.

7 Day Satisfaction Guarantee

Another exclusive Dick Smith offer: purchase this kit and inspect it for up to 7 days. If, for some reason, you do not wish to go ahead and construct the kit, simply return it to us in original condition and packing (ie. before construction has commenced) and with all instructions, cards, etc. and we will refund your money in full. What have you got to lose?

This is what Reg Hespe, Technical Officer of Gladesville had to say about 'Super 80'
"I enjoyed building the Super 80 project and felt it worthwhile, of immense educational value and quite easy to construct. It worked as soon as I turned it on and has provided many hours of enjoyment".

Very Advanced design – but works with any TV set!

The 'Super 80' offers a specification that we believe just cannot be bettered at the price. It uses the popular Z80 Microprocessor IC, a professional keyboard and has direct RF output so that you can use the computer with any TV set (you don't need to purchase a special video monitor).

Easy to build

Even though we would not recommend this kit to the raw beginner, it is very easy to build. Any person who can use a small soldering iron and can solder neatly should have no difficulty in construction. This is because of the unique double-sided board design which means there is virtually no other wiring. The board is covered with professional 'solder mask', this makes soldering much easier without the problems of bridges, etc. Once the components are soldered onto the board in their marked positions over 98% of the construction is completed. Even if you cannot get the completed kit to work, we have a special "Sorry Dick it doesn't work" repair service to assist you.

NEW lower price, higher specification - how is it done?

Most computers sold in Australia are manufactured in the U.S.A. where extremely high labour rates prevail - and you pay dearly for this on built up units. With this computer kit, you provide the labour and therefore save a fortune. And remember, this computer does not have a small toy-like calculator keyboard but a full size professional typewriter keyboard.

Advanced programming capability

The Super 80 Computer gives you a huge 9K of BASIC – comparable in fact, with the BASIC on our very popular Sorcerer computer (over 2000 sold) – and this machine sells for over $1,000. Many other computers currently available do not offer as much BASIC programming capability as the SUPER 80 – it is obvious that by building it yourself you are saving real money!

Electronics Australia/Dick Smith design

This is not a half baked design with no back up. The resources of Electronics Australia, Australia's most popular electronics magazine, and Dick Smith Electronics have combined to design and bring you this kit in the interests of computer enthusiasts actually building and not just buying. The design is fully Australian.

Imagine how much you will learn!

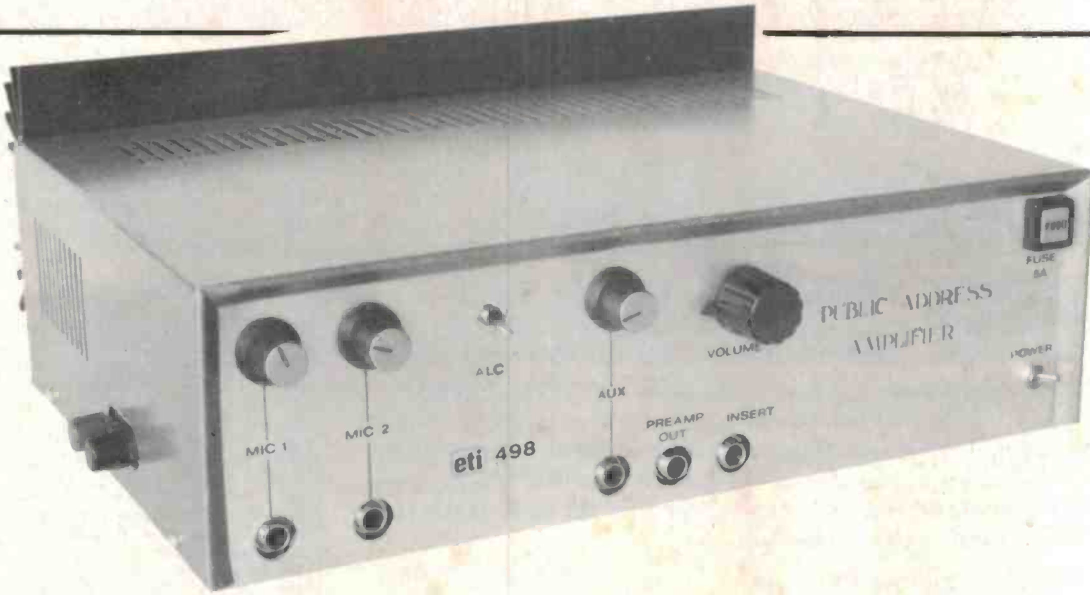
Most computer enthusiasts can program a computer but would have absolutely no idea of how to build one. By building this kit you will learn both the technical side of construction, how it works and then how to program. What a fantastic background for the future. . . . . . .

Sectional construction

We have designed this kit not only for the serious computer user but also for first time users like the student or hobbyist. This is why we have a short form kit which may be added to as you build (and as you have the money!). For example, you may build the computer originally and operate it with 'BASIC on tape' and then add 'BASIC in ROM', add the S-100 and provide other parts at a later stage.

SEE PAGE 34 FOR ADDRESS DETAILS

DSE/A193M/LM



Versatile public address amplifier

Featuring 'speech filtering' and ALC on the mic inputs to improve intelligibility, an 'insert' input and a power MOSFET output stage delivering 150 W RMS maximum output to 100 V, 70 V or low impedance lines, this PA amplifier has much to offer.

Geoff Nicholls

THIS PROJECT has been designed specifically for use in large open areas where ambient noise levels are often high, such as outdoor sporting events. It features *two microphone inputs,* which can be configured for *high or low impedance* microphones, as desired, when the project is constructed. The microphone signal path incorporates *speech filtering* to increase the intelligibility of the voice signal under 'difficult' conditions where other noises compete for the audience's attention. *Automatic level control* (ALC) is included to decrease the variation in voice level between different commentators using the PA and, again, improve 'penetration' where extraneous noise is present. This feature may be switched in or out, as desired.

An *auxiliary input* is provided, which can be used to connect a line level signal or a speaker output from a radio, etc. A *preamp output* enables several power amplifiers to be 'slaved' from the one preamp, and provides a high-level signal for output to a tape recorder, for example.

The *insert* socket allows further signal processing devices to be 'inserted' in series with the signal path from the output of the preamp to the input of the power amp.

The completed amplifier has actually been used at a large, noisy outdoor venue driving eight horn speakers. It gave an excellent account of itself, especially when compared directly against a system using two of our old ETI-480 100 W modules (circa 1976) driven by an ETI-419 preamp (circa 1973!).

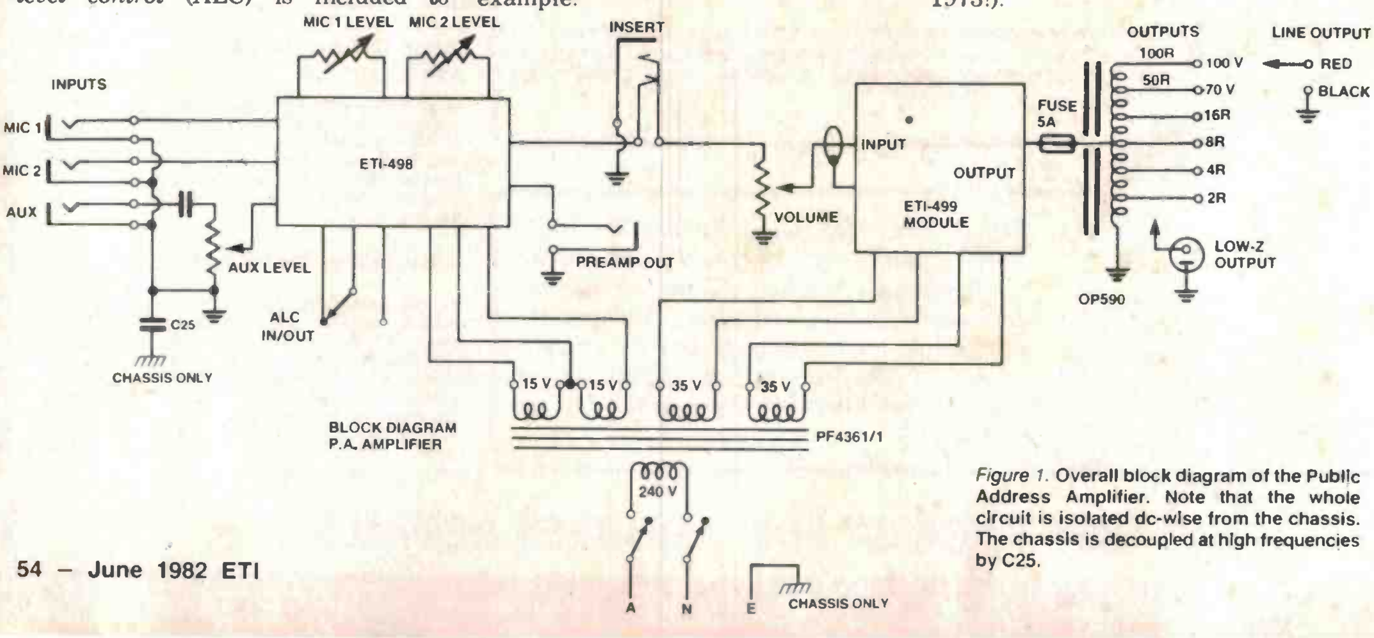


Figure 1. Overall block diagram of the Public Address Amplifier. Note that the whole circuit is isolated dc-wise from the chassis. The chassis is decoupled at high frequencies by C25.

Design notes

Most public address set-ups, for all but the largest outdoor events, generally use a single announcer or commentator, occasionally two. Thus as more than two microphones are rarely required, only two microphone inputs have been provided. This allows the constructor either to provide two low impedance inputs, two high impedance inputs or one of each. In a pinch, a low impedance input could be used with a high impedance, high output mic, provided the level control is near minimum. The auxiliary input is shunted by a low value resistor to provide loading for the earphone or external speaker output of radios, cassette decks, etc. It also terminates a line level output correctly.

The signal 'earth' is isolated at low frequencies from the chassis and mains earth to eliminate the possibility of hum loops brought about by connecting external mains powered equipment to the amplifier. The chassis is ac-coupled to the signal earth to higher frequencies as the impedance of capacitor C25 (which couples the chassis to the signal earth) decreases.

The frequency response of the microphone preamps is rolled off rapidly below 150 Hz. This allows the output transformer to deliver more useful power than would be the case if a flat frequency response were employed. The distortion is also reduced by rolling off the low frequencies. Distortion and frequency response curves for the OP590 are illustrated in the accompanying graphs (courtesy Ferguson Transformers).

Automatic Level control (ALC) is included, the purpose of which is to maintain a nearly constant output level with large excursions in signal level. For a signal input level range of greater than 20 dB, the output level will only vary by 3 dB or less for typical microphone input levels. This greatly improves intelligibility and 'punch' of the sound produced, particularly where all sorts of extraneous sounds are about, interfering with the audience's ability to hear the PA.

To provide ALC, I have used half of an NE570/571 audio compressor IC. The basic circuit employed is shown in Figure 2. Inside the NE570/571 are a precision rectifier (the block shown with the diode inside), a variable gain cell (Δ G) and an op-amp. Resistors R1, R2 and R3 are inside the chip. The rectifier and variable gain cell operate in the feedback circuit of the op-amp, the gain of which is varied with signal level. At high input levels, the op-amp gain is reduced, at low input levels the gain is increased. Resistor R_x is used to set the maximum gain. The gain of this circuit is given by:

$$K = \frac{R1\,R2\,I_B}{2R3V_{IN\,(avg)}}$$

where $I_B = 140$ uA

and $\dfrac{V_{IN}}{V_{IN\,(avg)}} = \dfrac{\pi}{2\sqrt{2}}$

for sine waves

The maximum gain is limited (by R_x) to prevent high output levels occurring at low input levels (such as background noise).

The maximum gain is given by:

$$\frac{\frac{R1 + R_x}{1.8}\,.\,R2.\,I_B}{2R3}$$

The output voltage is determined by:

$$V_{out} = \frac{R1R2I_B}{2R3}\cdot\frac{V_{IN}}{V_{IN\,(avg)}}$$

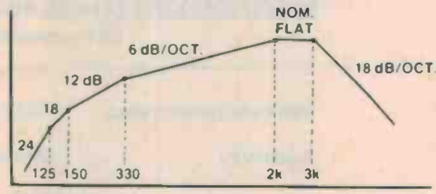
The time constant is important as the circuit needs to react quickly to plosive sounds, yet 'hang on' following peaks. The ALC time constant is determined by:

$$\tau = R1.C_{RECT}$$

The value of C_{RECT} affects the distortion, so its choice is a compromise between providing an effective time constant and keeping the distortion within bounds. Reducing C_{RECT} improves the time constant but increases the distortion; increasing it reduces the distortion but reduces the ALC effectiveness. Distortion is determined by:

$$\text{Distortion} = \frac{100n}{C_{RECT}}\;\frac{1\,\text{kHz}}{\text{freq.}}\cdot 2\,(\%)$$

The frequency response of the mic signal path is 'tailored' to improve speech intelligibility. There is much redundant energy in the spectrum produced by the voice. Reducing those components below 300 Hz and rapidly attenuating components above 3 kHz removes the redundancy and subjectively provides improved intelligibility for the listener — particularly where extraneous noise is present. Speech 'weighting' filters are used to great effect in communications equipment. In the preamp, the response below 330 Hz is rolled off at 12 dB per octave down to 150 Hz, where an extra filter section provides 18 dB/octave roll-off down to 125 Hz, where the roll-off is further increased to 24 dB/octave. Between 330 Hz and about 2 kHz, the preamp has a response rising gently at 6 dB/octave. Between 2 kHz and 3 kHz, the response is essentially flat. At 3 kHz the response rolls off steeply at 18 dB/octave.



Generalised shape of the preamp mic signal path response showing the rolloff frequencies and attenuation rates. This response provides an effective 'speech weighting' filter to improve 'punch' under noisy conditions.

The steep roll-off below 150 Hz reduces distortion contributed by the output transformer at low frequencies, as mentioned earlier.

The combination of ALC and speech filtering has an additional advantage in that it permits greater sound levels to be achieved before howl-round feedback becomes a problem.

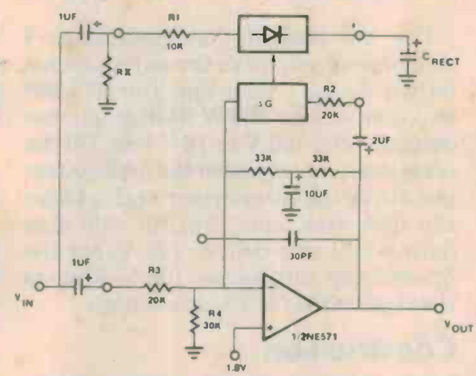
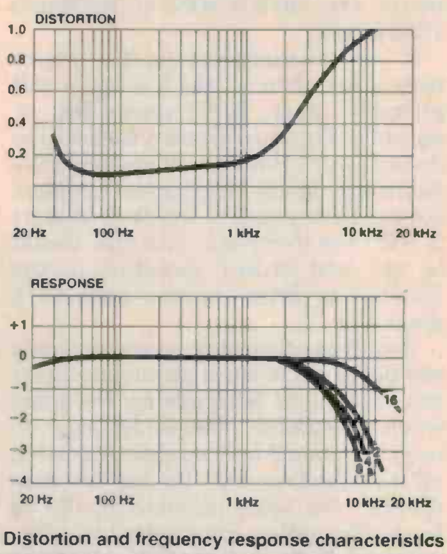


Figure 2. General circuit of the NE570/571 audio compressor chip connected as an automatic level control (ALC). Note that R1, R2, R3 and R4 are inside the chip.



Distortion and frequency response characteristics of the Ferguson OP590 line output autotransformer (courtesy Ferguson Transformers).

SPECIFICATIONS ETI-498/499 PUBLIC ADDRESS AMPLIFIER
(as measured on prototype)

Maximum power output		150 W RMS (at onset of clipping)	
Sensitivity		(RMS input for full output)	
		1 kHz	2 kHz
	MIC 1	50 mV	15 mV (level at min.)
		1 mV	0.3 mV (level at max.)
	MIC 2	100 mV	35 mV (level at min.)
		30 mV	10 mV (level at max.)
	AUX.	60 mV	60 mV (level at max.)
Signal/noise ratios			
(level controls set to provide rated output for the quoted input levels at 2 kHz — ALC off)			MIC 1 −71 dB re 1 mV MIC 2 −73 dB re 50 mV AUX. −74 dB re 100 mV
Outputs		2 ohms, 4 ohms, 8 ohms, 16 ohms	
(selectable)		50 ohms (70 V nom.), 100 ohms (100 V nom.)	

For the majority of applications I recommend you drive the output transformer at the 8 ohm tap. The ETI-499 will then deliver 100 W RMS maximum output to the 100 V or 70 V line. On the occasions you may need the greater output, drive the transformer at the 4 ohm tap. However, note that the 100 ohm output will now deliver 123 V, but the 50 ohm tap will deliver 108 V. Change the taps on the OP590 accordingly.

Construction

This article covers construction of the ETI-498 preamp board and assembly of the preamp and ETI-499 power amp module into the case. For details on constructing the ETI-499 150 W MOSFET power amp module refer to the March 1982 issue.

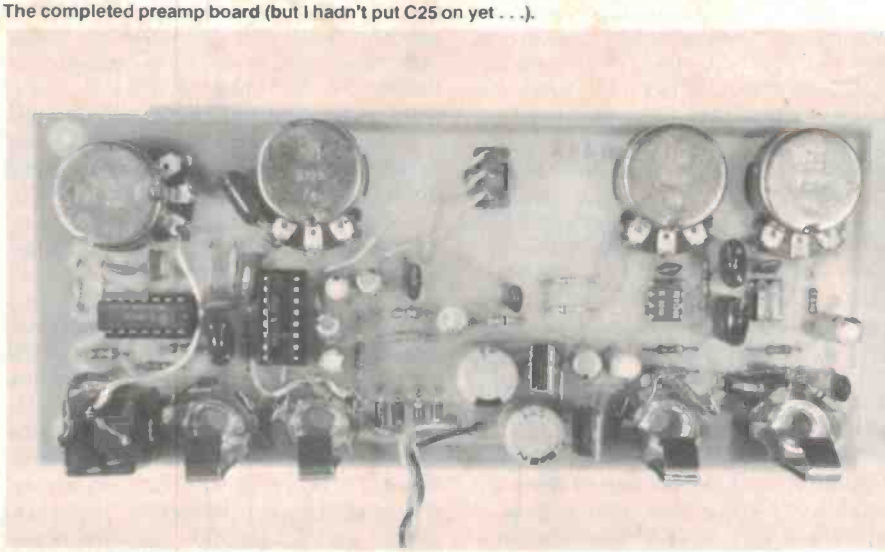
If you are constructing this project from a kit, then all the hardware will probably have been pre-drilled or punched. This can certainly save a lot of dreary work. However, if you have the facilities and are tackling the complete construction yourself, the place to start is with the hardware. The case should be cut and drilled according to the dimensions given in our metalwork diagrams.

Note that all the potentiometer shafts should be cut to leave about 12 mm for the knobs to fit flush against the panel when assembled. The solder lugs on each pot should be modified by cutting off the eyelets so that the lug can pass through the holes provided in the pc board for soldering directly to the relevant pad. Pads for the pot lugs should be drilled with a 2 mm diameter hole. When cutting the eyelets from the lugs, make sure you leave as much of the stem of the lug as you can, otherwise they may not reach through the pc board. Note that the volume control pot, RV4, has only one lug soldered to the pc board — check the photo of the assembled pc board and only modify the relevant lug. The auxiliary level pot, RV3, has only two lugs modified.

Bend the modified lugs down *toward the pot shaft* and install each pot on the pc board. Pass the pots through the board from the *non-copper* side and secure them with *one nut* on the copper side.

Next mount the jack sockets. Orientate them so that their lugs are adjacent to the relevant holes in the pc board, and tighten the nuts firmly.

The completed preamp board (but I hadn't put C25 on yet . . .).



Mount R1, R6 and R15 between the switch and tip lugs on the two MIC jacks and AUX jack, respectively. Extend the switch lug end of the resistor pigtails to the sleeve lug in each case, as shown in the accompanying drawing.

General assembly of the pc board-mounted components follows. Note that *all soldered joints on the copper side of the board should be 'clinched' or cut short* as the board is mounted close behind the front panel of the case.

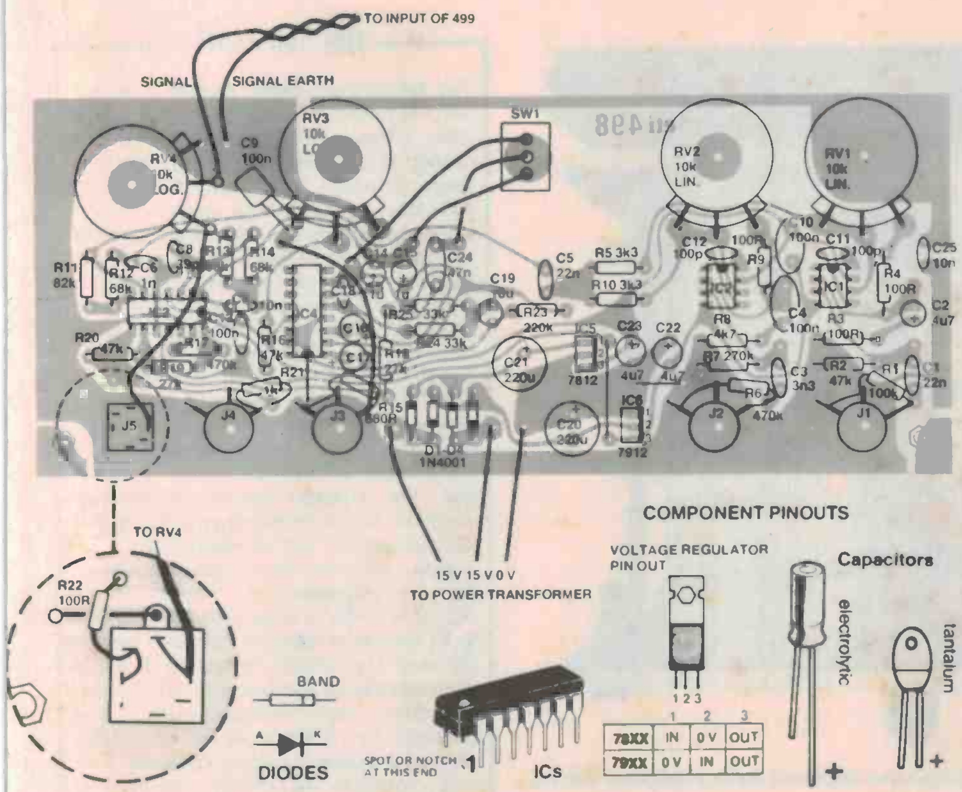
Mount R21 and R22 between the pc board and the lugs of the PREAMP OUT and INSERT jack sockets, as shown on the component overlay.

Probably the easiest order of construction is to first install all the resistors, then the ICs and diodes, followed by the capacitors. Watch the orientation of the ICs, the four diodes and the tantalum and electrolytic capacitors. The component overlay shows the appropriate orientation of all these components. Note there are a number of links on the board. Use insulated hookup wire for these.

Having finished the assembly of the components to the board, check it carefully to see that you have everything in its correct place and that there are no suspect joints, missed joints or solder bridges on the copper side of the board.

Now solder the two 15 V windings of the PF4361/1 power transformer to the preamp board (make sure they're correctly phased) and attach about 100 mm of twisted-pair hookup wire from the preamp output. Use hookup wire at least as big as 24 x 0.2 mm for this twisted-pair lead.

Mount two countersunk 8 BA x 12 mm screws in the appropriate front panel holes and secure them with *one nut and*

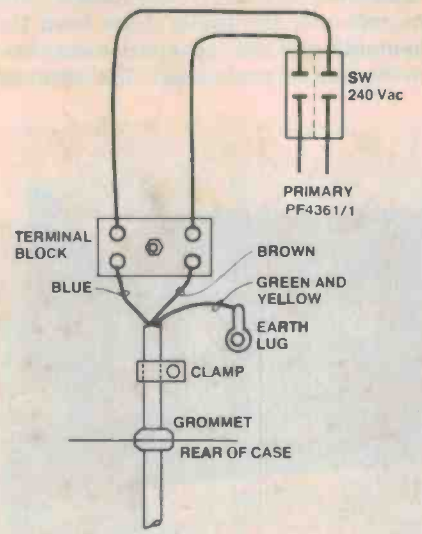


two flat washers each. Cut a piece of thin cardboard to fit between the rear of the pc board and the rear of the case front panel. Cut out clearance holes for the pot shafts and jack sockets. Mount the assembled preamp board to the front panel, not forgetting the cardboard cut-out, which prevents any possibility of shorts between the rear of the pc board and the front panel. Sit the power transformer inside the case as you do this. Check that all sockets clear the case. Use a shakeproof washer (8 BA) and nut on the *component* side of the pc board when securing it to the two screws previously mounted to the case front panel. We used a metal Scotchcal label to 'dress up' the front panel and indicate what controls and sockets were what. This should be attached next. Take care aligning it and smoothing it in place. When you've got it right, install a nut on each pot shaft and all will be secured. Put insulation tape on the case bottom beneath each jack socket to preclude the possibility of the jack contacts touching the bottom of the case.

Next, install the low-Z output socket on the rear of the case. This is a polarised DIN-type socket and installs from the outside. Secure it with two 8 BA x 12 mm screws — nuts on the inside of the case. Install a grommet in the rear panel of the case for the mains cord. We used a Heyco nylon insulated bushing type A2030.

Now for the heatsink, which I presume has already been drilled to take the power amp mounting bracket. There are six other holes in the heatsink: four for the mounting bolts, one to allow access to the low-Z output socket and one for the mains cord. Another grommet should be installed in the latter. Then feed the mains cord through this and through the mains-entry grommet in the rear of the chassis. Just let the mains cable 'hang loose' for the moment.

Mount the heatsink using 6 BA x 20 mm long screws and 6 mm long brass spacers to hold off the rear panel.



Mains cable wiring. Be sure to sleeve all exposed connections for your own protection.

Use lock washers and nuts on the inside of the case, passing the screws through the heatsink and spacers.

Now you can mount the mains terminal block; expose the three wires at the end of the cable inside the case, remove about 20 mm of the mains cable outer sheath and clamp the cable securely to the bottom of the case with a cable clamp. Make sure the mains wires can ▶

PARTS LIST — ETI 498

Resistors	all ½W, 5% unless noted
R1	100k
R2, 16, 20	47k
R3, 4, 9, 22	100R
R5, R10	3k3
R6, R17	470k
R7	270k
R8	4k7
R11	82k
R12, 13, 14	68k
R18, R19	27k
R21	1k
R23	220k
R24, R25	33k

Potentiometers	
RV1, RV2	10k lin.
RV3, RV4	10k log.

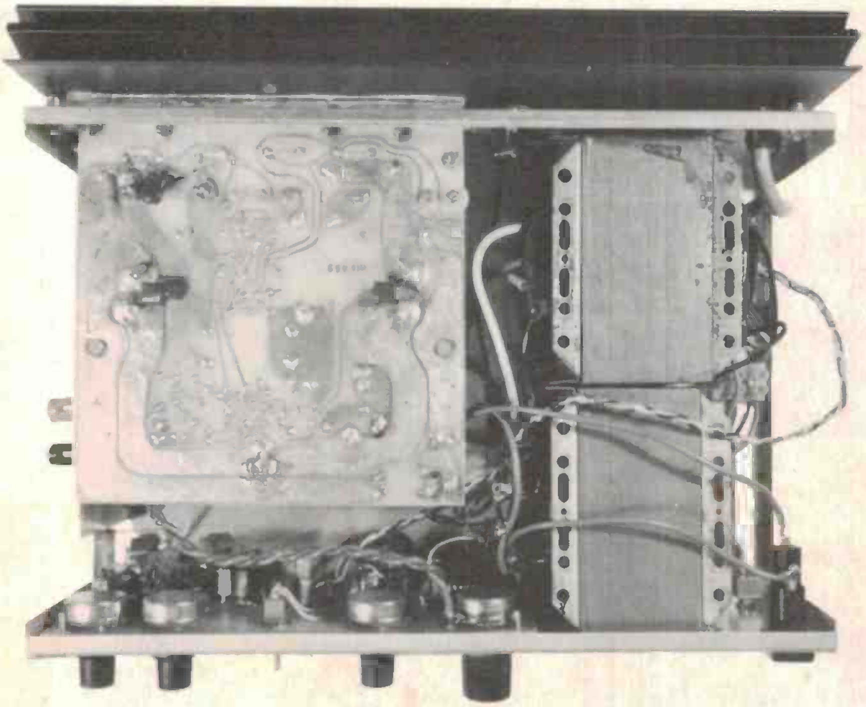
Capacitors	
C1, C5	22n greencap
C2, 22, 23	4u7/50 V RBLL
C3	3n3 greencap
C4, 9, 10, 13	100n greencap
C6	1n greencap
C7 C25	10n greencap
C8	39p ceramic
C11, C12	100p ceramic
C14, C15	1u/25 V electro.
C16	2u2/25 V electro.
C17	470n/20 V tant.
C18	33p ceramic
C19	10u/25 V electro.
C20, C21	220u/35 V electro.
C24	47n greencap

Semiconductors	
IC1, IC2	NE5534, NE5534A
IC3	TL074, uA774
IC4	NE570, NE571
IC5	7812
IC6	7912

Miscellaneous
ETI-498 pc board; 4 x 6.5 mm mono phono jack sockets — shorting type; 1 x 6.5 mm stereo phono jack socket with switch (closed when empty); SW1 — SPDT miniature toggle switch; etc.

Other components to complete PA amplifier
ETI-499 150 W MOSFET Module (March ETI); 1 x PF4361/1 Ferguson power transformer; 1 x OP590 Ferguson line output transformer; 1 x DIN-type polarised speaker connector; 1 x front-loading fuse holder and 5 A fuse; spring terminal type speaker connector strip; K&W case, model C1284; Scotchcal or silk-screened front panel to suit; heatsink — e.g. Rod Irving type HS5 300 mm length black anodised flat-sided, fan-finned type or similar; 4 x 6.5 mm long stand-off pillars; four knobs to suit; mains cable, cable clamp and plug; hookup wire, nuts, bolts & etc.

Price Estimate $230—$240 inclusive



General view inside the case showing location of components. Mount the mains transformer with the 15-0-15 V winding tags uppermost for easiest access.

be easily terminated in the terminal block.

Now install the mains on/off switch on the front panel and wire it up to the terminal block *exactly as shown.* Sleeve all exposed mains connections on the rear of the switch.

Connect the two 35 V windings on the PF4361/1 power transformer to the ETI-499 module (which I presume is ready assembled and waiting). Make sure they're correctly phased. Bolt the transformer in position using 4 BA x 6 mm bolts and lock washers under the nuts. Solder its primary leads to the power on/off switch (sleeve exposed connections, as before).

Install the line output terminals next. I used a spring terminal pair mounted on a strip. These are common speaker connectors, mounted on an angle bracket at the left hand side of the case (when viewed from the front). If you have to fabricate the bracket yourself, do this now. We'll leave the exact details to you as you may have different terminals from the ones I used. The angle bracket is mounted to the bottom of the case with a couple of 8 BA x 6 mm screws. Make sure the bracket clears the filter capacitors on the ETI-499 module. This module mounts upside down from the heatsink and the capacitors come close to the line output bracket. The terminal

Rear view of the amplifier. Note the access hole for the Lo-Z output socket in the heatsink, just left of centre, and the line output terminals protruding from the right hand side of the case.

THE '100 V LINE'

The 100 V line voltage system is widely used for public address loudspeaker reticulation because it simplifies the interconnection of a number of loudspeakers to a single amplifier. It is analagous to the 240 Vac mains voltage system, which allows appliances of vastly different power consumption to be operated from a single supply. For example, a toaster designed to consume 1 kW is made with an impedance of $(240)^2/1000$, or 58 ohms. An electric clock can be run from the same supply, but it only draws 3/5 of 5/8 of 30% of half of . . . and probably has an impedance of 10 000 ohms or more. The ac mains supply can drive many different loads to their designed power rating because it can maintain the voltage supply substantially constant. This is another way of saying the supply has a low source impedance.

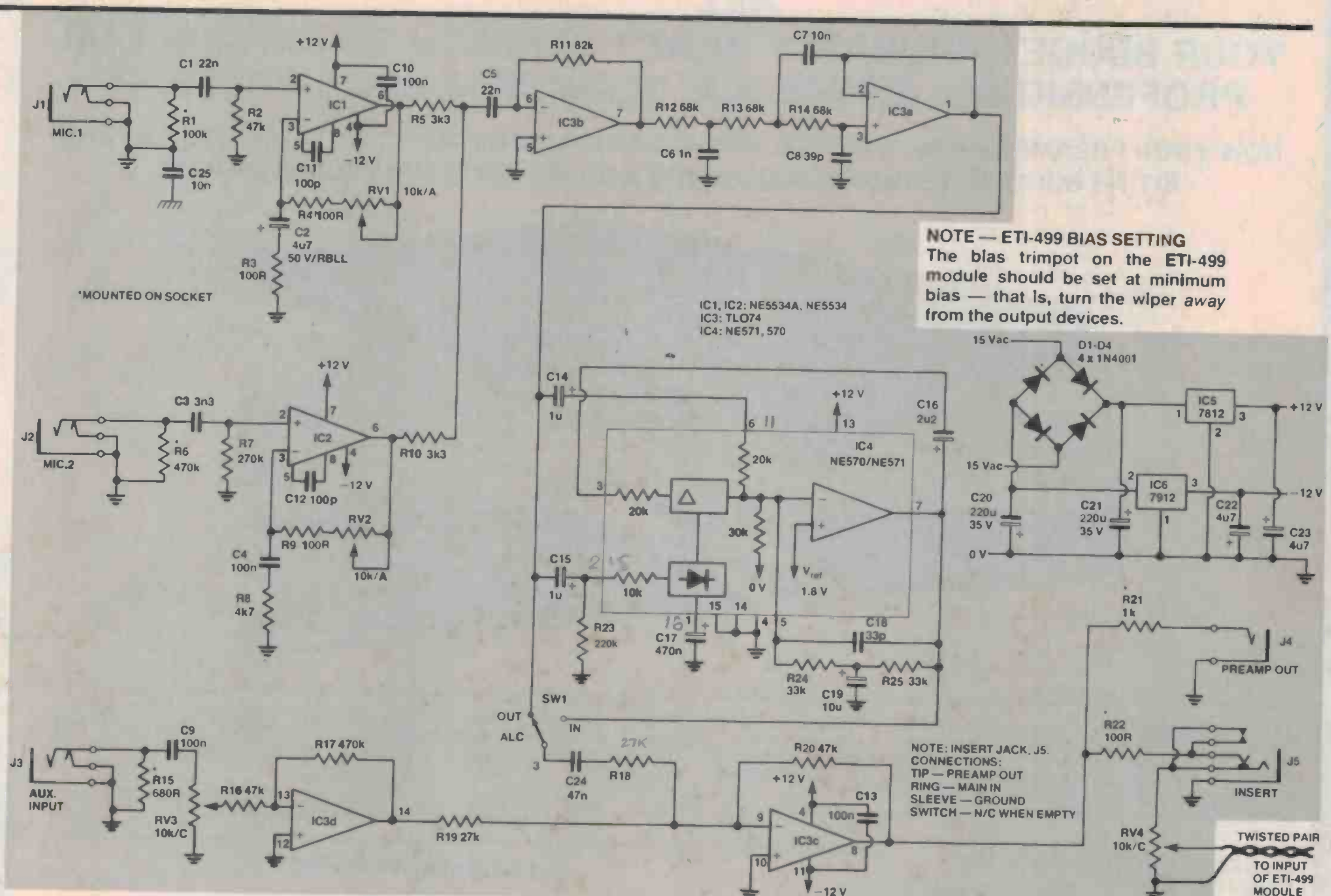
Now, public address set-ups often require many loudspeakers of varying power ratings. In order to drive every loudspeaker to its maximum rating at the same time, a constant line voltage is assumed (for a given amplifier power output) and individual step-down transformers (usually with tappings for different power/impedance ratings) are used at each loudspeaker. The most common line voltage employed is 100 V. This means that each loudspeaker will deliver its rated power when fed with a 100 V signal.

For example, a loudspeaker with an 8 ohm voice coil impedance and a 30 W maximum rating will require a drive voltage of $\sqrt{(8 \times 30)} = 15.5$ V to achieve full output. Thus it will require a step-down transformer having a turns ratio of 100:15.5. With tappings at greater ratios, less power will be delivered to the speaker; i.e: at a tapping providing a ratio of 100:11, 15 W will be delivered to the speaker; at a ratio of 100:9, 10 W will be delivered, and so on.

Any other loudspeaker power/impedance combination with a suitable transformer ratio can be connected to the same 100 V line and driven to the power rating selected, provided that the total loudspeaker power requirement can be supplied by the amplifier driving the line. That is, if ten 10 W-rated loudspeakers are connected to the line, the amplifier must be rated to deliver 100 W. Alternatively, a 100 W amplifier may be employed to drive four 10 W-rated loudspeakers and two 30 W-rated loudspeakers, all connected to the same line.

In practice, horn loudspeakers — which are commonly employed in PA applications — are usually operated at about ¼ to ½ of their maximum rated power, so that a 150 W amplifier with a 100 V line output (such as the one described in this article) will happily drive 15 or 20 horns with maximum ratings of 20 to 30 watts.

Note that a 70 V line system is sometimes employed, but this is less common than 100 V line systems. It works in the same way.



NOTE — ETI-499 BIAS SETTING
The bias trimpot on the ETI-499 module should be set at minimum bias — that is, turn the wiper *away* from the output devices.

HOW IT WORKS — ETI 498

The overall circuit arrangement and design features are explained in the general text, so this explanation will be confined to specific circuit description.

MIC INPUTS

We have designated MIC 1 as a low-impedance input and MIC 2 as a high-impedance input. Signals from the MIC 1 input are amplified by IC1. The gain of this stage can be varied by varying RV1, a potentiometer connected in the feedback loop of IC1. The gain can be varied between about 2 and 102. Signals from the MIC 2 input are amplified by IC2, the gain of which can be varied in the same way as IC1. RV2 here can vary the gain between 1 (unity gain) and 3. Resistors R1 and R6 provide dc return for each input capacitor, preventing 'clicks' or 'pops' when inserting or unplugging a mic.

An RC network on each of the MIC 1 and MIC 2 inputs forms single-pole high-pass filters with a breakpoint set at about 150 Hz to reduce low frequency output (the reason for this is explained in the main text). C1-R2 are the relevant components on the MIC 1 input, C3-R7 on the MIC 2 input. A further single-pole high-pass filter is introduced in the feedback network of each mic amp stage: C2-R3 for IC1 and C4-R8 for IC2. The breakpoint is set at 340 Hz and is the lower roll-off point for the speech filtering.

MIC SUMMING

The amplified microphone signals are summed at the outputs of IC1 and IC2, at the junctions of R5 and R10. Another high-pass pole is introduced by these two resistors, in conjunction with C5. This too, is part of the speech filtering.

IC3b buffers the summed mic signals and provides a further amount of gain. The output of this stage, pin 7, drives a low-pass filter stage comprising R12, 13 and 14, capacitors C6, 7 and 8 and IC3a. This filter has a breakpoint set at 3 kHz, providing a sharp roll-off above this frequency.

The net effect of the high and low-pass filters up to this stage provides filtering of the voice frequency spectrum to improve 'intelligibility' where listeners to the PA have to contend with a variety of interfering noises from numerous sources at open-air events.

ALC

The 'automatic level control' (ALC) circuit centres on IC4, an NE570 or 571 'compander' IC. This circuitry attempts to maintain a near-constant output, provided the input from the microphone stages exceeds a threshold level determined by the value of R23. Decreasing R23 *increases* the threshold, reducing the effect of the ALC. The ALC prevents 'soft' sounds from being lost in external noise while helping prevent clipping from plosive sounds ('p' and 't' for example) in speech.

The 'attack' time of the ALC is determined by C17. Decreasing the value of this capacitor improves the transient response of the stage (helping it cope with plosives) but has the drawback of increasing the distortion. We chose the value shown as a compromise between these two parameters and it seems to work well in practice.

The input to the ALC circuit (from pin 1, IC3a) and the output (from pin 7, IC4) go to SW1, a SPDT switch, which selects ALC IN or ALC OUT.

AUX INPUT

The auxiliary input is meant for low impedance, 'line level' signals, such as from the output of a tape recorder. Input impedance is determined largely by R15 and is around 600 ohms or so. IC3d provides amplification, having a gain of 10. The input level may be attenuated by RV3. This, in conjunction with C9, provides a single-pole high-pass filter.

INPUT MIXING

The MIC and AUX inputs are summed at the input of IC3c (pin 9). C24 and R18 provide a further high-pass filter for the MIC-ALC stages with a breakpoint at 125 Hz, further increasing the attenuation below this region.

OUTPUTS

The output of IC3c (pin 8) passes to the input of the ETI-499 power amp module via the INSERT jack (J5) and the volume control, RV4. A PREAMP OUTPUT is provided too, at J4.

The INSERT jack is a stereo/switched type and provides a point where a graphic equaliser or howl-round stabiliser can be introduced (see the ETI-485 Graphic Equaliser and the ETI-486 Howl-Round Stabiliser in our publication '30 Audio Projects').

Resistors R21 and R22 provide isolation between the outputs and short-circuit protection for the output of IC3c.

POWER SUPPLY

The on-board power supply derives its input from the two 15 Vac windings on the PF4361/1 power transformer used to supply the ETI-499 module. These two windings are connected to provide a centre-tapped 30 Vac supply (15-0-15). Two full-wave capacitor input rectifiers, comprising D1 to D4 and C20-C21, then provide about ±20 Vdc input to a pair of three-terminal regulators: a 7812 which provides a +12 V rail, and a 7912 which provides a −12 V rail.

To page 65

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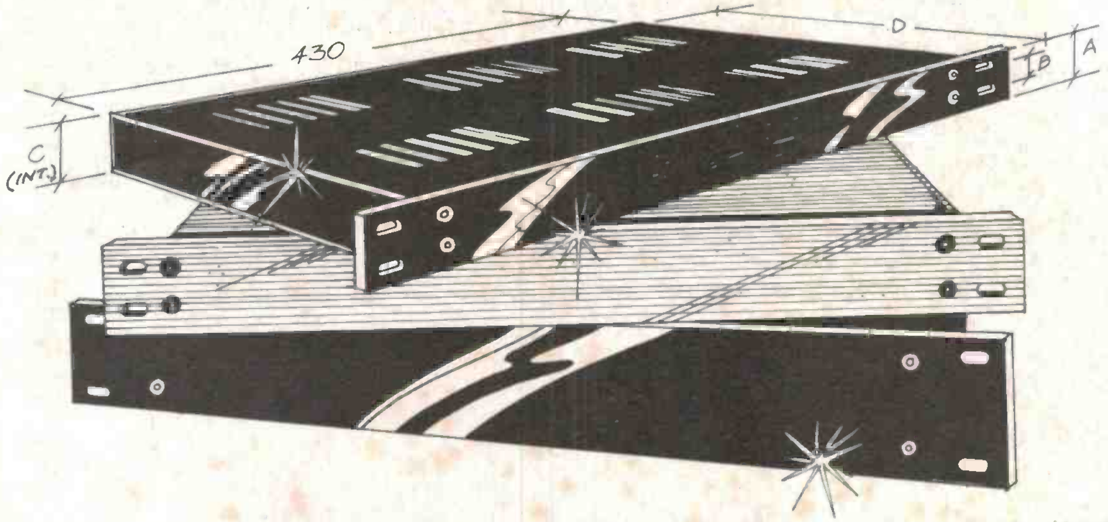

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ET 599C	2.90	Infra Red Remote Control	May 80	
ET 599D	2.20	I.R. Remote Cntrl Power Supply	May 80	
ET 603	4.90	Music Synthesizer Sequencer	Aug 77	
ET 604	604	Metronome	Spt 77	
ET 606	3.90	Electronic Tuning Fork	Nov 79	
ET 607A	2.90	Sound Effects Generator	Aug 81	
ET607nf	2.90	Sound Effectis Generator	Aug 81	
ET607nf	2.90	Sound Effects Generator	Aug 81	
ET631-2	7.50	Keyboard Encoder	Apl 77	
ET 635	3.90	Train Steam Whistle	Apl 81	
ET 636	16.90	7 Slott S100 Mother Board	May 80	
ET 637		Cassette Interface	Jan 78	
ET 638A	4.90	Eprom Programmer	Jly 78	
ET 640	65.00	Memory Mapped VDU		$140.00
ET 650A	4.50	Stac Timer	Nov 78	
ET 650B	4.50	Stac Timer	Nov 78	
ET 650C	4.50	Stac Timer	Nov 78	
ET 660	19.00	Learners Microcomputer	Oct 81	$90.00
Key Set (18) To Suit ET660				$30.00
Colour Option Kit to Suit 660				$14.00
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ET 730		UHF TV Converter	May 81	$37.50
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ET 735	3.90	UHF to VHF Convertor	May 81	
ET 760	2.50	Video Mod. To Suit 660 Micros	Spt 81	$14.00
ET 824	2.90	Slot Car Power Supply	Dec 81	$10.00
ET 825	5.90	Slot Car Controller	Dec 81	$70.00
		Without Case		$56.00
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ET1501B	2.50	Negative Ion Generator	Apl 81	
ET1501C	1.50	Negative Ion Generator	Apl 81	
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EA				
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Dream 6802	12.50			$100.00
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HEX Keypad 19 keys				$29.50
75CD7	3.50			
75L11	2.50			
76E04	1.00			
76PC9	5.50			
78TM8	2.90			
78C5	4.90			
78A06	3.90			
78N6	3.50			
78T3	4.50	Photo Timer	Mar 78	
78NG4	2.90	Pink/White Noise Gen.	Apr 78	
78UT4	4.50	Low Cost VDU Keyboard	Apr 78	
78UP10	9.50	2650 Extra Ram	Oct 78	
79SB10	3.90	Bass Filter	Oct 79	
79FE11	2.50	Photo Flash Exposure MTR	Nov 79	
79PC9	3.90	Pulse Generator	Sep 79	
79SE3	3.90	Train Model Sound	Mar 79	
79TI11	2.90	Transistor Assisted Ign.	Nov 79	$34.00
79PS11	2.90	Experimentors Power Sup.	Nov 79	
79PC12	2.90	Fan Speed Control	Dec 79	
79SF10	2.50	Photo Slave Flash	Oct 79	
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79UPS6	2.50	Universal Power Supply	Jun 79	$29.50
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80ST10B	2.50	Stylus Timer	Oct 80	
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80CM3B	2.50	Digital Capacitance MTR	Mar 80	
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80PP3	2.50		Mar 80	
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80SA10	9.90	Stereo Amp. Mosfet	Jan 81	$100.00
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81GA3	11.50	Colour Graphic Analyser	Mar 81	$80.00
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81IR4A	4.50	Infra-Red Relay	Apr 81	$30.00
81IR4B	2.90	Infra-Red Relay	Apr 81	
81SP1	2.90	RS232 TRS80 System 80 In.	Jan 81	
81S13	7.90	TRS80/System 80 Serial In.	Mar 81	
81SW1	3.90			
81MC7	2.90	Moving Coil Preamp	Jul 81	
81RM2	2.50		Feb 81	
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81A010	3.50	Audio Test Unit Cass.Deck	Oct 81	$47.00
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81SG9	4.20	Led Sandglass	Sep 81	$22.50
81P19			Sep 81	
81C19		Digital Clock Thermometer	Sep 81	$80.00
81SS11	4.90	Slide Cross Fader	Nov 81	$30.00
81GA9	3.90	Photon Torpedo Game	Sep 81	$23.50
81UC8		Universal Timer	Aug 81	
81MC7	9.50	Moving Coil Preamp	Jul 81	
81SW7		Train Steam Whistle	Jul 81	$17.00
81SM7	2.90	Bagatelle	Jul 81	
81VM2	2.90	High Impedance DC Voltmtr	Feb 81	
81HB4A	7.50	Heart Rate Monitor	Apr 81	$84.00
81HB4B	2.90	Heart Rate Monitor	Apr 81	
81MA4	2.50	Touch Sensitive Alarm	Apr 81	
81RC4A	3.50	Infra Red Remote Control	Apr 81	
81RC4B	2.50	Infra Red Remote Control	Apr 81	
81RC4C	2.75	Infra Red Remote Control	Apr 81	
81SP5	2.50	Sound Pressure Meter	May 81	$37.00
81OR7	9.50	Electronic Organ	Jly 81	$50.00
81CH12	3.50	Christmas Decoration	Dec 81	$15.00
81fm10a	4.90	500MHZ Digital Freq.Mtr.	Dec 81	$126.00
81fml0a	4.90	500MHZ Digital Freq.Mtr.	Dec 81	$126.00
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From page 59

strip should be mounted to the bracket with countersunk 8 BA x 6 mm screws — secure them well so that the screw heads are flush. A cutout is necessary in the case lid to clear these terminals.

Mounting of the OP590 output transformer comes next. First, solder three lengths of heavy gauge hookup wire to the appropriate lugs on the transformer. Use 24 x 0.2 mm insulated hookup wire, at least. Bolt the OP590 in place using 4 BA x 6 mm bolts and lock washers under the nuts. Wire the output of the ETI-499 module to the fuseholder. Then wire up the OP590, the low-Z output socket and line output terminals.

The ETI-499 power amp module can now be mounted. First, however, wire up the twisted-pair input from the preamp. Apply thermal compound to the heatsink bracket on the power amp module and then bolt the module to the heatsink using 2 BA x 12 mm screws and lock washers under the nuts.

Now do a double check of all your interwiring. Using an ohmmeter, ensure there is no dc path between the preamp-power amp signal earth and the case. If all seems well, install a three-pin on the mains cable and you're ready to power up for a test run.

Testing it

Set all level controls to the minimum position (fully anti-clockwise). Connect a loudspeaker to the appropriate output (either low-Z or line output). Turn the ALC off. Insert a microphone in the appropriate jack — according to what mic you have and how you've configured the inputs. Hold your breath . . . and turn on. Advance the mic level control and the volume control and talk into the mic. The sound should be clear and undistorted. If you have any problems, switch off and trace the fault before continuing.

Assuming all is well at this stage, obtain a cassette deck or tape recorder and plug it into the auxiliary input. Play a pre-recorded tape and see that the sound is clear and that the gain controls have plenty of 'room to move'. Next, try recording on tape, taking the recorder input from the preamp output jack while speaking into the mic.

Try out the effect of the ALC. There should be a dramatic difference in the dynamic range when speaking, without noticeable distortion.

Note that the speech filtering in the mic circuits reduces the bass and 'softens' plosive sounds like 'p' and 't'. The steep roll-off above 3 kHz contributes to making the voice sound less 'natural', but dramatically improves intelligibility when extraneous noise is present. There is no filtering on the auxiliary input and the bandwidth is only limited by the output transformer.

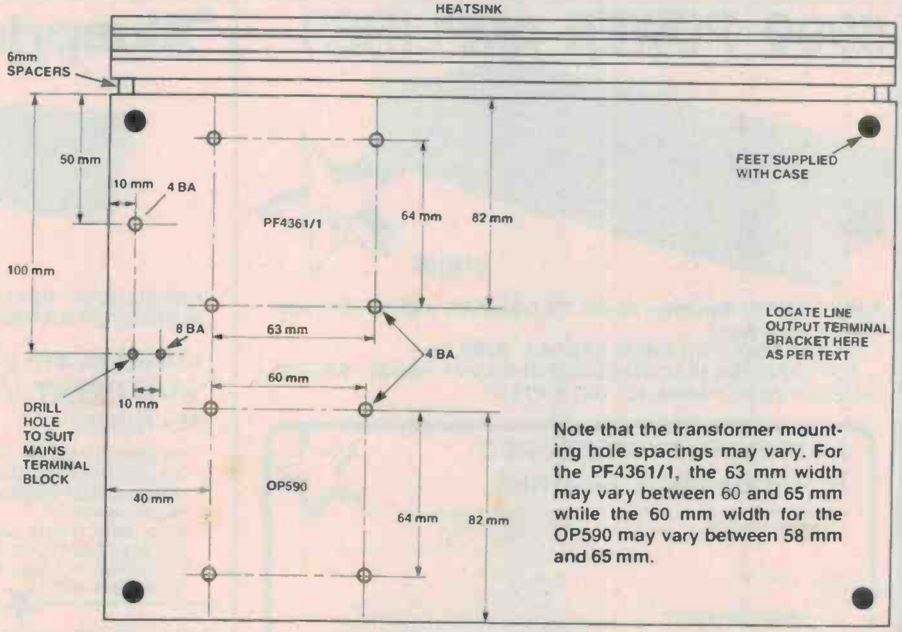
Conclusion

In use, the ALC needs to be employed with care — it is not necessary on all occasions. It is generally most effective when other sources of extraneous noise are present in the area.

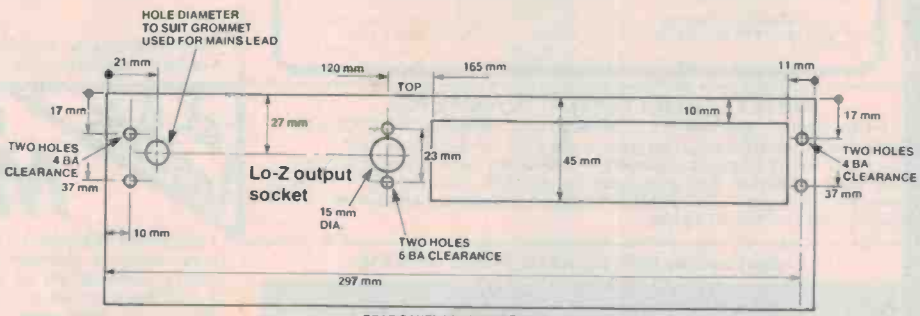
The heatsink proved more than adequate for the job, from experience, barely getting warm to the touch.

I think you'll find the ETI-488/499 PA very effective — may it 'cut through the mush' for you every time! ●

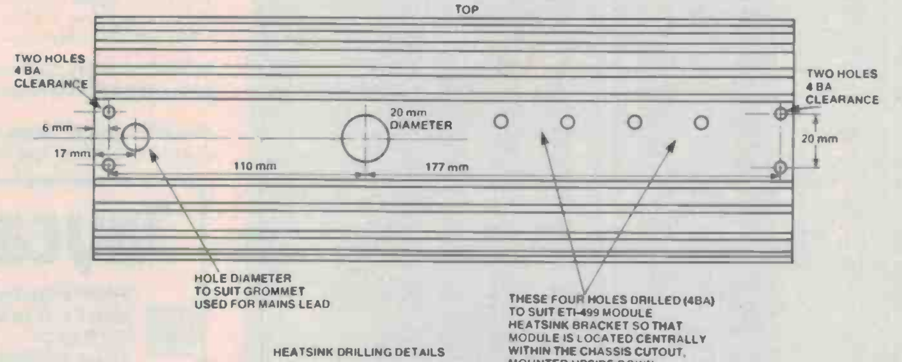
ARTWORK: Full-size reproductions of the pc board and front panel artwork are available from ETI by sending an A4 stamped, self-addressed envelope to ETI-498/499 Artwork, 15 Boundary St, Rushcutters Bay NSW 2011.



DRILLING DETAILS — BOTTOM OF CASE



REAR PANEL DRILLING DETAILS



HEATSINK DRILLING DETAILS

NOTE: The front panel is best marked out and drilled using the preamp pc board as a template. The output fuseholder and mains power switch are located at the extreme right of the front panel, at top and bottom, respectively. The front panel artwork or Scotchcal panel may be used to locate hole centres for these, and they mount directly on the panel. Drill clearance holes for the preamp controls and input jacks, 2 — 3 mm oversize.

Add-on sequencer for our percussion synthesiser

Design: **Ray Marston** Development: **Geoff Nicholls**

This sequencer enables you to 'program' a rhythm sequence of up to eight steps on the percussion synthesiser for automatic accompaniment.

THIS IS the sequencer unit promised in our Percussion Synthesiser project published in the April issue. It is a straightforward add-on unit that can provide a variety of 'programmed' rhythms, employing one or both channels of the synthesiser, with up to eight steps in the sequence. In addition, a variable control allows you to set the tempo of the rhythm sequence set-up. Two dual-in-line-package (DIP) switches, with eight switches each, are employed to choose the rhythm pattern, one DIP switch package for each channel output.

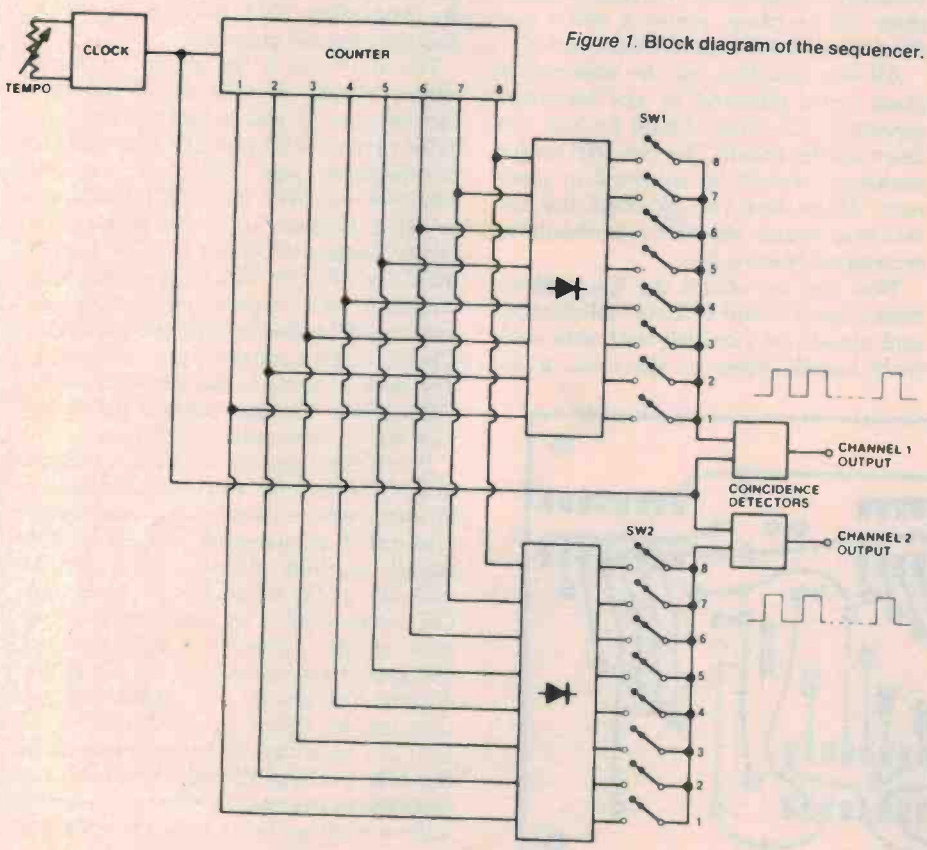


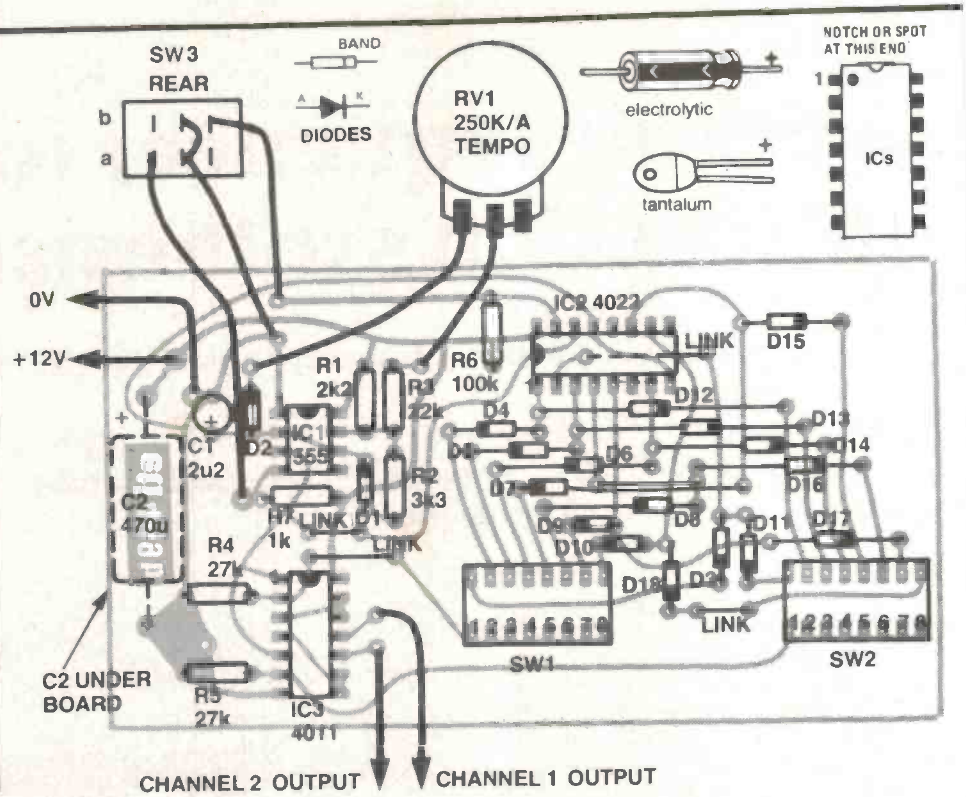
Figure 1. **Block diagram of the sequencer.**

Design

Figure 1 shows the overall arrangement of the sequencer unit. A clock oscillator drives an 'octal' counter. One of the eight outputs goes high with each clock cycle, each output going high in turn — 1, 2, 3, 4 . . . 8. Each output of the counter is connected to one switch in each of two switch banks — SW1 and SW2 — via a diode, which provides isolation between the switches in each bank. If switch 1 of SW1 is selected, the first output of the counter ('1') will be passed to the input of a 'coincidence detector'. This pulse is gated with the clock pulse in the coincidence detector as the counter outputs are one clock cycle wide and the coincidence detector effectively 'shortens' the output pulse to the same width as the clock pulse (5 ms). The output of the coincidence detector connects to the 'SEQ. IN' line of the relevant channel on the Percussion Synthesiser. The same goes for any of the switches.

Closing switches on SW1 and SW2, while leaving others open, provides a pulse train that generates the required rhythm. For example, closing switches 1, 3 and 4 will generate a waltz rhythm.

The clock 'rate' or repetition frequency can be varied by means of a potent- ▶



PARTS LIST ETI-469B

Resistors — all ½W, 5% unless noted

R1	2k2
R2	3k3
R3	22k
R4, R5	27k
R6	100k
R7	1k
RV1	250k/A pot.

Capacitors

C1	2u2/20 V tant.
C2	470u/16 V axial electro.

Semiconductors

D1-D18	1N914, 1N4148
IC1	555
IC2	4022
IC3	4011

Miscellaneous

SW1, SW2	8-pole DIP switches
SW3	DPDT toggle switch

ETI-469B pc board; four 6 mm spacers; four 25 mm 4 BA countersunk head bolts; four 4 BA nuts and washers; hookup wire.

Price estimate
$18 — $20

iometer to vary the tempo of the output rhythm pulses.

Construction

This is quite a straightforward project to build. Contrary to popular assumption, however, all the components *do not* mount on the non-copper side of the pc board! If you peruse the component overlay diagram you will note that C2 is mounted on the track side of the board. This is to provide clearance when mounting the project in the case housing the Percussion Synthesiser.

There are five links on the board and these should be inserted first — one of them is partly under IC2. Note that one link is located between the positions of D6 and D7 and is not identified on the overlay with the word 'LINK'. Use 22 or 26 gauge tinned copper wire for the links. You could use insulated hookup wire but tinned copper wire is generally more convenient.

Tackle all the diodes next. There are 18 of them and you need to take care with their orientation. Having soldered them all in place, pause a while and check each one for correct orientation.

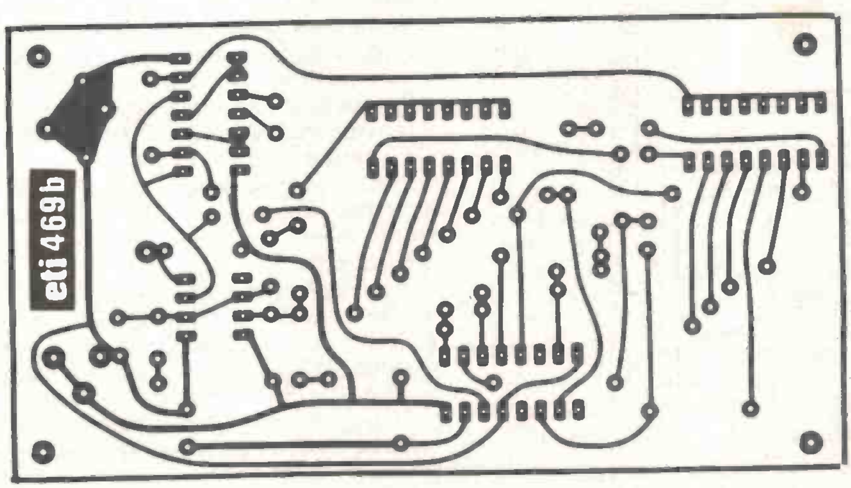
All the resistors can be soldered in place next, followed by the tantalum capacitor, C2. This should be laid flat down on the board. The two DIP switch packages should be soldered in place next. Make sure you get them the correct way round: the 'ON' side should be orientated toward IC2.

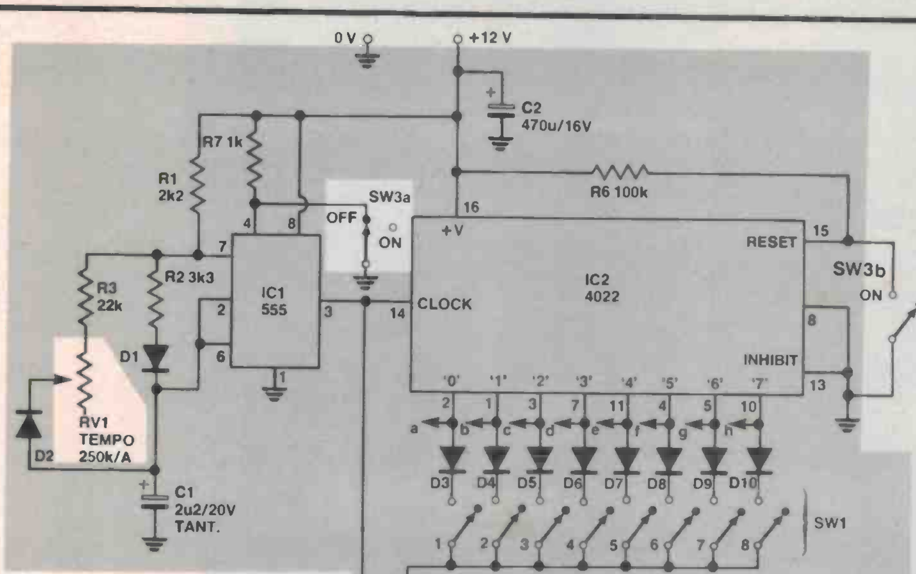
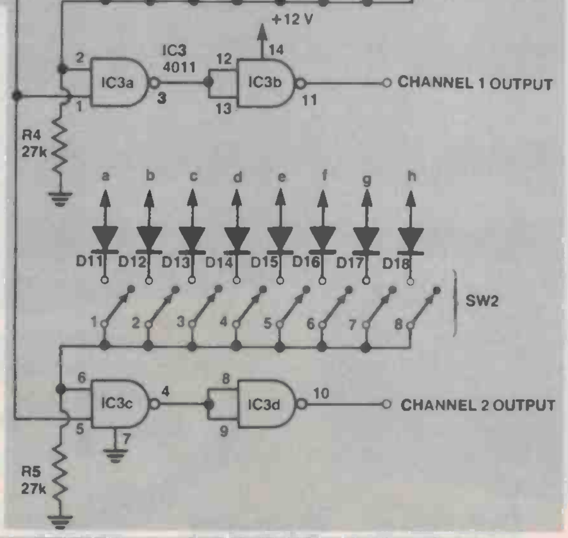
Now you can solder the ICs in place. Note that IC2 and IC3 are CMOS types and should be handled with due care. Only handle them by the ends; avoid handling the pins. When you insert them solder pins 8 and 16 of IC2 first; with IC3, solder pins 7 and 14 first. Having soldered these (the supply and 0 V pins), solder all the other pins.

Finally, solder C2 in place on the copper side of the board and attach leads for connecting RV1, SW3, 0 V, +12 V and the channel outputs.

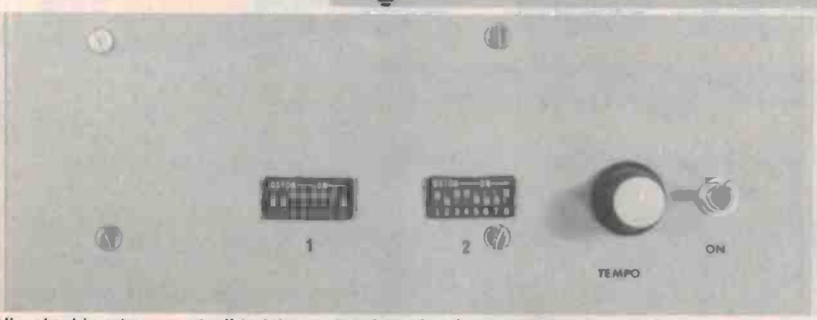
The unit can be tested very simply before wiring it into the Percussion Synthesiser, if you so desire. Temporarily wire up RV1 and SW3. Set RV1 to mid-position and SW3 off. Set all switches on SW1 and SW2 to the on position. Connect a crystal earpiece on either output. Connect a 12 V supply and turn SW3 on. You should get a loud clicking in the earpiece if all is well, and varying RV1 should vary the click rate. Check that the other output is working. Try setting some of the switches of the DIP switch for that channel off to see how the rhythm pattern changes.

If you don't get the anticipated result at first, switch off and check the board for dry joints, missed joints, incorrectly orientated components, etc. With the supply applied, check supply pins of each IC, *at the IC pins*. If it checks out OK, switch SW3 on again and, using your crystal earpiece (handy piece of test gear, that!), check pin 3 of IC1 for an output. You should get a loud clicking that can be varied by varying RV1. If not, you may have IC1 inserted back to front or perhaps diodes D1 or D2 are incorrectly orientated. Check the latter with a multimeter. Check that SW3 is correctly wired.



Timing diagram for IC2 (4022).



View looking down on the lid of the synthesiser showing the sequencer installed.

HOW IT WORKS — ETI 469B

General operation of the sequencer is explained in the main text. The 'clock' here is provided by a 555 timer, IC1, the octal counter is IC2 and the two 'coincidence' detectors are formed by gates IC3a and IC3c.

The 555 is arranged as an astable oscillator generating a non-symmetrical output of 5 ms-wide pulses, the inter-pulse period being variable over a considerable range by means of RV1, the 'tempo' control. (See also 'Lab Notes', May 1981, page 66). The charge and discharge paths of the timing capacitor, C2, are separated by means of D1 and D2 respectively, and thus the charge and discharge time constants can be controlled independently. R1-R2 largely determine the charge time constant by setting the pulse width here, while RV1-R3 determine the discharge time constant. Varying RV1 will vary the pulse repetition rate.

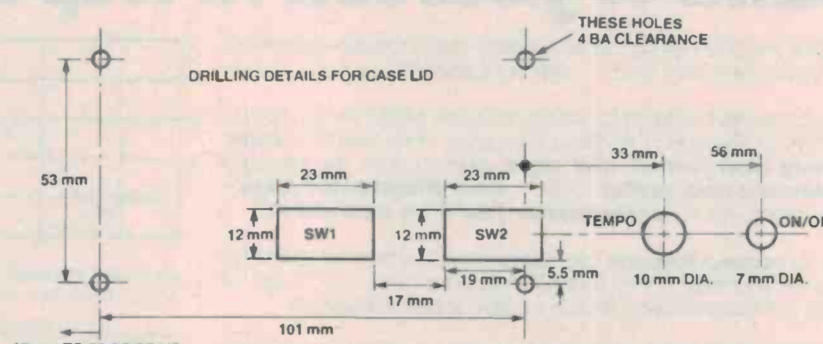
The output of the clock, IC1, drives the input of the 4022 counter, IC2. This is an 'octal' (i.e: 'one-of-eight') counter chip having eight decoded outputs. Each output goes high in turn for each complete clock input cycle. So the '0' output goes high first, then the '1' output, then the '2' output and so on until the '7' output goes high when the whole sequence repeats. Each output can be selected by a switch from the DIP switch packages, SW1 and SW2, coupled to the switch via a diode so that pulses are not coupled from switch to switch. Any output selected by a switch goes to one input of a NAND gate — pin 2 of IC3a for channel 1, pin 6 of IC3c for channel 2. The other input of each of these gates (pins 1 and 5 respectively) are driven by the clock pulses. Looking at IC3a, pins 1 and 2 will be high only for the duration of a clock pulse and thus the gate output, pin 3, will be low for 5 ms during the time whichever counter output selected occurs. IC3b is simply an inverting buffer and pin 11 goes high for 5 ms whenever the selected counter output goes high. Similarly for IC3c and d.

The sequencer is powered from the synthesiser board. To turn the sequencer off when not required, SW3a shorts the RESET pin (pin 4) of the 555 (IC1) to 0 V, preventing it operating and causing the output (pin 3) to go low. At the same time, SW3b allows the RESET pin of IC2 (pin 15) to be pulled high, via R6. This sets outputs '1' to '7' low and output '0' high, as can be seen from the timing diagram at left. If pole 1 of SW1 or SW2 happens to be closed, no output will result as the clock output (pin 3 of IC1) is low. Thus the DIP switches, SW1 and SW2, may be left 'programmed' and not affect the operation of the synthesiser, as the channel 1 and channel 2 outputs will be low while the sequencer is turned off. In addition, when SW3 is switched to the ON position, the sequencer will commence automatic operation at the start of the programmed sequence and not at some random beat.

If the 555 output is OK check each output pin of IC2. You should get a regular clicking at ⅛ the clock rate. Again, varying RV1 should vary the click rate. With a multimeter, and while the sequencer unit is disconnected from the power supply, check that pins 8 and 13 of IC2 are connected to the 0 V line and ▶

VARIATIONS

If you find the tempo control covers too wide a range for your tastes, then use a 100k/A potentiometer instead. You can set the maximum tempo by changing the value of R3. You'll probably find it too fast anyway when RV1 is at minimum resistance, so its value should be increased. Try 100k, for starters.



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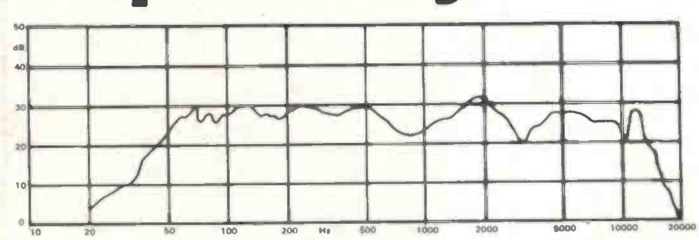

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Neville Williams & Leo Simpson
(EA, March 1982)

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DICK SMITH Electronics

SEE PAGE 34 FOR ADDRESS DETAILS

DSE/A285/PAI.LM

From page 69

that pin 15 is shorted to 0 V when SW3 is turned to the *on* position. If there are any problems, sort them out before continuing.

If IC2 checks out OK, see that the output pulses are getting to pins 2 and 6 of IC3. Just close one switch in each DIP switch package for this test. If signals are present here, check pins 3 and 4 of IC3 (the outputs of IC3a and IC3c, respectively). Note that these outputs are normally high (at +12 V) and go low (0 V) on the receipt of coincident pulses at the gate inputs.

Mounting

We mounted our sequencer unit in the lid of the box of our Percussion Synthesiser, as shown in the accompanying photographs. The 'tempo' potentiometer and on/off switch are mounted adjacent, as detailed in the accompanying drilling/cutout diagram on page 69.

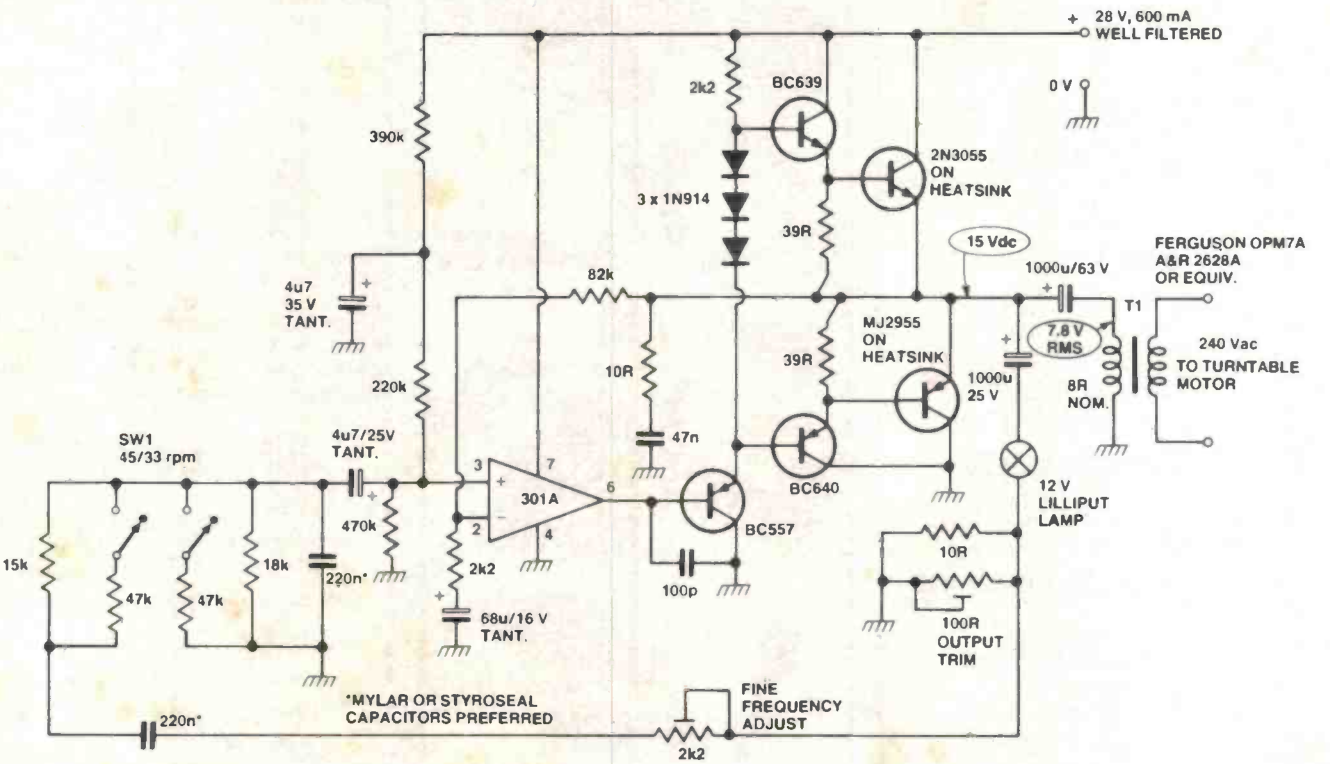
The best way to go about mounting the sequencer unit is to first drill holes for the on/off switch and tempo pot, as shown. Measure up and mark out the positions with a soft pencil (HB is fine) and centre-punch the hole positions. Drill from the *top* side of the lid to avoid burrs or blemishes appearing on the outside surface. Next mark out the cutouts for the DIP switches — not the pc board mounting holes, they're last. The DIP switch cutouts are best cut using a small jigsaw (the MiniTool model 000.62.108 is ideal for the job — see the April issue), but the 'traditional' hobbyist's technique of drilling around the inside of the marked cutout, removing the material and then filing the edges is effective, though care needs to be exercised with the file to get a neat appearance. Less filing is necessary, and it's easier, when a jigsaw is used.

With the DIP switch cutouts completed, fit the board from the underside of the lid, pushing it hard up against the lid. Carefully mark the pc board hole positions, using the board as a template. Remove the board, centre punch the holes and drill them to clear 4 BA bolts. Countersink the holes on the top side of the lid.

Now the pc board can be mounted on the lid. It is spaced away from the under surface by four 6 mm spacers. These allow the DIP switches to project through the top surface of the lid while not jamming the components on the board against the lid. With that done, mount and wire up SW3 and RV1. Wire the sequencer unit to the synthesiser board and give it all a test run. If/when all is OK, complete the case assembly and your Percussion Synthesiser with Sequencer is ready to rock! (or waltz, or foxtrot . . .).

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.



Turntable speed controller

Philip Allison of Summer Hill NSW submitted this useful idea.

This device was designed to vary the supply frequency to the motor of a synchronous turntable, enabling correction of the 3-5% excess speed found with the unit. In addition, provision has been made for 45 rpm drive without the tedium of belt changing — a feature useful to owners of expensive single-speed turntables like the Linn Sondek. Other advantages of this circuit include a steady voltage output and low distortion compared to the mains. Note that one can also slow down those pop recordings that appear to be recorded at slightly high speed, producing a more 'natural' sound (maybe the apparent fast speed is deliberate? — Ed.)

The circuit is based around the ETI-452 Guitar Practice Amp power output stage (this appeared in the January 1980 edition but the ETI-453 General Purpose Amp Module, April '80, uses the same circuit — Ed.) I have made some modifications and additions, as shown in the circuit diagram, converting it to a power Wien Bridge oscillator using a 12 V lilliput bezel lamp as the stabilising element. I used a 2N3055 and MJ2955 combination for the output stage (though this is unnecessary — Ed.). The output transformer came from a discarded valve hi-fi amp, but others with a 30:1 ratio and at least a 12 W rating should be fine. A power transformer is not recommended here as I found they had poor efficiency.

The 100 ohm trimpot is adjusted to give 240 Vac with the turntable connected. A strobe disc allows setting the correct speed (using the 2k trimpot). Component tolerances may necessitate small adjustments to be made to the Wien Bridge capacitors or resistors to give the desired frequency range. Extra resistors are switched in circuit to increase the frequency for 45 rpm operation.

Any ideas?

Have you had a bright idea lately, or discovered an interesting circuit modification? We are always looking for items for these pages so naturally, we'd like to hear from you.

We pay between $5 and $10 per item — depending on how much work we have to do on it before we publish it.

The sort of items we are seeking, and the ones which other readers would like to see, are novel applications of existing devices, new ways of tackling old problems, hints and tips.

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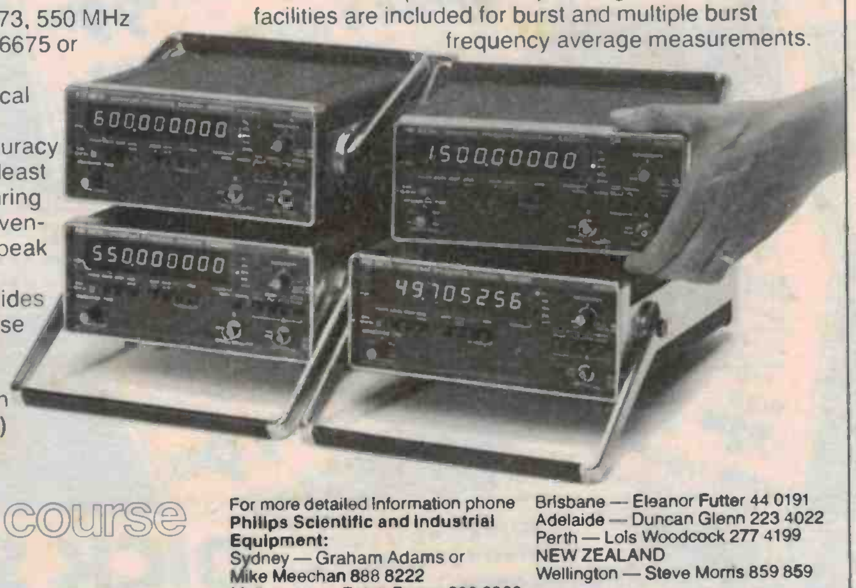

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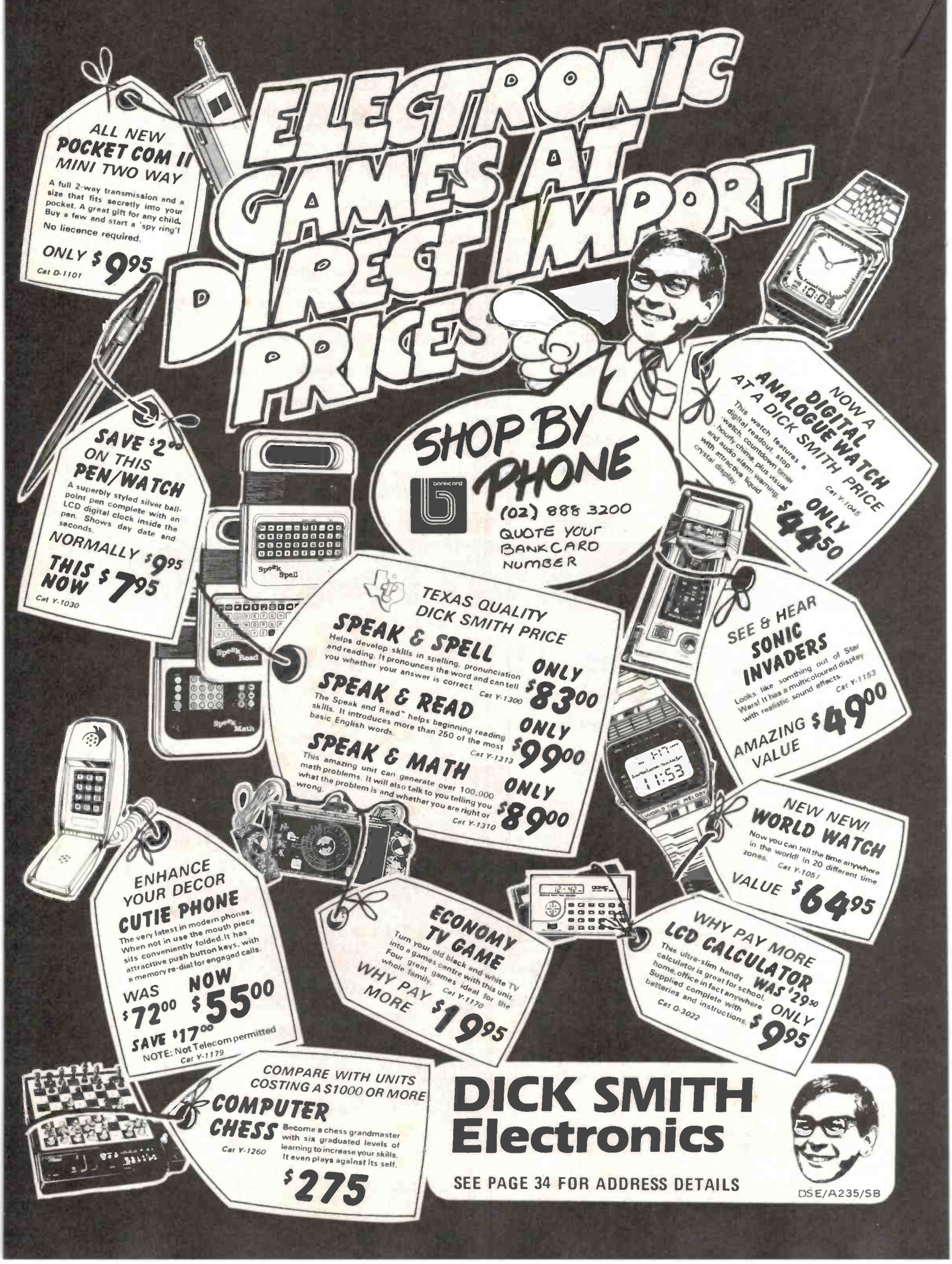
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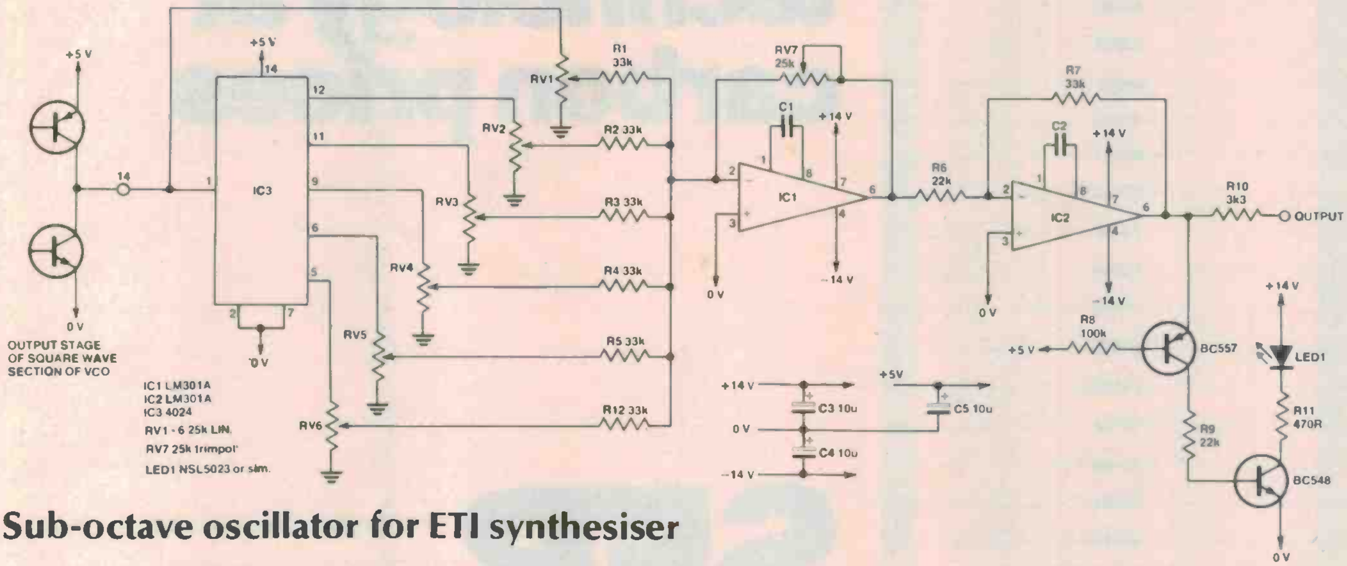
Ideas for Experimenters



Sub-octave oscillator for ETI synthesiser

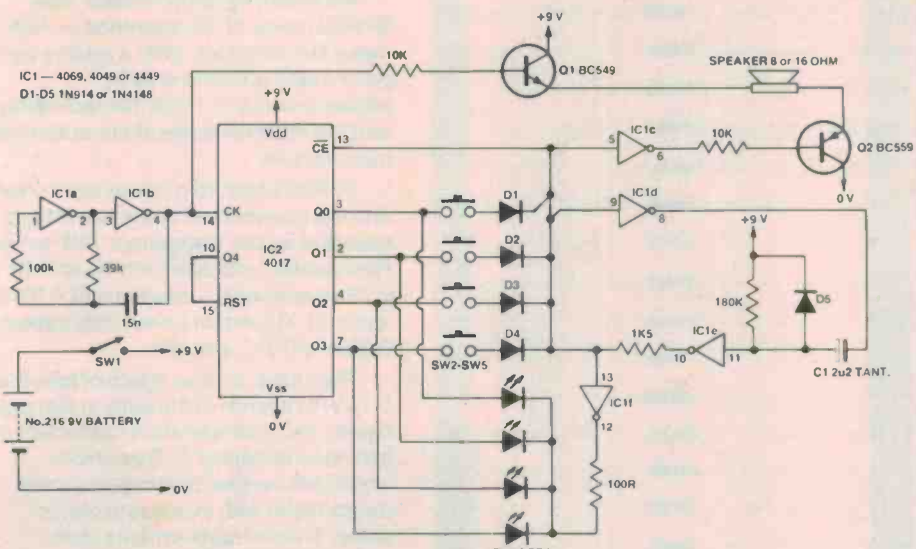
Ken Stone, of Cheltenham in Victoria, devised this sub-octave oscillator for his ETI synthesiser and passes it on for other ETI synth owners.

Each sub-octave is created in the 4024 (IC3) by the division of the original frequency. Five sub-octaves are created and mixed together, along with the original square wave, in a mixer which is based on the synthesiser's mixer (board 601b). No level control is put on the front panel; level can be adjusted by RV7. This is because the unit is installed between one VCO's square wave out position on the waveform selection switch of the VCO, allowing the volume to be controlled by the existing mixer.

When using the unit, switch the VCO 'range' control to one of the higher frequencies.

The sub-octave unit could be mounted in a utility box bolted to the top of the synthesiser. It can be used to create 'warm' and deep 'feelable' sounds.

Pick the winner!



This idea, from **J. Gallant of Tasmania,** is useful in competition situations to provide an impartial method of determining which competitor pressed a button first.

The circuit operates as follows. IC1a and b operate as a square wave oscillator with a frequency of about 1 kHz. This clocks the 4017, causing it to scan the switches. If one is closed, the high from the 4017 output will be fed through that switch to the 4017 CE input, which then keeps that output high. At the same time, the appropriate LED is turned on, and the speaker emits a 1 kHz tone.

Now, IC1d and e form a monostable with the input to IC1d normally kept low by IC1e, which has its input pulled high by the 180k resistor on its input. Thus the output of IC1d is normally high, so C1 is discharged. When the input to IC1d is pulled high by the closed switch, its output goes low, pulling down the input to IC1e through C1. C1 now starts to charge up through the 180k resistor. When the voltage across it reaches the inverter input threshold, the monostable reverts to its original state and C1 discharges through D1. The LEDs and speaker are then turned off; the monostable period is about two seconds.

Current drain is fairly low in the quiescent state and a 216 type 9 V battery will power this circuit for a fairly long time, as it is normally only used intermittently. None of the components are critical, and the oscillator frequency and monostable period could be changed if desired.

Ideas for Experimenters

Temperature probe for a DMM IDEA OF THE MONTH

Ian Hogan, Linden Park SA

The circuit diagram below is for an adaptor unit which converts a digital multimeter, which has a 200 mV range, into a digital thermometer. The temperature can be read directly, as 1 mV corresponds to 1°C.

As shown, the circuit can be regarded as two sections. Section A is a regulated battery power supply. This is based on a circuit in ETI, Feb. '82 (p. 21). As configured, the output voltage is 7.4 V. Section B is the actual temperature transducer. The LM334 is a temperature controlled current regulator. Its current, I_t, is given by the equation:

$$I_t = F.T_k$$

where T_k is the temperature in °K, and F is the current-to-temperature ratio. The value of F is set by adjusting RV3. In this circuit F is set to 1 uA/°K.

Now, RV2 is set to 1k so the potential drop across it, E_t, is given by:

$$E_t = I_t.1000$$

Therefore, substituting for I_t, using the first equation and the given value of F, we find:

$$E_t = 10^{-6}.T_k.10^3$$

and so,

$$E_t = T_k/1000$$

Hence the potential drop across RV2 (in millivolts) corresponds *directly* to the temperature of the LM334, in °K.

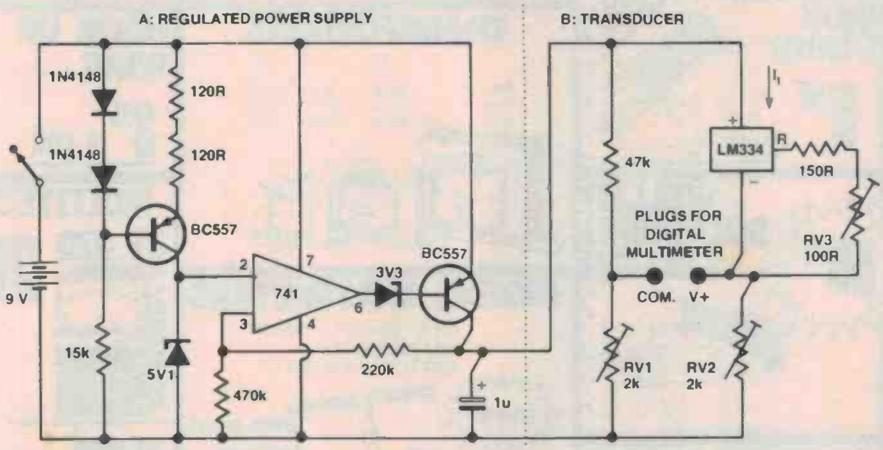
However, we want the temperature to be in °C, and we know that:

$$T_k = T_c + 273.2$$

where T_c is the temperature in °C. So the 47k resistor and RV1 are set up as a voltage divider, to provide an offset voltage of 273.2 mV. So the voltage across the multimeter plugs, in millivolts, corresponds directly to the temperature of the LM334, in °C, as desired.

The device was built on a small piece of Veroboard, and housed in a very small zippy box. The banana plugs for the multimeter were screwed directly onto the back of the box, so the unit sits on top of the multimeter. The LM334 was put into a probe on the end of a short piece of cable. The leads were soldered onto the cable, and each covered with heat-shrink tubing to prevent shorts. The probe body was formed from a larger piece of heat-shrink tubing. The top half of the LM334 was allowed to protrude, to provide good thermal contact with the body being measured.

Before the leads to the probe are connected, adjust RV2 to 1k as accurately as possible. Then adjust RV1 to give 273.2 mV potential drop. Finally, with the probe connected and immersed in ice water, adjust RV3 so that there is no potential drop across the multimeter plugs. The probe should be wrapped in plastic to protect it from direct contact with the ice water.



✱ '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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ETI-645 Turtle Robot

As notified last month, a complete kit of parts for this project is being offered at a special introductory price by Flexible Systems, and ETI is acting as a clearing house for orders and despatching kits; see page 47 for further details. You can call into our Sydney or Melbourne offices during business hours to see a Tasman Turtle and purchase kits. In Sydney, you'll find us at:

4th Floor, 15 Boundary St,
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Note that 'Tasman Turtle' is a registered trademark of Flexible Systems.

ETI-498 PA Amp

This project will be widely available, most kit suppliers having indicated they will be stocking it in one form or another. The ETI-499 MOSFET power amp module used in the PA amp is readily available in kit form, too.

For those not constructing this kit in the case described in our article, components, pc boards, transformers, etc, should be readily available from kit and component suppliers. Suitable cases are *legion!* For those looking for something *rugged*, you should ogle a new range of rack-standard cases from Altronics in Perth. They're obtainable in standard rack heights with natural aluminium or black anodised finish. A standard 87 mm high box costs around $45, has tons of room and should last a lifetime. Altronics are located at 105 Stirling St, Perth, (09)328-1599, or on the other side of P.O. Box 8280, Perth 6000 WA.

The Ferguson OP590 output transformers are the only ones we've been able to find for the job, but constructors should have few difficulties obtaining them. They aren't cheap, but they're way ahead of whatever's in second place!

ETI-469B Sequencer

The ETI-469 Percussion Synthesiser featured in the April issue made mention of an add-on sequencer for auto-rhythm accompaniment. This issue describes the promised sequencer and all suppliers carrying the percussion synthesiser kit have indicated they'll be stocking the sequencer. The only 'non-stock' component is the 250k/A tempo potentiometer, but, as one was required in the synthesiser, constructors should have little trouble obtaining one — for those assembling the unit for themselves. In any case, a 100k/A pot may be substituted, as explained in the text.

PC Boards, panels etc.

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

RCS Radio
651 Forest Rd
Bexley NSW 2207

All Electronic Components
118 Lonsdale St
Melbourne Vic. 3000

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

Radio Despatch Service
869 George St
Sydney NSW 2000

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

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

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

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

Sunbury Printed Circuits
10 Counihan St
Sunbury Vic. 3429

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

Rod Irving Electronics
425 High St
Northcote Vic. 3070

VK2ETI on the air!

The Electronics & Communications Club of Murray Publishers, publishers of ETI and 21 other specialist titles, has been granted the callsign of VK2ETI following representations to the D.O.C. when renewing this year's licence.

The club, formerly known as the Modern Magazines Electronics & Communications Club, recently changed its name as the publishers had a name change. The club had held the callsign VK2DTE since October 1980.

VK2ETI does not have a 'fixed' set-up as yet, but plans are afoot. The club station has been activated on two metres recently. If you hear us on the bands, give us a call!

Shuttle comms

Like a boy scout — be prepared for the next Shuttle flight. You can receive Shuttle downlink frequencies if you have the right equipment, some being in the SHF 'S' band, others being on VHF.

In the 'S' band, the astronaut voice downlink frequencies are centred on 2287.5 MHz primary and 2217.5 MHz secondary. You may also find FM data transmissions and TV signals around 2205 and 2250 MHz.

Back-up communications may be found on 243.0 MHz, 259.7 MHz and 296.8 MHz, predominantly on voice. You're going to have to be resourceful with your receiving system as very little commercially available gear covers those bands. But it could be interesting . . .

Spurious sidebands

Phase IIIB OSCAR launch has been delayed until this month owing to a problem with a recently launched European Space Agency satellite yet to be solved. Apparently, a plasma ring formed around the satellite causing corona discharge problems, and a 'freeze' on future Arienne launches has been implemented until it's solved. (Westlink Report).

BY1PK, Peking, China is on the air. Reported operational since March 25, when the Communist Chinese government authorised limited "club station CW-only operation on 15 and 20 metres". 21 030 kHz is reported to be the best frequency, 0200-0600 Z daily. (Westlink Report).

Six metres hot with activity levels and dx reported as 'better than last year'. Long haul VK5 to W5 (South Australia — Texas) contacts have been noted amongst some good openings to the Pacific and Asian regions. Them sunspots have a lot more life in them yet! (Thanks to Graeme, VK2ZZV).

'Pro' scanner from Tandy

Tandy's PRO-2002 scanning receiver covers the range from around 70 MHz to 500 MHz in four bands and can be run from 240 Vac mains or 12 Vdc supply.

The receiver, manufactured under the Realistic label, covers 68-88 MHz, 108-136 MHz, 144-174 MHz and 410-512 MHz, and features a comprehensive digital display that can show channel number, time and frequency with ease.

The PRO-2002 can handle both AM and FM transmissions at the push of a button and is promoted as their 'Rolls Royce' scanning receiver. It sells for $495.95 retail, catalogue No. 20-9116. Enquire at your nearest Tandy outlet.

New Vicom releases

Vicom International recently released a new range of VHF/UHF power amplifiers, SWR meters and antennas.

Seven new Tono VHF/UHF amplifiers were released, five for 2 m with outputs ranging up to 210 W. One model, designed for the handheld owner, delivers 45 W from 3 W input. Most feature an in-built preamp giving up to 13 dB gain. Two 70 cm band models were also released with outputs of 45 W and 65 W, the latter also featuring a preamp.

Three new Daiwa meters have been added to Vicom's extensive range, all featuring the unique 'cross needle' principle. The CN630 N is designed for the serious VHF/UHF enthusiast, being identical with the popular CN630 but having N connectors fitted. Specified frequency range is 140-450 MHz, and power ranges are 20 and 200 W fsd. In addition, the new CN510 is a compact unit covering 1.8-60 MHz and power ranges of 20 and 200 W. The model CN540 is also new to the range, being identical with the CN150 but covering 50-150 MHz.

Three new antennas have been added to Vicom's collection: the GPV5, a 2 m collinear comprising two ⅝ waves in phase plus decoupling radials with a height of 1.7 m and a claimed gain of 6.8 dB; the GPV7, a 70 cm collinear comprising three ⅝ waves in phase plus decoupling radials with a height of 1.7 m and claimed gain of 6.8 dB; and for the dual band enthusiast, there's the GPV720, designed for operation on both 2 m and 70 cm. Again a collinear, it has a height of 1.1 m and a claimed 2 m gain of 2.8 dB and 70 cm gain of 5.7 dB.

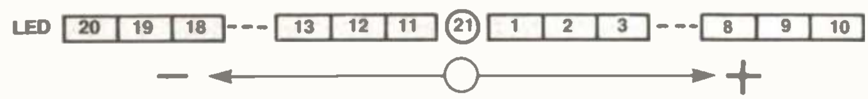
For further information on these products contact Vicom International, 57 City Rd, South Melbourne, Vic. (03)62-6931, or 339 Pacific Highway, Crows Nest, NSW, (02)436-2766.

Centre zero LED bar/dot meter

D.H. Dawes
Granville NSW

THIS CIRCUIT drives twenty LEDs with a single bar/dot driver. Ten LEDs (green) are for a positive input signal and ten LEDs (red) for a negative input signal. A yellow LED, which is lit permanently, gives the centre zero indication. The LEDs would, for best effect, be mounted on a panel as shown below:

CENTRE ZERO BAR/DOT METER



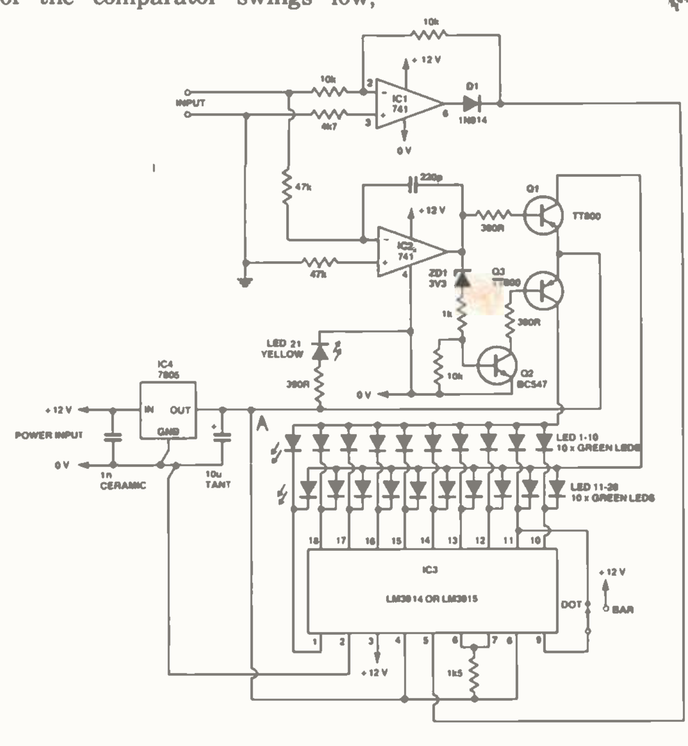
When used in the bar mode, the bar of light elongates to the left for an increasing negative signal and to the right for an increasing positive signal.

The circuit runs from a single 12 Vdc supply. A 5 V regulator is included, which serves both to power the LEDs and to provide a reference line for the positive and negative input signals.

IC1 is connected as a simple (but effective) 'absolute value' amplifier. This drives the LM3914, which will only accept positive input signals. IC2 is connected as a comparator, and serves as a polarity indicator. When the input is positive the output of the comparator is high, which drives Q3 via ZD1 and Q2, enabling LEDs 1-10.

When the input is negative, the output of the comparator swings low, switching off Q3 and switching on Q1, which enables LEDs 11-20. As there is no gain in the absolute value amplifier, the full-scale reading is equal to that set by the internal reference of IC3. This means that the full-scale value of this circuit is about ±1.2 V. This value can be altered by conditioning the required input signal. The LM3915 may be substituted for the LM3914 if a logarithmic, rather than a linear, scale is desired.

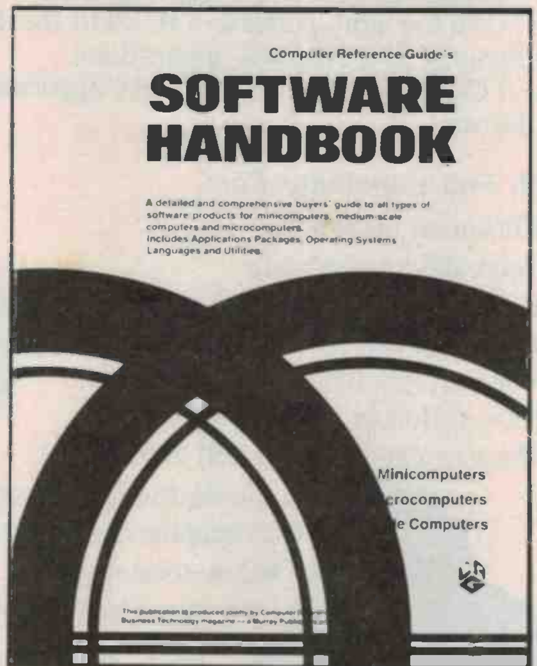
This circuit can, apart from its obvious applications as a general centre zero meter, be used to display the difference between two voltage levels, e.g: a reference level and an unknown level. In this application the position on the circuit marked 'A' would be separated from the +5 V line and would be connected to the reference voltage. The unknown voltage to be compared would be connected to the input terminal. Both the reference and the unknown would be referred to 0 V. The only limitation is that the reference voltage should be between 4 and 8 volts above 0 V when using a 12 V supply. ●



COMPUTER REFERENCE GUIDE'S SOFTWARE HANDBOOK.

Contents

The Australian Software handbook, released by Computer Reference Guide in March, has been designed to provide information and advice for prospective computer users and present computer users on software products available for most of the major micro, mini, and medium-scale computers sold on the Australian market. An important feature of this handbook is that it allows software packages to be indexed by two major criteria: Application and Machine type — providing easy reference according to need.



For further information:

COMPUTER REFERENCE GUIDE
Suite 204, 284 Victoria Avenue
Chatswood NSW 2067 Phone: (02) 419 3277

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"Why buy just a video game when you can get a full colour computer for this price."

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Learn more about Commodore, the micro-computer you can depend on. Call or write for the name and location of your Commodore dealer nearest you.

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

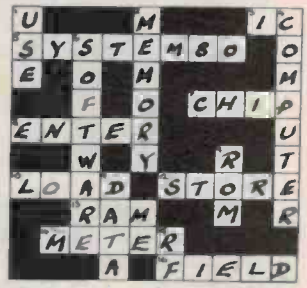
commodore
COMPUTER

MLVL1460a

COMPUTING TODAY

Batchelor girl wins System 80!

— December issue contest results



It was with a distinct feeling of deja vu that we selected the winner of the 1981 Dick Smith System 80 Contest — Ms Kay Pitman of Batchelor in the Northern Territory.

Why the deja vu feeling? — both winners of the 1980 System 80 Contest (Sept. issue) were women! On top of that, entries for the 1981 contest far outstripped those for the 1980 contest — which was one of the most successful contests we'd ever run!

It has taken us an enormous length of time to wade through the thousands of entries. Heavens, what a job! We were literally staggered at the response. Choosing a winner proved extremely difficult. There were many imaginative and clever entries, not forgetting quite a few who had innovative ideas as to how they would use a System 80.

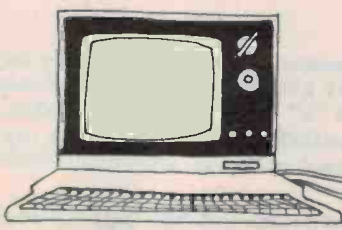
Apart from a large number of entrants who said they'd use a System 80 for applications like schoolwork and games playing, we had entries ranging from an industrial chaplain who wanted to use it as a sort of 'computer ambassador' to reduce computer fear, to a resident of King Island (where computers 'don't exist') who wanted to introduce islanders to the world of computers. There were entries from doctors who wanted to use the System 80 in statistical research into cancer, from teachers of the handicapped to aid in their work and from researchers and social workers who wanted to use the System 80 in their work with the unemployed. The variety of applications suggested are just too many to list here, but that's a representative sample.

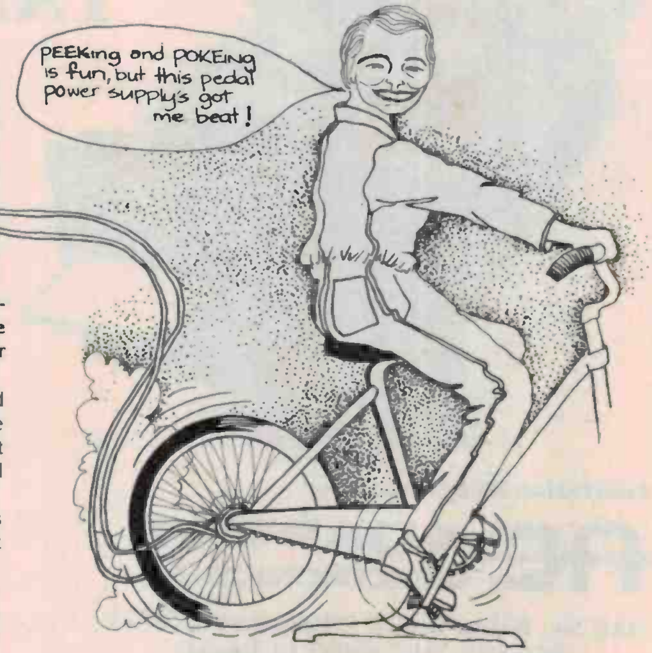
What did the winner have to say? Here it is: "Can the heartbeat of the 'chip' decade serve those whose heartbeat has been in this land for 50 000 years? If I had a System 80 I know it could help span the years. I train traditional aboriginals as teachers. The System 80 would be invaluable for vital research and curriculum development."

Congratulations, Kaye, you should be well advanced with your scheme for the System 80 by the time this appears in print. We wish you all success.

By the way, it might interest people to know that the Editor had to do a lot of persuading before he could get away with the 'Batchelor girl' crack in the heading of this article. He wants it firmly stated that he's neither sexist nor a bad speller — he just can't resist a good pun!

Finally, thanks to all those readers who entered and made the contest such a success.





Chromasette

Many readers know of CLOAD, the monthly cassette of seven programs from the US for TRS-80 Models I and III. There are far more buyers than subscribers, as most buy back issues through larger computer stores, avoiding the hassle of bank drafts.

You may not have heard of 'Chromasette' monthly from the same stable. It contains six to eight programs for the TRS-80 Colour Computer, or '80C'.

It got off to a good start in July 1981, with entirely fresh programs. In honesty, Chromasette have tossed in the odd Model I/III program recharged for 80C, but rarely. They have a huge user-base to draw on for programs. Often these have been so lengthy that they have had trouble squeezing them onto the tape, even though the 80C loads at 1500 baud (three times the Model I speed)!

Greg Wilson (P.O. Box 9, Potts Point NSW 2011) acts as their agent here.

For $55 in our money you get a cassette airmailed from the US every month for a year. Back issues are not as cheap, at $6 each.

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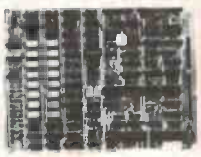

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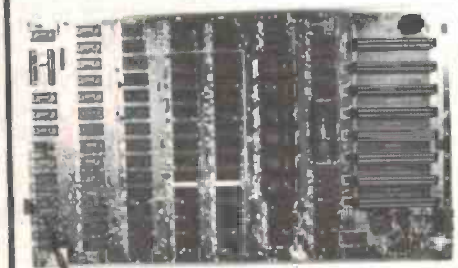
This intelligent CRT Controller is completely contained on a 6x6½" printed circuit board. The design is based on an 8085A Microprocessor and an 8275 Integrated CRT Controller. It features the following:

- 25 Lines, 80 characters/line
- 5x7 Dot Matrix
- 8085 CPU
- Two 8185s
- Two 2716s (1 for software, 1 for user programmable character generator)
- Serial interface RS232 and TTL
- Baud rates of 110, 150, 300, 600, 1200, 2400, 4800 & 9600.
- Keyboard Scanning System
- Uses +5V power supply and ± 12V power supply.

Bare Board $89.95 + Sales Tax

Orange Micro



(Price $275.00 + Sales Tax)

Features:

- runs Apple™ software.
- PAL is on main board, saves buying a PAL add on card.
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- board is fully socketed and has all passive components and crystal. Just add IC's, ROM's, keyboard, power supply and case.
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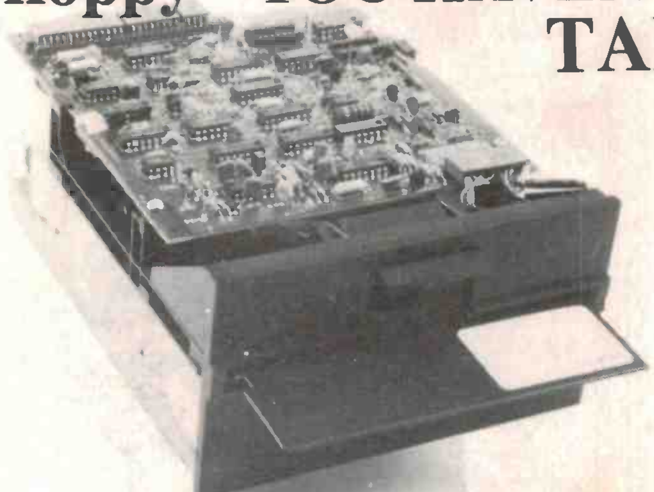
Telephone (03) 429 5844

If you're still looking for the best 5¼" floppy—YOU HAVEN'T FOUND US YET!!

TANDON TM100—S.



Tandon's TM-100 family of mini-floppies offer the absolute highest storage capabilities of any 51/4" high-speed, random access disk drive available in two single head and two double head models, single and double density.

Unsurpassed Storage Capacity - Up to an incredible 1000K bytes information on 160 tracks. Recording density is 5877 BPI.

Advanced Dual-Head Design - Tandom Magnetics has for years been the leading designer and supplier of read/write heads to most major disk drive manufacturers.

Increased Throughput - Tandon's TM-100 have a track-to-track access time of only 5 milliseconds (an incredible 3 milliseconds double track density.)

Proven Reliability - Designed for total reliability, as demonstrated by more than 50,000 production models in operation.

Australian Representative

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Printout

Four million pixels on hi-res CRT

The Philips M38-200, just released, is a new, very high resolution CRT which is capable of displaying four million (1728 x 2288) picture elements, say Philips.

It resolves the equivalent of 3000 TV lines in a nominal 15-inch (380 mm) diagonal format. This very high resolution permits the tube to give excellent quality graphic displays — or a minimum of 8000 complicated (including non-Roman or subscripted) characters in full detail, using for example an 18 x 32 dot matrix cell.

The M38-200 is said to be suitable for such applications as high-resolution facsimile systems, phototypesetting, CAD graphics, and full-page document displays in word processing.

The unrivalled resolution of the M38-200 is achieved by a specially designed electron gun in combination with the matching deflection coil, type AT1991. Distortion, deflection, defocusing and raster pin-cushion effects in the tube/coil combination are said to be negligible.

The same combination of tube and deflection unit can be used in both vertical (portrait) and horizontal (landscape) screen formats.

The M38-200 has a wide neck and a 70° deflection angle. Several phosphors are available, including W, WA and GH types, to match all applications.

Further Information, commercial and technical, is available from Philips Components, 67 Mars Road, Lane Cove NSW 2066. (02)427-0888

ITOH 8510 dot-matrix printer

Software Source have released a new printer manufactured by C-ITOH Electronics, the 8510.

Priced at under $900 including tax, the 8510 comes standard with friction and tractor feed, dot-programmable graphics, 100 character-per-second logic-seeking head with nine print-wires, giving remarkable clarity of print and full ascender/descenders on the upper and lower case character set.

A unique feature of the 8510 is that the pin-feed is **behind** the print platen, allowing printing on the top line of the first form of a box of paper, avoiding the usual wastage.

The 8510 is capable of printing with full incremental proportional spacing, and has an internal proportional mode which may be software-selected.

Also standard is a complete pre-programmed graphics character set giving square and round-cornered borders, angles, symbols, and various block graphics, as well as a complete set of Greek and mathematical symbols, a comprehensive set of general algebraic and trigonometric symbols, properly formed ½ and ¼, as well as a superscript and subscript character set.

Linefeeds may be software-selected in any number of one-hundred-and-forty-fourths of an inch and may be printed in either forward or reverse direction. All characters may be printed boldfaced or underlined, and characters per line may be selected from 40 to 136.

A serial version allowing a multitude of protocols up to 9600 Baud is available at an additional cost. Full details from Software Source, 89 Oxford St, Bondi Junction NSW.

Club Call

MICOM (the Microcomputer Club of Melbourne) has changed its meeting place to Burwood State College on Burwood Highway. Meetings are held on the third Saturday of each month from 2 pm to 5 pm, and cater for varying interests, such as beginners' problems in choosing a home or business computer and comparisons by experienced programmers of the relative merits of various program languages. MICOM also currently has one user group for CP/M users, which also meets monthly. For further information contact MICOM, P.O. Box 60, Canterbury Vic. 3126.

Friction feed for Epson printers!

Melbourne-based deForest Software recently announced the availability of a friction feed kit for the Epson MX70, MX80 and MX100 printers.

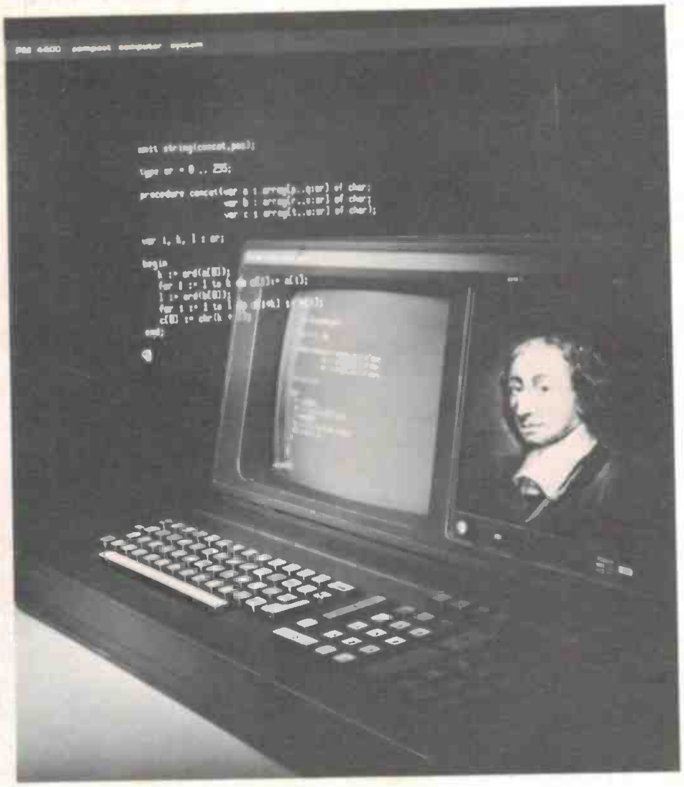
This kit installs in minutes and allows the printer to accept friction feed paper. This was the only drawback of the Epson printers, say deForest.

The unit sells for $55 and is available from deForest Software, 26 Station Street, Nunawading Vic. 3131. (03)878-9276.

Printout

'Universal' Philips development system

The Philips PM4421 is a complete tool for development of microcomputer and microprocessor-based products based on a variety of currently available microprocessors (e.g: 8085, Z80, 2650, R6500 family, 8400 family, 6800 family, M68000 and more).



It has the capacity to handle both 8-bit and 16-bit microprocessors as well as multi-microprocessor set-ups. Aids such as a text editor, assemblers and high-level languages are provided for the software designer, while the hardware designer is supported with techniques including real time in-circuit emulation, tracing and state analysis.

The PM4421 is housed in a single cabinet together with a video display, two mini-floppy disk drives and a detachable keyboard.

At the heart of the system is a Philips P851 mini-micro central processing unit. Other features are a 64K system memory and control units for the VDU, keyboard and floppy disks.

System memory is completely isolated from emulation memory to give full memory protection, essential when debugging systems under development.

The PM4421 has a multibuss-multiprocessor architecture so that real-time microcomputer emulation is as accurate and complete as possible.

This means that system functions (including buss and memory) and emulation functions are totally separate. In particular, the emulating microprocessor is not slowed down by any system management task or constraint.

No restriction whatsoever is placed on memory space addressing, I/O addressing or interrupt levels that can be accepted.

Further information on Philips' MDS is available from Philips Scientific & Industrial Equipment, 25 Paul Street, North Ryde NSW 2113. (02)888-8222.

Motorola micromodule memory-I/O expansion board

Motorola has introduced 'Micromodule 16', which provides RAM, ROM, I/O and timer expansion for the Motorola Micromodule series of 8-bit monoboard microcomputers.

Micromodule 16 incorporates 2K of static RAM, which can be backed up with an external battery and power-fail detect circuit, and mounts an additional four 24-pin sockets in which the user may install his choice of 1K, 2K, 4K or 8K EPROMs, MOS or bipolar PROMs, mask ROMs or pin-compatible RAMs for up to 32K of additional memory.

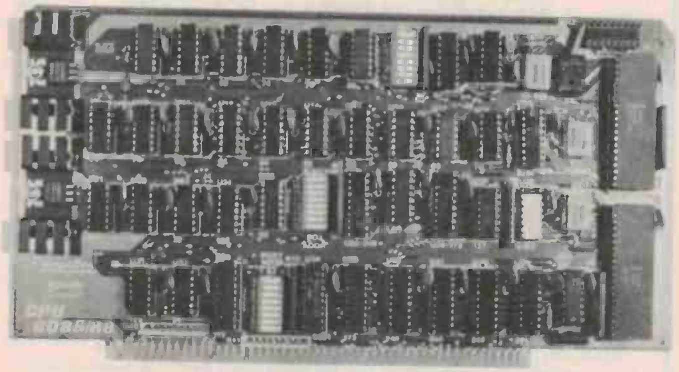
Both parallel and serial input/output are provided. The parallel I/O is shipped as a standard Centronics-type interface, but can be configured by the user as a buffered PIA port. The serial I/O is shipped as an MC6850 ACIA with user option for Baud rates from 50 to 19.2K and for RS-232C, RS-422 or RS-423 interface applications. The user can replace the ACIA with an MC6852 SSDA (Synchronous Serial Data Adaptor) if the system requires synchronous serial communications. An MC6840 triple, programmable, 16-bit counter/timer is included.

Other features of Micromodule 16 include 1 MHz or 2 MHz operation and on-board address, data and control buss buffers.

Micromodule 16 may be ordered in any of three versions. Immediate availability is through the factory and selected authorised Motorola Systems distributors.

16-Bit #1

In the past, 8-bit technology was all that was available in microcomputer chips. 16-bit technology was on the horizon, and the prospects were very exciting.



16-bit microchip technology is now a reality as operating systems and end user industrial and business applications software packages are now available.

By far the most exciting way of entering the field of 16-bit computing is via the 8085/88 S100 card, according to AED. It can completely support current 8-bit CP/M and other software as well as the new CP/M-86 and other 16-bit software. The card allows 8-bit software to run under the 16-bit disk operating system and 16-bit software to run under the 8-bit DOS.

If you wish, one program can contain both 8-bit and 16-bit code. The card runs the 8-bit 8085 and the 16-bit 8088 at 5 MHz. However, 8 and 10 MHz 16-bit chips are under development and these will both run on this card.

The card is imported into Australia by AED Microcomputer Products, 130 Military Rd, Guildford NSW. (02)681-4966.

16-Bit #2

Cromemco dealer Informative Systems announced in February a 16-bit dual processing unit (DPU) carrying a 68000 and a Z80A featuring error checking and correction (ECC) RAM, said to be available in Australia by July.

"The new upgrade path opened by Cromemco will maintain compatibility with existing 8-bit software while opening up the full 16 Megabyte address space of the 68000," Mr Norman Rosenbaum, Informative's National Sales Manager, said.

The 16-bit enhancement relies on hardware rather than software, and is less cumbersome and more efficient than translation programs.

"With the extra address space the DPU can handle up to twelve remote users, doubling the existing multi-user capacity of the Cromemco."

New programs written for the 68000 under the (also new) 16-bit Unix-like Cromix operating system, which contains the 8-bit Cromix as a hybrid program, are given a 16-bit input/output command as a header.

The memory boards in the DPU will come in 256K and 512K byte increments, using 150 ns 64K RAMS.

"The DPU board will be available to all existing Cromemco users from July as a single board, and to new users in packaged systems," added Mr Rosenbaum.

A basic System One with DPU, dual floppies, 256K of EEC RAM will cost $5825. The same system with 5Mb of Winchester hard disk storage will cost $8995.

"The cost of a single board for existing systems will be well under $2000."

For further information contact Norman Rosenbaum, Informative Systems Pty Ltd, 337 Moray St, South Melbourne Vic. 3205. (03)690-2284.

16-Bit #3

Digital Equipment claim to have introduced the computer industry's smallest 16-bit single-board computer (SBC) in Australia and New Zealand.

The compact size of their Falcon SBC-11/21 makes it ideally suited for build-in applications by original equipment manufacturers (OEMs) where space is at a premium, they say.

The new low-end member of Digital's microcomputer family is priced at just under $600 in Australia in quantities of 100 (just under NZ$800)

According to Werner Faets, Microcomputer Business Manager for the South Pacific Region, the Falcon SBC-11/21 provides designers with the power and flexibility of 16-bit microcomputers, yet is priced competitively with 8-bit SBCs.

"We are targeting the new board toward the market space traditionally held by 8-bit boards. Falcon brings full 16-bit computer power to application areas where cost and size — what we call form factor — previously made it impractical to use the longer word-length microcomputers."

The new Falcon SBC-11/21 is aimed at dedicated ROM-based applications in such areas as laboratory instrumentation, manufacturing monitoring and control, process control, robotics, and medical devices.

Dimensions are 132 x 228 mm, enabling integration into instruments and control machinery where space is critical.

For further information contact Marion Rhydderch, Digital Equipment Australia Pty Ltd, Chatswood Plaza (Northern Tower), Railway Street, Chatswood NSW 2067. (02)412-5252

Printout

THE CHIP-8 COLUMN

What with the RCA COSMAC VP-111, the ETI-660 and several other small, low-cost computer systems running CHIP-8 language interpreters, we've had a big demand for programs. We've been publishing plenty of '660 software, but little for the RCA COSMAC. Our new column is intended to redress the balance.

Contributions for this column are welcome. We'd like to see programming hints and tips as well as your own programs. Commented listings are preferred and MUST BE TYPED; you must prove them by loading the program from your typed submission. All contributions will be paid for.

This first contribution comes from J.L. Elkhorne of Chigwell in Tasmania. It is a game, called 'COSMAC Asteroids'. You have a ship which you can move around the screen and fire missiles at huge asteroids which come flying across the screen. If your missile hits an asteroid, you score. If the asteroid hits you, points are deducted from your score. Your score is displayed at the end of the game and a reset brings a new asteroid on screen.

After the CHIP-8 interpreter is loaded, key in the following program. A spaceship appears which can be controlled by the following keys:

4 — left
6 — right
2 — up
8 — down
5 — fire

Notes on the game: The writer works with an expanded 4K VP-111. A modular concept is used in development, with an area assigned to each subroutine; this makes it easy to add features or otherwise modify the scheme. After the program is tested, it's put into linear form for ease of keying in. The documented original is kept on file, along with a copy of the final version. (If a reader is really keen, he can tear the listing apart, as I've done in the past. Presenting all the documentation and comments seems unnecessary.) However, some additional information is supplied:

Variables Used	Function
A, B	Ship co-ordinates
1, 2	Asteroid co-ordinates
5, 6	Missile co-ordinates
E	Tone, timer
D	Missiles/energy
9	Score
7	Missile range
C	Miscellaneous

Module	Address
Mainline	0200 — 023F
Move ship	0242 — 025B
Missile	025C — 027D
Hit asteroid	0280 — 02B5
Move asteroid	02B6 — 02CF
Scoring	02D0 — 02F9
Patterns	0300 — 0312

COSMAC ASTEROIDS–J.L. Elkhorne, Tas.

```
0200    A300 6A1F 6B10 DAB3
0208    6900 6D14 6C00 A304
0210    6100 6200 D126 6718
0218    A300 6306 E3A1 2242
0220    6304 E3A1 2248 6302
0228    E3A1 224E 6308 E3A1
0230    2254 6305 E3A1 225C
0238    22B6 4718 12D0 1236
0240    1242 DAB3 7A02 1258
0248    DAB3 7AFE 1258 DAB3
0250    7BFE 1258 DAB3 7B02
0258    DAB3 00EE A303 4718

0260    2276 D561 77FE 4F01
0268    2280 D561 7503 3700
0270    00EE 6718 00EE 85A0
0278    86B0 7601 7DFF 00EE
0280    6C06 6E02 FE18 6E03
0288    FE15 FE07 3E00 128A
0290    7CFF 3C00 1282 7902
0298    6718 A304 D126 C305
02A0    8934 F31E F065 C3EE
02A8    8032 F055 7108 A304
02B0    D126 A303 00EE A304
02B8    C302 C401 D126 8134

02C0    8244 D126 3F01 00EE
02C8    6E0A FE18 7DFF 00EE
02D0    3D00 1218 A313 F933
02D8    F265 00E0 6A18 6B0A
02E0    F029 DAB5 7A06 F129
02E8    DAB5 7A06 F229 DAB5
02F0    A30C F565 A304 F555
02F8    12F8 0000 0000 0000

0300    C0E0 C010 3C7E FFFF
0308    7E3C 0000 3C7E FFFF
0310    7E3C
```

Printout

Stag programmer

Digitec Australia Pty Ltd have been appointed as sole Australian agents for Stag Electronic Designs Ltd of the UK.

Stag are a well-known manufacturer of universal PROM programmers. Their personality modules available for the PPX programmer cover bipolar PROMs, EPROMs, CMOS PROMs and EEPROMs. Other modules are available for Signetics IFL, BRAL and PAL.

For further information contact Digitec Australia Pty Ltd, 1155 Toorak Road, Hartwell Vic. 3124. (03)299-2088

Book Review

Computer Reference Guide's Software Handbook (produced jointly with Murray Publishers). Tony Webster. $25.50. Available from Computer Reference Guide, Suite 204, 284 Victoria Avenue, Chatswood NSW 2067. (Include $2.50 for postage and handling.)

The cost of this book is sure to be a deduction on the tax forms of every person wanting to keep up with the Australian computing industry. Previously the only means of gathering reliable software information was the old ring, run around and wait method, which was, in one word, tedious. Tony Webster with his software handbook has provided a much-needed service for the supplier, user and potential purchaser of all kinds of computer equipment.

The handbook is broken down into easy to read sections comprising micros, minis, mainframes and industry category applications. In the latter section listings range alphabetically from access control through dry cleaners to word processing.

If you already own or use a system and wish to review other software product offerings, there is also a section indexed by machine type. Effective cross-referencing connects the various sections.

An annoyance and frustration often encountered with handbooks of this type is the lack of contact addresses and telephone numbers for the products, etc. reviewed. To save the cat, desk or telephone from being kicked, Tony Webster has provided not only phone numbers and addresses, but also wherever possible the Managing Director's name.

Now that Tony has produced the Microcomputer Handbook and the monumental Software Handbook we're waiting breathlessly for his next mammoth production — the Who's Who of Computing in Australia, or maybe The Whole Computer Catalogue?

TRS-80C software update

Since writing the article for the March issue (p. 101), Greg Wilson (P.O. Box 9, Potts Point NSW 2011 or (02) 358 6491) has been granted licences to reproduce 80C software under licence. The growth in suppliers parallels the spectacular sales being achieved by the 80C in USA. It took ten months to take off there. How long here?

Aardvark-80, 23352 S.Commerce, Walled Lake, MI 48088
Abrams Clayton, 2758 Comstock Ave, San Jose, CA 95124
Adventure International, PO Box 3435, Longwood, FL 32707
Alford & Associates, PO Box 6743, Richmond, VA 23230
Algorix Inc, California (Greg licence)
Allen Gelder Sftwr, California (Greg licence)
American Business Computers, 118S.Mill St, Pryor, OK 74361
Armadillo Sftwr, Austin (Greg licence)
Artwork Sftwr Co, 150 North Main St, Fairport, NY 14450
Avalon Hill Game Co, 4517 Harford Rd, Baltimore, MD 21214
Bank Sftwr, 37 Balmoral Dr, Spring Valley, NY 10977
The Berg Works, Box 742H, Janesville, WI 53545
Cer-Comp, Nevada (Greg licence)
Cognitec, 704 Nob Av, Del Mar, CA 92014
Color Sftwr Services, Texas (Greg licence)
Computer Information Exchange, Box 159, San Luis Rey, CA 92068
Computer Island, New York (Greg licence)
Computer Simulations Co, 305 Hammes Ave, Joliet, IL 60436
Computerware, Dept CPO Box 668, Encinitas, CA 92024
Connection-80, 93-15 86 Drive, Woodhaven, NY 11421
Coolidge & Associates, 2050 S.Lamar #10 Austin, TX 78704
Datasoft Inc, 19519 Business Center Drive, Northbridge, CA 91324
DSL Cmptr Products, Michigan (Greg licence)
Digibyte Systems Corp, 31 East 31 St, New York, NY 10016
Dorset Educational Systems, PO Box 1226, Norman, OK 73070
Eigen Systems, PO Box 10234, Austin, TX 78766
Erickson, PO Box 11099, Chicago, IL 60611
Edward L. Gittelson, 577 Wildwood Rd, West Hempstead, NY11552
Graphic Source, Rt 2 Box 44, Canton, KS 67428
Great XPT, Michigan (Greg licence)
Harmonycs, Utah (Greg licence)
Frank Hogg Lab Inc, 130 Middletown Plaza, Syracuse, NY 13210
HW Electronics, 19511 Business Center Dr, Northridge,CA 91324
Hoyt Stearns Electronics, 4131 E.Cannon Dr, Phoenix, AZ 85028
Huntington Computing, PO Box 787, Concoran, CA 93212
Illustrated Memory Banks, Massachusetts (Greg licence)
Jarb, California (Greg licence)
Land Systems, Ohio (Greg licence)
Lyman Frank, 12 Reservoir St, Cambridge, MA 20138
Gary Magnusen, Indiana (Greg licence)
Mark Data Products, California (Greg licence)
Martin Consulting, Canada (Greg licence)
MG Products, PO Box 7544, Tulsa, OK 74105
Micro Learningware, PO Box 2134, N.Mankato, MN 56001
Micro Prcsr Systems, 37060 Garfield, Mt Clemens, MI 48043
Micro Works, PO Box 1110, Del Mar, CA 92014
Micro-Labs Inc, 902 Pinecrest, Richardson, TX 75080
Mint Sftwr, Louisiana (Greg licence)
Tom Mix Sftwr, Michigan (Greg licence)
Britt Monk, Ohio (Greg licence)
Moses Engineering Co, South Carolina (Greg licence)
Andrew Mucci, 73 Maitland Place, Garfield, NJ 07026
Warren Napier, Pennsylvania (Greg licence)
Neff Systems & Sftwr, 4340 Solano Way, Union City, CA 94587
Nelson Sftwr Systems Inc, PO Box 19096, MPLS, MN 55419
Peacock Ent, Pheasant Run Box 494 RD#3, Canastota, NY 13032
Prickly-Pear Sftwr, 3518 S.Randi Place, Arizona, AZ 85730
Program Store, 4200 Wisconsin Ave, Washington, DC 20016
Programmer's Institute, Nth Carolina (Greg licence)
Rainbow Connection Sftwr, Minnesota (Greg licence)
Sandhill Color, 1524 Toluca, Alliance, NE 69301
Seebrees Computing, 456 Granite Ave, Monrovia, CA 91016
Charles M. Smith, 92748 N.Macauthor, Oklahoma City, OK 73132
Snake Mtn Sftwr, Nth Carolina (Greg licence)
Soft Sector Marketing Inc, Michigan (Greg licence)
Spectral Associates, Washington (Greg licence)
Strawberry Sftwr Inc, Box 743, Vashon Island, WA 98070
Sugar Sftwr, Ohio (Greg licence)
Superior Graphic Sftwr, 406 Little Mountain Rd, Waynesville, NC 28786
Talbot Microsystems, 5030 Kensington Way, Riverside, CA 92507
Tallgrass Tchnlgs Corp, 9009 W.95th St, Overland Park, KS 66212
Tandy Electronics, 210 Victoria Rd, Rydalmere
Transformation, Illinois (Greg licence)
TRC, Nth Carolina (Greg licence)
VEICO International, 3870 West 143rd St, Cleveland, OH 44111
Wizard Sftwr, 3410 Leigh Rd, Pompano Beach, FL 33062

Computer graphics seminar

The Frost & Sullivan show is on again, folks! Now in its seventh year worldwide, Frost & Sullivan's 'Understanding and Using Computer Graphics' seminar returns to Australia for the second time in July.

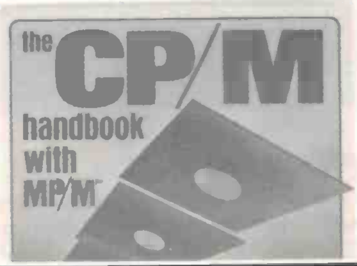
To be held in the Southern Cross Hotel, Melbourne, over 7 — 9 July, and the Menzies Hotel, Sydney, over 14 — 16 July, the show is still led by Carl Machover, the internationally recognised authority on computer graphics.

The seminar aims to make the full usage and benefits of computer graphics known to both potential and current users.

With the introduction of new versatile low-cost hardware and software, the role of computer graphics is changing, becoming a workaday time and money saving tool. With graphics you can show a variety of charts, graphs, pictures and animated processes to communicate ideas and information easily and effectively.

For people who are now using or who are making decisions about using computer graphics within their organisations, this three-day seminar will describe computer graphics; show how installing computer graphics can be justified; explain what hardware, software and systems are available; give costs and performance comparisons; show how to get started; show how computer graphics is being used in various applications.

For information please contact Jill Morris, Sales Department, Frost & Sullivan Ltd, 104-112 Marylebone Lane, London, W1M 5FU, United Kingdom. Intelex: 261671 FANDS G.



CP/M finally explained!

Rodnay Zaks

Anyone interested in computers will have heard the expression CP/M, but many may still be unclear as to what it is and what it does. Rodney Zaks' book The CP/M Handbook with MP/M will answer any questions you may have about using a computer equipped with CP/M.

CP/M stands for Control Program for Microprocessors, and is the industry standard in operating systems for small computers. It is available on nearly all computers using the 8080, 8085 or Z80 microprocessors, as well as some using the 6502 microprocessor.

The **CP/M Handbook** is a simple, clear and practical introduction to the use of CP/M-equipped computers, and a reference text. For beginners this book offers step-by-step instructions for using CP/M without fear — turning the system on, inserting a diskette, correct user discipline, remedial action for a problem situation — and everything is explained in a clear, concise and easy-to-read format.

For experienced programmers the book includes a comprehensive description of all CP/M facilities and resources, plus a complete discussion of all versions of CP/M, up to and including 2.2, MP/M and CDOS. Fifteen appendices feature complete summaries of all commands and facilities.

Contents include:

- An introduction to CP/M
- CP/M and MP/M facilities
- Handling files with PIP
- Using the editor
- Inside CP/M and MP/M
- Reference guide to CP/M and MP/M commands and programs
- Practical hints
- The future

The CP/M Handbook with MP/M is available from ETI Book Sales, 4th Floor, 15 Boundary St, Rushcutters Bay NSW 2011 for $16.95 plus $2 postage and packing.

Please send me . . . copies of The CP/M Handbook with MP/M at $16.95 + $2 p&p per copy

Total ....

Name ....

Address ....

.... Postcode ......

Signature ....

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● **Conditions:** Name and address plus phone number (if required) must be included within the 24 words. Reasonable abbreviations, such as 25 W RMS or 240 Vac, count as one word. Adverts must relate to electronics, audio, communications, computing etc — general adverts cannot be accepted.

Send your advert to:
ETI Mini-Mart,
4th Floor, 15 Boundary St,
Rushcutters Bay NSW 2011.

AUDIO

FOR SALE: Playmaster 136 amplifier, superb performance for the price, $80. Bh (03)489-9255, ah (03)723-1532.

STAX UA7 carbon fibre tonearm with extra aluminium segment. Never used, half price, $225 ono. Ian, 1/23 Mulwarree Ave, Randwick NSW 2031. (02)398-1189.

FOR SALE: National colour video cassette recorder. Search, dubbing, auto repeat, etc. $450 ono. Bh (03)489-9255, ah (03)723-1532.

VALVE AMPLIFIER, Pioneer 24 W RMS, Shure cartridge, Byer professional studio turntable and arm, large speaker enclosures, superb system, sacrifice $300 ono. (02)46-5451.

MISCELLANEOUS

FOR SALE: Large screen oscilloscope, BWD 1722D, as new condition with manuals, $350. (068)47-2491.

FREE to genuine schoolboy, ETI and EA etc, approx 100. Ring (02)807-1374, ask for Peter, between 6 and 7 pm.

2 kVA 240 Vac to 110 Vac autotransformer, $35; old HP frequency counter and modulation meter, both valves, $20 each. (02)337-5241 ah.

WANTED: Dec, Feb, Mar, Apr 1978 ETI mags in reasonable condition. Contact Andrew Hartwich, 11 Laby St, Ararat Vic. 3377.

MAGAZINES for sale: ETI, EA, Creative Computing etc. Inquiries: ring ah (03)80-4221. Address: A. Pam, 43 Mont Victor Rd, Kew 3101, Melbourne.

WANTED: Back issues of ETI and EA or R & H prior to 1973. Novice AOCP requirement. Bob Simpson, P.O. Box 150, Brighton 3186. (03)67-8871.

COMMUNICATIONS

KENWOOD R300 communications receiver. 0.1 MHz to 30 MHz, AM and SSB. Mint condition, accessories, VHF converters, $270 ono. Five range marker gen, $25 (051)22-1395 ah.

SWLs: The Southern Cross DX Club covers all bands in 'DX Post'. For a sample magazine and details write to PO Box 64, Campbelltown SA 5074.

COLLINS R390/391/390A rear-mounted tools, valve pullers and coverplates required. Some modules for sale. Bruce, 3 Shadwell St, Cheltenham Vic. 3192. (03)583-1638.

COMPUTERS

SELL: TRS-80 level II, 16K RAM. Near new, has lower case and numeric keypad, with power supply, manuals. Jeff, 2 Nodding Ave, Frankston Vic. (03)783-5179 (Mon-Thur.).

FOR SALE: Technical manual for the Sorcerer MK II, very little use, excellent condition, $11. (03)690-5486, ask for John.

SELL: 1200 baud cassette interface, suit 6800-based system, with software and data, $60. Book: 33 games for TRS80/Apple/PET, $7. W. Geary, 63 Second Ave, Rossmoyne 6155. (09)457-8809.

MICROACE: 4K ROM, 16K RAM plus adaptor, leads, manual and book of programs, $250. (02)639-3115 ah.

SELL: ZX80, 16K RAM, 8K ROM, power supply, programming manual, some programs, $240. Phone Mick or leave message, (062)41-5140.

SELL: ZX81 16K RAM, as new with $100 of software (understanding your ROM, games, four newsletters). Suit beginner. Price $375 ono. Phone (058)83-9427.

An alternative pocket computer printer

Tom Moffat
39 Pillinger Drive,
Fern Tree, Tasmania.

For the thin-of-pocket or frugal-minded, here's how to employ a cheap 'surplus' teleprinter as a printer for your Sharp or Tandy pocket computer.

THIS IS ONE of those stories about doing things on the cheap; in this case, getting a printer for a pocket computer, or any computer for that matter, without paying a lot of money for it. A couple of things have to be assumed . . . first, your pocket computer is your second computer — you've got a bigger system as well (and for many people this seems to be the case). Second, you've got a teleprinter, or you think you may have a use for one. Suggestions in my earlier series of articles, "Get Going on Radioteletype" (ETI, Aug. — Sept. '79), may whet the appetite.

Of course, it's possible to buy a printer for the Sharp or Tandy pocket computers; they've been advertised lately for around $180 and are quite good value . . . but they've only got one use: pocket computers. (Maybe it's a bit early to say that, it might be worth looking into . . . hmmm!) For that $180 you can buy one very fine pre-owned teleprinter, the electronics to get it going (ETI-730 converter kit), many rolls of paper and ribbons, and still have money left over! The only real problem is that an old Baudot teleprinter isn't really designed for communicating with modern computers, and some of the important ASCII characters are missing. But it's quite possible to make do, as you'll soon see.

You'll find the old teleprinter slow and noisy, compared to modern printers, but pocket computers aren't renowned for their speed either. But why worry, you can sit back and contemplate the excellence of the program you've just written as it's slowly pounded out on the teleprinter.

The method

The computer used to drive the teleprinter in this instance is a small one with a Motorola 6800 processor, 1K of RAM, and a PIA (peripheral interface adaptor) to communicate with the outside world.

The operating program is written in pure 6800 machine code, and can be located in any part of the computer's memory. There are also three tables and a code store, which can also be located as desired. Two of the tables contain teletype codes and the third is a small one involved in code conversion. Their addresses must be specified in the main program as follows:

Input code store address at 0214 and 0236 (loc. C1B0)
One-byte character table at 02EA (0090)
Four-byte character table at 02D0 (00C0)
Code conversion table at 02BE (01A0)

Information must be entered at these addresses to show the locations of the various tables in your system. The information in brackets are the locations in my system. A four-byte software shift register and some other storage bytes are located at 0030. These are best left where they are; it would be messy to move them. The PIA is located at 8012/8013.

The same general programming technique should work with just about any system, using say Z80 or a 6502, providing you have something resembling a PIA for interfacing. You must be able to program it so that some bits are inputs while others are outputs. In this case we use bit 3 as an input to feed data from the pocket computer into the main system, and bit 4 as an output to tell the pocket computer when the teleprinter is busy printing. Bit 0 is an output through which the serial data is fed to the teleprinter. Bits 1 and 2 must also be outputs. The other bits in the PIA can be set to whatever your system requires.

A small modification is necessary to the pocket computer's cassette interface to make some connections to the plug that mates with the socket in the side of the pocket computer. This involves opening the cassette interface and installing a 4009 IC to invert and buffer the pocket computer signals so they can be used in the main system. The IC is installed in the flat part of the interface, with the pins cut off short so it will fit in. The leads and resistors are simply soldered to what's left of the pins (see Figure 2 for details). The 10k and 33k resistors are for safety; the 33ks prevent damage if the PIA is accidentally programmed into the output mode where it should be an input, causing two outputs to fight against each other. Many PIAs have been blown up this way. The 10ks are there because the designers of the pocket computer saw fit to isolate all the other input/outputs with 10ks — better safe than sorry.

Counting from the end where the cassette cable leaves the interface, pin 1 carries data out of the pocket computer, pin 2 tells it 'printer busy', and pin 3 is an input that is held low by another 10k to tell the pocket computer a printer is connected. Four of the six inverters in the 4009 are wasted, but it's still the easiest way to achieve the desired result. This scheme results in a voltage difference of 4.5 volts between the cases of the pocket computer and the main system, but in practice it hasn't caused any problems. Just don't touch them together or you will flatten the batteries in the cassette interface.

The interface at the teleprinter end need be nothing more than the transistor loop switch section of the ETI-730 RTTY receiving converter (Aug '79). Perhaps the easiest way to arrange this would be to buy the ETI-730 circuit board and only install the parts necessary to get the loop switch going (the rest of the parts can be added later if desired). The loop switch section was designed to accept TTL-compatible signals straight in, if the jumper from the rest of the circuit is deleted. Of course you'll need something to supply the loop current as well. See the original article.

Data format

The pocket computer stores each character and basic keyword as a single eight-bit binary number (which henceforth will be expressed as hexadecimal). When you type in 'RETURN' what actually gets stored is hex 'DE'. The letter A is '51', figure 1 is '41', and so on The entire code set is detailed in Table 1. When the pocket computer is told to LIST or PRINT, it first sends out 8D or 8E, depending on the command, followed by a string of data. Every line ends in '00'.

Each byte is sent out four bits at a time in serial format, with four data bits preceded by a start pulse. The start pulse and each data pulse are 2 ms long, and there is a 9 ms pause between each half-byte. See Figure 1.

Before the data comes in, the 6800 system is sitting in a loop, looking for a start pulse. When it's detected, a subroutine loads the following four bits into an accumulator. It then looks for a start pulse again and when it comes it fills the rest of the accumulator with the following four bits. The completed byte is then stored away and the procedure is started again for the next byte. A store 80 bytes long is provided, enough to hold the longest program or print line available from the pocket computer.

After each byte is stored it is inspected to see if it's a '00'. If it is, the 6800 system sets bit 4 of the PIA low to tell the pocket computer to hold off sending while the teleprinter prints what it's already got. But there's a lot to do before a character is printed.

The first job is to determine whether the data resulted from a PRINT or a LIST command by checking the first byte for 8D or 8E. If LIST, a line number is required, and the computer counts the number of digits in the line number, inserts leading spaces, and prints a ':' between the line number and the program statements that follow. If PRINT, it skips over the line number routine and just prints everything out as is.

An inspection of the pocket computer code table will reveal that it's full of holes and that several codes are present which are direct commands and will never appear as part of a stored program (they are the shaded ones). The table in its original form would be very wasteful of memory, so the 6800 system packs it down, eliminating the empty holes and direct commands. The result is two tables, one of which contains most of the functions that can be represented by one character, such as the figures, the letters, and some punctuations. One▶

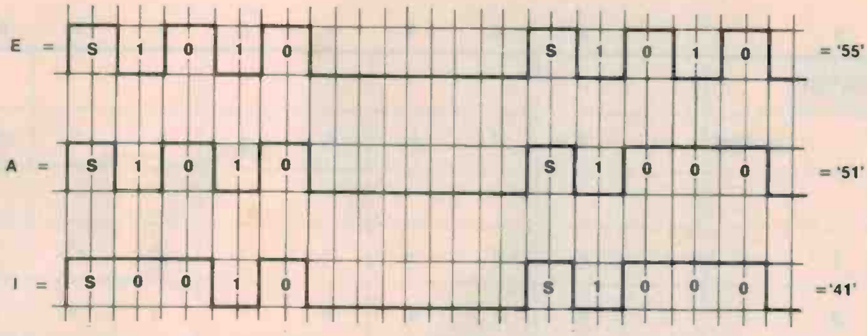


Figure 1. Pocket computer serial data format (1 ms per division).

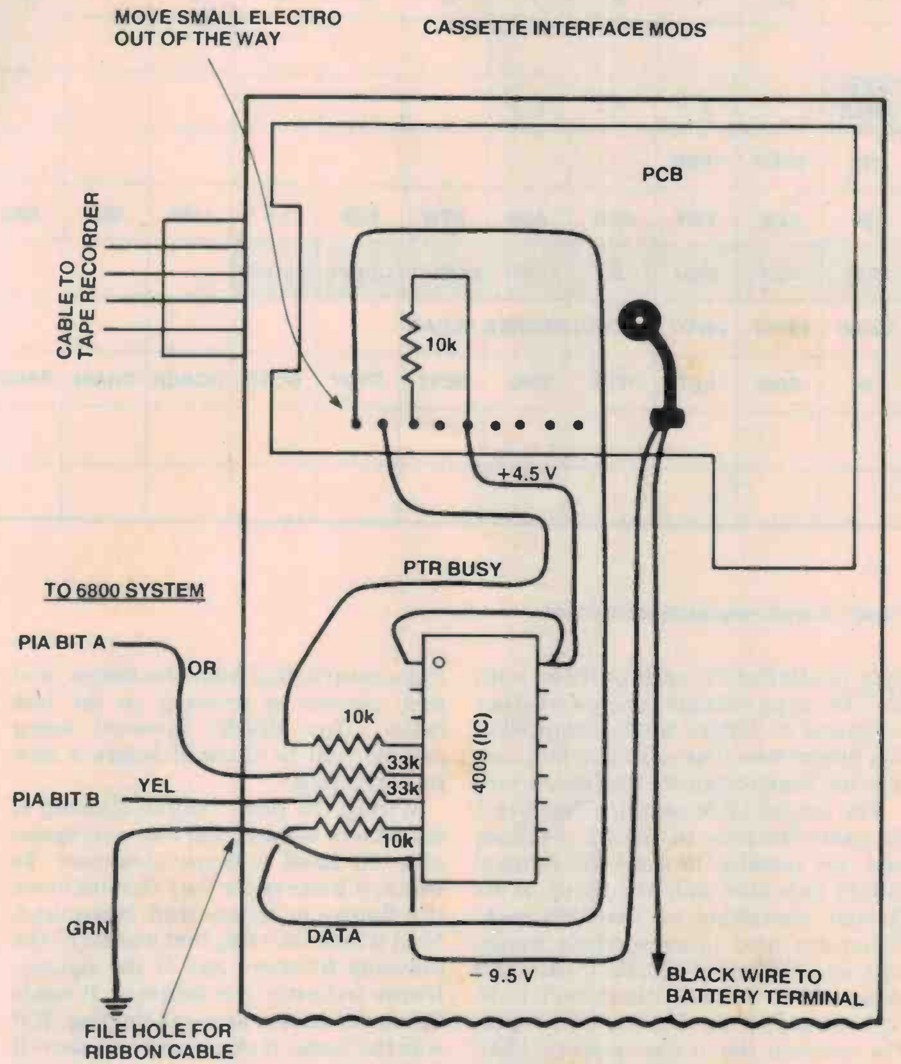


Figure 2. Pocket computer cassette interface modifications. Pinout of the 4009 IC shows the view looking down on top of the package.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	ENTER															
1		SPACE	"	?	!	#	%	¥	$	π	√	'	;	:		
2																
3	(	)	>	<	=	+	−	•	/	^						
4	Ø	1	2	3	4	5	6	7	8	9		E				
5		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
6	P	Q	R	S	T	U	V	W	X	Y	Z					
7																
8	FILE IDENT		>=	<=	<>									LIST LINE IDENT	PRINT LINE IDENT	DATA BLOCK IDENT
9	TO	STEP	THEN													
A	SIN	COS	TAN	ASN	ACS	ATN	EXP	LN	LOG	INT	ABS	SGN	DEG	DMS		
B	RUN	NEW	MEM	LIST	CONT	DEBUG	CSAVE	CLOAD								
C	GRAD	PRINT	INPUT	RADIAN	DEGREE	CLEAR										
D	IF	FOR	LET	REM	END	NEXT	STOP	GOTO	GOSUB	CHAIN	PAUSE	BEEP	AREAD	USING	RETURN	
E																
F																

Table 1. Pocket computer function codes.

byte is allowed for each of these, with bit 7 being an indicator to show whether a 'figures' or 'letters' shift is required in the teleprinter. The next five bits contain the Baudot code for that character.

The second table contains four bytes for each function. In the 32 resulting bits, it's possible to store the figures/letters indicator, followed by up to six Baudot characters at five bits each. These are used to store whole words, such as GOTO, GOSUB, RETURN, and some of the symbols that don't have equivalents on the Baudot teleprinter. For instance, the <= sign becomes 'LEQ' and * for multiply becomes 'space-dot-space'. For ';' we use ':,', and π becomes 'PI'. It ain't pretty, but it works.

Once the 6800 system figures out where to look in which table, it transfers the contents down into a software shift register and then goes into the print routine. When it encounters a '00' it knows that line is finished and it goes back to the start of the program, telling the pocket computer to load another line into the store. Each character printed is counted, and if the characters in a line exceed 60 the computer inserts a carriage return, line feed, five spaces, and then carries on printing on the line below. Any BASIC keyword being printed will be finished before a new line is started.

Within the print routine a string of stored bits is converted into a recognisable 50 baud teletype character. To begin, it looks at the very first bit to see if a figures or letters shift is required. Next it looks at a flag that was set by the previous function, and if the figures/letters indicator was different, it sends figures or letters and sets the flag. If it was the same, it skips over this part. It then generates a 20 ms start pulse, and then goes to the software shift register where the character or function is waiting to be printed. The figures/letters routine has already dumped the first bit out of the shift register, so what's left are valid teletype bits. The program shifts five of these along and sends them, with a delay of 20 ms between each. It then sends a stop pulse of 30 ms before going to the next five data bits. The result of all these gyrations comes out bit 0 of the PIA as a string of TTL-compatible highs and lows that are serial Baudot teletype signals.

Back in the shift register, each bit shifted out is replaced by a '0' going in the other end, and the bits that don't represent characters already contain 0s. When the computer sees nothing but 0s it knows the shift register is empty, and goes back to the input store for the next data byte put there by the pocket computer. Although this seems complicated it happens in the twinkling of an eye and the result is a nice string of teletype print running at what the experts call 'machine speed', ticking along with no gaps or pauses. There is a short pause between each line as the pocket computer loads in its next line of data, the length of the pause depending on the length of the line to be printed.

To summarise, consider the handling of a program line, such as '80:GOSUB 200'. This comes out of the pocket computer as '8D-48-40-D8-42-40-40-00'. 8D says it's a LIST line, so the line number routine is required. The line number routine then counts the digits in the line number, (actually every code starting with a 4), until it comes to something else. In this case there are two digits, so it tells the teleprinter to print one space, then the digits 8 and 0, and a ':' (the ':' wasn't supplied by the pocket computer). It then gets the next code, D8, finds it means 'GOSUB', and prints that. The next code, 42, produces '2', and then come two 40s, each producing a '0'. Finally comes 00, meaning end of the line. The computer prints a carriage return, a line feed, resets the character counter, and then tells the pocket computer to load the next line into the store. An example of a complete pocket computer program, formatted for the teleprinter, is LISTed and RUN in Figure 3. As you can see, having a full page width to work with makes life much easier.

Now, if you happen to be the proud owner of a 'proper' ASCII printer, this same technique could be used to hook it to the pocket computer, with the routines generating 7-bit ASCII characters instead of 5-bit Baudot. The figures/letters determination would be unnecessary. Or going after it in the other direction, most of the routines could be used to translate ASCII output from the main computer into Baudot, allowing the use of an 'el cheapo' teleprinter with a 'big' computer system. ●

```
LIST:

 10: INPUT 'WHAT DEGREE INCREMENT? ':,A
 20: PRINT 'X (DEGREES)          SIN (X)          COS (X)          TAN
       (X)'
 30: PRINT '-----------          -------          -------          ---
       ----'
 40: PRINT ''
 50: FOR X=A TO 360 STEP A
 60: B= SIN X:C= COS X:D= TAN (X+E-9)
 70: PRINT '   ':,USING 'XXXX':,X:,'               ':,USING 'XX.XX
       XXX':,B:,'       ':,C:,'       ':,USING '.XXXXX PWR ':,D
 80: NEXT X
 90: USING
100: END


SAMPLE RUN:

X (DEGREES)       SIN (X)        COS (X)        TAN (X)
-----------       -------        -------        -------

   30             0.50000        0.86602        5.77350E-01
   60             0.86602        0.50000        1.73205E 00
   90             1.00000        0.00000       -5.72957E 10
  120             0.86602       -0.50000       -1.73205E 00
  150             0.50000       -0.86602       -5.77350E-01
  180             0.00000       -1.00000        1.74532E-11
  210            -0.50000       -0.86602        5.77350E-01
  240            -0.86602       -0.50000        1.73205E 00
  270            -1.00000        0.00000       -5.72957E 10
  300            -0.86602        0.50000       -1.73205E 00
  330            -0.50000        0.86602       -5.77350E-01
  360             0.00000        1.00000        1.74532E-11
```

```
POCKET COMPUTER TO TELETYPE: 6800 MACHINE CODE
----------------------------------------------

1-BYTE CHARACTER TABLE:
0090 B4 F4 E4 C0 A8 84 D4 F0 B0 8C 9C 40 60 4C 38 48
00A0 40 58 2C 14 30 68 73 24 1C 18 0C 34 74 28 50 04
00B0 70 3C 64 5C 54 44 10 D0 CC 9C 5C D8 54 AC 00 00
4-BYTE CHARACTER TABLE:
00C0 11 AC 20 00 12 9D 51 00 98 00 00 00 B8 C0 00 00
00D0 B8 00 00 00 F8 00 00 00 A4 00 00 00 11 61 20 00
00E0 11 21 20 00 BC 00 00 00 C4 00 00 00 E0 00 00 00
00F0 90 E4 00 00 DC 00 00 00 11 B9 51 00 11 70 E9 00
0100 11 30 E9 00 10 D0 E9 00 10 23 20 00 12 81 83 48
0110 10 25 81 38 12 8C 31 00 11 C3 A1 00 10 38 31 00
0120 13 14 31 00 13 0E A1 00 13 01 31 00 12 17 69 00
0130 11 26 20 00 11 23 59 00 11 86 09 00 13 13 A1 00
0140 12 8B 31 00 12 50 59 00 12 47 A1 00 2D 58 90 00
0150 35 4C 30 48 30 CD E0 48 2B 12 66 0C 4A 0B 54 20
0160 39 30 C2 80 32 C4 00 00 58 6A 20 00 11 30 09 00
0170 2A 07 20 00 40 D2 00 00 1A 17 09 00 50 23 68 00
0180 2C 61 19 00 2C 74 E4 C8 38 B8 61 88 37 1C A4 08
0190 4E 10 69 00 61 50 C4 88 72 8C 32 C8 2A 01 E2 8C

CONVERSION TABLE:
01A0 00 15 00 03 C0 BB BB 00 BB B0 A3 00 91 87 00 00
INPUT STORE: 01B0-01FF
```

```
MAIN PROGRAM:
0200 CE 80 12 C6 3B E7 01 C6 77 E7 00 C6 36 E7 01 DF
0210 34 8D 7B CE 01 B0 DF 36 DE 34 86 1F A7 00 8D 53
0220 16 8D 50 58 58 58 58 1B DE 36 A7 00 08 4D 26 E6
0230 86 0F B7 80 12 CE 01 B0 A6 00 08 DF 36 81 8E 27
0240 1E C6 FF 8D 24 08 8D 21 37 CB 03 27 02 8D 50 33
0250 37 8D 57 33 5C 26 F9 86 1D 8D 62 C6 01 8D 40 DE
0260 36 6D 00 27 AC 8D 43 20 F6 A6 01 84 F0 81 40 26
0270 01 5A 39 86 03 A5 00 26 FC 8D 0B 8D 07 44 8A 08
0280 A4 00 24 F7 8D 00 37 C6 A1 5A 26 FD 33 39 86 10
0290 8D 46 8D 44 86 40 8D 40 86 3C 97 3B 39 C6 05 86
02A0 20 8D 35 7A 00 3B 5A 26 F8 39 DE 36 A6 00 8D 0D
02B0 7D 00 3B 2A 04 8D D7 8D E4 7C 00 37 39 CE 01 A0
02C0 16 54 54 54 54 08 5A 26 FC AB 00 81 2E 2B 1A CE
02D0 00 C0 80 2E 48 48 20 15 36 37 8D 63 33 32 39 8D
02E0 00 C6 05 8D 9F 5A 26 FA 39 CE 00 90 5C DF 38 9B
02F0 39 97 39 86 00 99 38 97 38 DE 38 86 80 A4 00 91
0300 3A 27 0D 97 3A 4D 26 04 86 F8 20 02 86 D8 8D C8
0310 DE 38 5D 26 0C A6 03 97 33 A6 02 97 32 A6 01 97
0320 31 A6 00 97 30 8D 0B 8D 18 7A 00 3B 7D 00 30 26
0330 F6 39 78 00 33 79 00 32 79 00 31 79 00 30 39 97
0340 30 DE 34 86 0E A7 00 8D 96 C6 05 37 86 07 8D E2
0350 49 A7 00 8D 8A 33 5A 26 F2 86 0F A7 00 8D 80 8D
0360 80 39
```

Apple graphics guide

The Apple II, despite its relative age, has much to offer. Apart from colour, which should be cliche by now, the Apple features three display modes, including hi-res and lo-res graphics. Here's a beginners' guide.

Mike James

THE APPLE was perhaps the first personal computer to offer graphics capabilities. I remember finding the early glossy colour advertising for the system unbelievable because it was so far in advance of its competitors in terms of presentation and performance. Now we have colour boards for the S100 buss and machines such as the Atari 800 and the Peach all offering high resolution and easy-to-use graphics, but the Apple still has a lot to offer.

If you have an Apple, this article will help you understand its graphics capabilities and make the most of them. If you are thinking of buying a micro, graphics is an important factor to bear in mind, so read on to see what the Apple has to offer.

Apple's graphic features

The system has three distinct display modes: Text, Low-Resolution Graphics and High-Resolution Graphics. When first switched on, the Apple starts out in Text mode displaying just 24 lines of 40 characters. This, to me, is one of the most disappointing features of the Apple. Not only are you restricted to 40 characters per line, but there is no lower case! You can't win 'em all!

In low-res graphics mode you can display any number of blocks from an array of 40 blocks wide and 48 blocks high. A block can be any of sixteen different colours, so you need a colour TV to see them. Low-res graphics are easy to use, fast and ideal for simple games programs such as tennis, squash, arcade games, etc. Their obvious disadvantage is that it is not possible to draw precise shapes.

If you enter high-res graphics mode you can plot any of an array of 280 dots wide by 192 dots high. Dots can be any one of six colours but not every dot can be any colour. There is a limitation to the colour TV which means that not every colour is available at every position, and displaying two points in different colours side-by-side results in white! Because of these considerations, colour in high-res graphics is difficult to use reliably and we will concentrate on black and white graphics.

High-res graphics are very good for drawing graphs and line diagrams, but anything complicated can be a little slow and shading in areas of continuous tone is painfully slow.

Although high-res graphics is the most difficult of the Apple's graphics modes, it is also the most exciting and rewarding to work with. Adjacent blocks have no space between them so continuous areas of colour can be constructed.

Mixed modes

As well as the three 'pure' modes, the Apple can work in a mixed graphics and text mode rather than the pure graphics. If you want either pure low-res graphics or pure high-res graphics from Applesoft then you have to use a PEEK (see the Apple manual for details; Table 1 gives a summary).

Another feature of the display modes is that each has two pages. This means that you can write information to one page while displaying the other and then suddenly flip pages, thus making the new information appear. This can be useful for animation and generally speeding up display presentation. Under Applesoft, page two of low-res graphics can only be reached via a POKE, but page 2 of high-res can be invoked via an HGR 2 statement. Unlike HGR, HGR 2 gives a pure graphics mode, i.e: the four lines of text do not appear at the bottom of the screen.

Graphics in general

Now that we know the sort of thing the Apple can do, let's pause a moment and consider the way other micros tackle the graphics problem. Some micros (such as the Commodore PET) have adopted a very different approach to graphics. Instead of allowing the user to plot small points or blocks and then build up shapes, the PET supplies a set of graphics characters. This reduces the amount of memory used to store any display. It also allows a free mixing of graphics and alphanumeric characters anywhere on the screen. The disadvantage of this method is that you depend on the machine's designer to supply you with all the shapes that you need — i.e: battleships, rockets, etc, and you have the problem of fitting them together to make bigger shapes. For example, I remember trying to draw a square on the screen of a PET and spending hours trying to find the correct graphics character to complete a corner without leaving a gap. It is true that I found the beast after a rest and a coffee, but it brought home how much I was at the mercy of the available character set!

Not so on the Apple, however. A basic low-res character is simply a solid rectangular block — no hunting for shapes, you can either plot a block or leave it off. This is easy to use but the shapes that you can display are limited. To deal with shapes such as diamonds, hearts, spades and clubs you really have to go to high-res graphics. Although the range of shapes you can make in high-res mode is unlimited, drawing a common but complicated shape such as a heart is not easy and there have been times when it would have been nice to have a PET-style graphics set built in.

There is one innovation that was introduced by the Apple which provides a link between the two graphics methods: the shape table — but more of that later.

Co-ordinates

Using either of Apple's graphics modes depends on an understanding of co-ordinates. Among the questions most often asked by someone new to Apple graphics are, "How do I plot a diagonal line in low-res?", and "How do I plot a circle in high-res graphics?" The answer to both of these questions lies in the use of co-ordinates and co-ordinate geometry. If the introduction of the ▶

word 'geometry' has you remembering school and hence about to turn to another article, take courage and read on. Co-ordinate geometry is not about theorems and proofs but is about how to generate or draw geometric figures such as circles, ellipses, etc.

The best way to understand co-ordinates is to imagine a chessboard. Starting from the top left-hand corner, count off each column starting at 0 and then count off each row starting at 0. Now if you are asked to label any square you should have no trouble. This is all there is to the idea of a co-ordinate. By tradition, the first co-ordinate you give is the column number and the second the row number — so 3,6 means column 3, row 6. Also by tradition, the column number is called the x co-ordinate and the row number is called the y co-ordinate. Two important things to notice are that all the squares in the same column have the same x co-ordinate and all the squares in the same row have the same y co-ordinate. Moving horizontally across the board changes x and leaves y fixed and moving vertically changes y but leaves x fixed.

The Apple uses two co-ordinate systems. In low-res graphics the screen is divided into an array of 40 columns by 48 rows. As with the chessboard example, the numbering starts in the top left-hand corner of the screen with 0,0, making the block in the lower right-hand corner 39,47. If four rows of text are used at the bottom of the screen then the maximum y co-ordinate is reduced to 39.

In high-res graphics the screen is divided into an array of dots 280 by 192, once again with 0,0 in the top left-hand corner. The maximum co-ordinate (i.e: the bottom right-hand corner) is therefore 279,191. If four lines of text are included, then the maximum y value is reduced to 159. Details of the memory maps can be seen in Table 2.

Low-resolution graphics

After some theory it's time to look at how Apple handles low-res graphics. First we will go over the standard low-res commands and explain how they are used. In the next section a program will provide a practical demonstration of how the instructions can be used together to produce the sort of games so often seen on the Apple.

The first low-res graphics command we need is GR. This switches the Apple to mixed text and low-res graphics mode and clears the screen. Once in low-res the colour of the next and subsequent plotted points is set by:

```
COLOR=arithmetic expression
 (note American spelling)
```

The arithmetic expression must evaluate to a number in the range 0 to 15. The range of colours can be seen in Table 3, but the most often used are 0 for black and 15 for white. To plot a point in the currently selected colour, use:

```
PLOT arithmetic expression 1,
     arithmetic expression 2
```

The first arithmetic expression is the x co-ordinate of the point and the second is the y co-ordinate. The following program illustrates the use of these three commands:

```
10  GR
20  INPUT X,Y,C
30  COLOR=C
40  PLOT X,Y
50  GOTO 20
```

This program will let you enter the x and y co-ordinate and colour of a point to be plotted. Try using it to explore the screen and see what happens if you try to plot in the text area or outside the screen altogether. It is important to realise that you can alter the colour of a point only by replotting it. (Some machines have an UNPLOT command instead). For example, if you want to make a point flash on and off:

```
10  GR
20  COLOR=15
30  PLOT 30,30
40  COLOR=0
50  PLOT 30,30
60  GOTO 20
```

To make the point flash slower put a FOR . . . NEXT loop in between lines 30 and 40 and lines 50 and 60. (Why do you need two delays?)

It is obvious that plotting horizontal or vertical straight lines is something that we need to know how to do in low-res graphics. Although it is possible to plot lines using only the PLOT command, Applesoft provides two special commands, VLIN and HLIN, which plot vertical and horizontal lines in the selected colour much faster than the equivalent set of PLOTs. To specify a vertical line you have to say which y co-ordinate it starts and finishes at (i.e: its length) and which position on the screen it is at (i.e: its x co-ordinate). The form of the VLIN command is thus:

```
VLIN starting y co-ordinate,
     finishing y co-ordinate AT
     x co-ordinate
```

It should come as no surprise that the form of the HLIN command is:

```
HLIN starting x co-ordinate,
     finishing x co-ordinate AT
     y co-ordinate
```

For example, to draw a square:

```
10  REM**PLOT A SQUARE WITH
30  REM**CORNERS AT 10,10 AND 20,20
30  GR
40  COLOR=15
50  HLIN 10,20 AT 10
60  HLIN 10,20 AT 20
70  VLIN 10,20 AT 10
80  VLIN 10,20 AT 20
```

A command that deserves more attention than it usually receives is SCRN. The command:

```
C=SCRN (x co-ordinate,
        y co-ordinate)
```

returns the colour of a specified point on the screen. As we will see in the next section it can be used for some very interesting dynamic graphics.

As an example of low-res graphics the following program plots a sort of pinball board and then bounces a 'ball' around the screen. It is not a complete game but provides the starting material for a number of different games which the reader may care to develop himself.

```
  10  GR
  20  GOSUB 1000
  30  X=35
  40  Y=RND(1)*39
  50  HV=1
  60  VV=1
  70  GOSUB 2000
  80  GOTO 70
  90  END
1000  COLOR=15
1010  HLIN 0,39 AT 0
1020  HLIN 0,39 AT 39
1030  VLIN 0,39 AT 0
1040  VLIN 0,39 AT 39
1050  VLIN 8,12 AT 5
1060  VLIN 18,22 AT 5
1070  VLIN 28,32 AT 5
1080  PLOT 10,15
1090  PLOT 10,16
1100  PLOT 10,25
1110  PLOT 10,26
1120  PLOT 15,20
1130  PLOT 15,21
1140  PLOT 20,20
1150  PLOT 21,20
1160  PLOT 20,10
1170  PLOT 20,30
1180  VLIN 0,11 AT 30
1190  VLIN 39,28 AT 30
1200  RETURN
2000  COLOR=0
2010  PLOT X,Y
2020  COLOR=15
2030  X=X-HV
2040  Y=Y-VV
2050  IF SCRN(X,Y)=0 THEN PLOT X,Y:
      HFLIP=0:RETURN
2060  IF HFLIP=0 THEN HFLIP=1:
      X=X+HV:Y=Y+VV:HV=-HV:
      GOTO 2030
2070  VV=-VV
2080  HV=-HV
2090  X=X-HV
2100  Y=Y-VV
2110  HFLIP=0
2120  GOTO 2030
```

The main part of the program (lines 10 to 90) simply sets up starting values and calls subroutines. The first subroutine draws the pinball board using a list of HLIN, VLIN and PLOT commands. The method used is straightforward and the reader should be able to alter the board layout without any trouble.

The starting co-ordinates for the 'ball' are set up in lines 40 and 50, the x co-ordinate being random between 0 and 39. Lines 50 and 60 set the horizontal and vertical velocities (VV, VH) to 1. The values of VV and VH govern the distance and direction that the 'ball' will move at each step. Lines 70 and 80 call the 'move ball' subroutine repeatedly. If the ball moves too fast for your game, then slow it down with a FOR . . . NEXT loop at line 75. The move ball subroutine is the heart of the program. It moves the ball from X,Y to X-VH,Y-VV by first unplotting the existing ball position (line 2010) and then plotting the new ball position. Before the new position is plotted, it is checked to see if it is free, i.e: is black (line 2050), using the SCRN function. If it isn't free then it is part of the border or an obstacle and the ball cannot move into that position.

When the ball hits an area of white its direction changes. Either the vertical velocity is reversed (VV=–VV) or its horizontal velocity is reversed (VH=–VH) but not both.

The way this program achieves this 'bouncing' effect is a little unusual. At line 2080 the horizontal velocity is reversed and HFLIP is set to 1 to record this fact. The ball's position is now returned to its old value and a GOTO 2030 causes the program to try to plot the ball's new position. If this is yet again blocked by a white square then the horizontal velocity and the ball's position are returned to their previous values and the vertical velocity is reversed in another attempt to find a free location.

All this might seem very complicated, but it does mean that the ball will bounce its way around a screen full of whatever objects you care to plot in subroutine 1000.

The program can be extended to cope with different sorts of collision by plotting obstacles in different colours and using SCRN to test what should happen when the ball tries to move into an occupied location. (For example, you could increase the velocities when the ball strikes a red obstacle.)

High-resolution graphics

As mentioned earlier, high-res graphics is difficult to use but the effects it can achieve are well worth the trouble. To enter a mixed high-res and text mode the command HGR should be used. If you want a pure high-res screen then the command HGR 2 should be used instead, but notice that graphics page 2 is used. Either HGR command clears the screen before allowing you to plot using the colour selected by the HCOLOR = instruction. As discussed earlier, the use of colour in high-res graphics is a tricky subject and needs an article all to itself, so we will assume that all graphics will be in black and white. The high-res equivalent of PLOT is:

```
HPLOT x co-ordinate, y co-ordinate
```

although it is not used as much as PLOT because a single high-resolution point is very small indeed. The work-horse instruction for high-res is the extended HPLOT command:

```
HPLOT start x co-ordinate,
      start y co-ordinate  TO
      finish x co-ordinate,
      finish y co-ordinate
```

This will plot a line from the starting co-ordinates to the finishing co-ordinates. Horizontal and vertical lines are now special cases of the general line drawing. For example to draw a line from 40,10 to 100,90 use:

```
HPLOT 40,10 TO 100,90
```

When drawing diagonal lines it is sometimes disappointing to see the rough and ragged result looking more like a bolt of lightning rather than a straight line! There is nothing that can be done about this except to buy a computer with still higher resolution graphics. If you can put up with lines that aren't solid then I find it is better to plot only the points that lie exactly on the line and leave the eye to fill in the gaps. This is often the best way to plot graphs and curves to look smooth. For example, consider the two lines plotted by the program given below:

```
  1  HGR2
  2  HCOLOR=3
 10  X1=0
 20  Y1=50
 30  X2=259
 40  Y2=73
 50  ACC=.1
 60  HPLOT X1,Y1 TO X2,Y2
 70  M=(Y2-Y1)/(X2-X1)
 80  FOR I=X1 TO X2
 90  Y=M*I+80
100  D=Y-INT(Y)
110  IF D<ACC THEN HPLOT I,Y
120  NEXT I
```

The first line is plotted as a solid line using the HPLOT command and the second line only plots those points that are within a distance ACC of the true line. I leave you to choose which is better for your application.

The HPLOT command has two more ways in which it can be used. First, if you only give a pair of finish co-ordinates, then the last plotted dot is taken to be the start of the line, for example:

```
10  HPLOT 10,10
20  HPLOT TO 100,90
```

is the same as:

```
10  HPLOT 10,10 TO 100,90
```

Second, you can carry on an HPLOT command with as many TO final co-ordinate pairs as you can type. Each time a TO is encountered a line is drawn from the last pair of co-ordinates to the pair following the TO. An example might help to make this clear.

```
10  HPLOT 10,10 TO 100,90 TO 60,60
```

is the same as:

```
10  HPLOT 10,10 TO 100,90
20  HPLOT 100,90 TO 60,60
```

Some useful shapes

There are two ways of using high-res graphics — you can list and plot every point you're interested in (in which case you'd do well to invest in a light pen or a graphics tablet) or you can generate the shapes that you need by the use of formulae. To illustrate the point, consider the problem of plotting a circle. You could store the co-ordinates of every point on the circle in an array and then plot every point, or you could use the equation that defines a circle to generate each point in turn. If you need to draw a very complicated shape then you have little choice but to buy a light pen! Most graphics applications require nothing more than straight lines, circles and ellipses, so it's worth knowing how to draw them.

Drawing straight lines in Applesoft is easy; all you have to do is use the HPLOT command. But how do you draw a curve? The answer is to draw a number of straight lines that lie as close to the curve as possible. For example, if we consider the circle drawing problem, co-ordinate geometry tells us that any point on the circle is given by an x co-ordinate of rCOS(theta) + x and a y co-ordinate of rSIN(theta) + y, where r is the radius of the circle centred at x,y. As theta goes from 0 to 2*pi every point on the circle is generated, and we could use this fact to plot a sufficiently large number of points to give the impression of a continuous curve. This is what the following program does:

```
  1  HGR2
  2  HCOLOR=3
 10  PI=3.14159
 20  X=100
 30  Y=100
 40  R=60
 50  INC=.09
100  FOR THETA=0 TO 2*PI STEP INC
110  HPLOT R*COS(THETA)+X,
     R*SIN(THETA)+Y
120  NEXT THETA
```

You can vary the size and position of the circle by varying R, X and Y. Or, you can plot from point to point by making the following changes to the program: ▶

```
42   X2 = X + R
43   Y2 = Y
100  FOR THETA = 0 TO 2*PI + INC
     STEP INC
105  X1 = R*COS(THETA)+X
106  Y1 = R*SIN(THETA)+Y
110  HPLOT X2,Y2 TO X1,Y1
115  X2 = X1
116  Y2 = Y1
```

If you want to draw an ellipse, then you can do it by simply modifying the original dot-drawn circle program as follows:

```
35   R1 = 60
40   R2 = 20
110  HPLOT R1*COS(THETA)+X,
     R2*SIN(THETA)+Y
```

If you want to produce a line-drawn ellipse, then modify your line-drawn circle program as follows:

```
40   R1 = 60
42   X2 = X+R1
45   R2 = 20
105  X1 = R1*COS(THETA)+X
106  Y1 = R2*SIN(THETA)+Y
```

The two variables R1 and R2 are the axes of the ellipse. You can vary these to make a 'thinner' or 'fatter' ellipse. You can move the ellipse around on screen by varying X and Y. Drawing a cylinder is relatively easy; simply add the following lines to the line-drawn ellipse program:

```
51   GOSUB 100
52   X = 100
53   Y = 30
54   GOSUB 100
55   HPLOT R1+100,100 TO R1 + 100,30
56   HPLOT 100-R1,100 TO 100-R1,30
57   END
 . . . .
130  RETURN
```

Line 51 gets the lower ellipse drawn. Lines 52 to 54 then draw another ellipse of the same size above the first and lines 55, 56 draw the lines between the two.

For a bit of fun, take your line-drawn circle program and modify it thus:

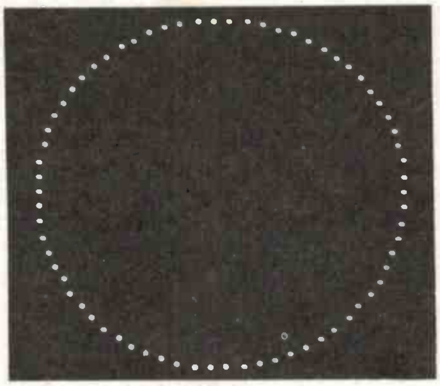
```
44   N = 4
45   A = 3
50   INC = 2*PI/A
100  FOR THETA = 0 TO N*PI + INC
     STEP INC
```

Voila! — a triangle. Now, in turn, try A = 2.5, 4 and 5. Interesting? Then set N = 8 and try, in turn, A = 2.25, 4.5, 6.75 and 9. Try exploring other relations.

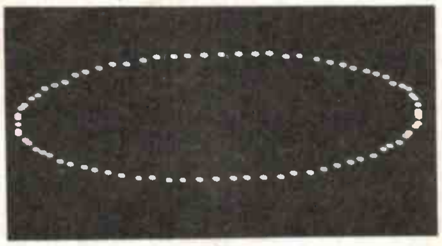
Shape tables

It was mentioned earlier that one of the problems of using Apple graphics is that standard shapes are not available from the keyboard. This can be overcome by use of a very clever idea — the shape table. Put simply, the shape table is a way of recording the outline of a shape and then plotting it at any point on the screen, any size and in any orientation. So, via a set of shape tables you could make often-used shapes as freely available in high-res graphics as if they were symbols on the keyboard. The only trouble is that shape tables are fairly difficult to use (it would take yet another article to explain them, for example) and my advice to anyone considering using them is to buy a shape table compiler.

A shape table compiler is usually a BASIC program that will allow you to draw your fundamental shape on the screen, accepts any corrections and then produces a shape table for it — this makes life very much easier. Shape tables are often used to provide a set of standard characters (e.g: A-Z and 0-9) so that text can be placed *anywhere* on a graphics screen.



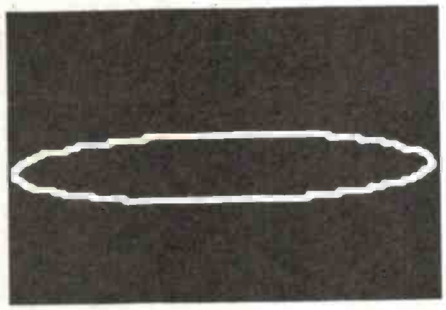
A circle composed of dots



An ellipse composed of dots

Conclusions

In this fairly rapid look at Apple graphics I have tried to show the sort of things an Apple can do and how they can be done. I have obviously had to treat some topics very briefly, but I hope I have given the reader sufficient understanding to go on and discover how more advanced graphics are achieved. I say 'discover', for although you can go out and read books on graphics in general, the Apple is an ideal machine for learning about graphics by experiment — and it's fun! ●



A 'continuous' ellipse — it's better done with dots.

Location	Function
49232 (C050)	Display GRAPHICS
49233 (C051)	Display TEXT
49233 (C052)	Display all TEXT or GRAPHICS
49235 (C053)	Mix TEXT and GRAPHICS *
49236 (C054)	Display Page 1
49237 (C055)	Display Page 2
49238 (C056)	Display Low-Res *
49239 (C057)	Display High-Res *

Table 1. The various display modes and the soft switches which control them. The items marked with an * only function in the graphics mode.

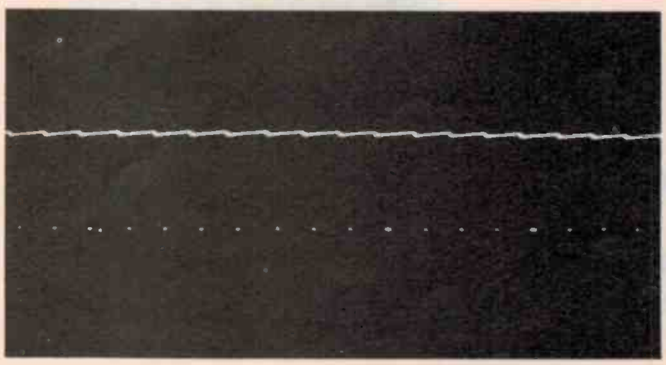
Mode	Page 1	Page 2
Text	1024-2047 (0400-07FF)	2048-3071 (0800-0BFF)
Low-Res	As Text	As Text
High-Res	8192-16383 (2000-3FFF)	16384-24575 (4000-5FFF)

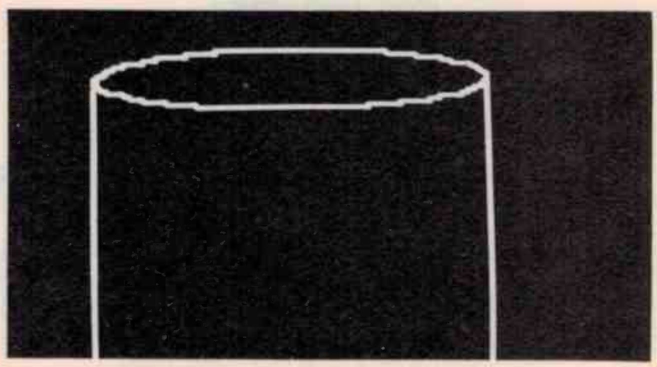
Table 2. The three 'pure' modes and their corresponding screen addressing.

Dec	Hex	Colour
0	0	Black
1	1	Magenta
2	2	Dark Blue
3	3	Purple
4	4	Dark Green
5	5	Grey 1
6	6	Medium Blue
7	7	Light Blue
8	8	Brown
9	9	Orange
10	A	Grey 2
11	B	Pink
12	C	Light Green
13	D	Yellow
14	E	Aquamarine
15	F	White

Table 3. The available colours and their codes for low-res graphics.

CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL
0	@	32		64	AS COLUMN 1 BUT FLASHING	96	AS COLUMN 2 BUT FLASHING	128	@	160		192		224	
1	A	33	!	65		97		129	A	161	!	193		225	
2	B	34	"	66		98		130	B	162	"	194		226	
3	C	35	#	67		99		131	C	163	#	195		227	
4	D	36	$	68		100		132	D	164	$	196		228	
5	E	37	%	69		101		133	E	165	%	197		229	
6	F	38	&	70		102		134	F	166	&	198		230	
7	G	39	'	71		103		135	G	167	'	199		231	
8	H	40	(	72		104		136	H	168	(	200		232	
9	I	41	)	73		105		137	I	169	)	201		233	
10	J	42	*	74		106		138	J	170	*	202		234	
11	K	43	+	75		107		139	K	171	+	203		235	
12	L	44	,	76		108		140	L	172	,	204		236	
13	M	45	—	77		109		141	M	173	—	205		237	
14	N	46	.	78		110		142	N	174	.	206		238	
15	O	47	/	79		111		143	O	175	/	207		239	
16	P	48	0	80		112		144	P	176	0	208		240	
17	Q	49	1	81		113		145	Q	177	1	209		241	
18	R	50	2	82		114		146	R	178	2	210		242	
19	S	51	3	83		115		147	S	179	3	211		243	
20	T	52	4	84		116		148	T	180	4	212		244	
21	U	53	5	85		117		149	U	181	5	213		245	
22	V	54	6	86		118		150	V	182	6	214		246	
23	W	55	7	87		119		151	W	183	7	215		247	
24	X	56	8	88		120		152	X	184	8	216		248	
25	Y	57	9	89		121		153	Y	185	9	217		249	
26	Z	58	:	90		122		154	Z	186	:	218		250	
27	[	59	;	91		123		155	[	187	;	219		251	
28	\	60	<	92		124		156	\	188	<	220		252	
29	]	61	=	93		125		157	]	189	=	221		253	
30	^	62	>	94		126		158	^	190	>	222		254	
31	_	63	?	95		127		159	_	191	?	223		255	





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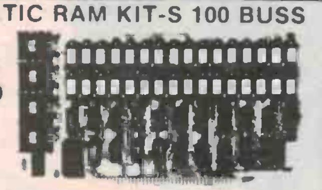

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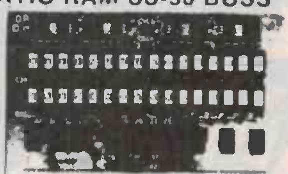

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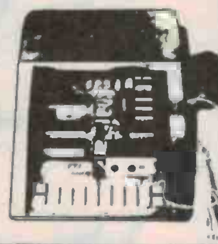

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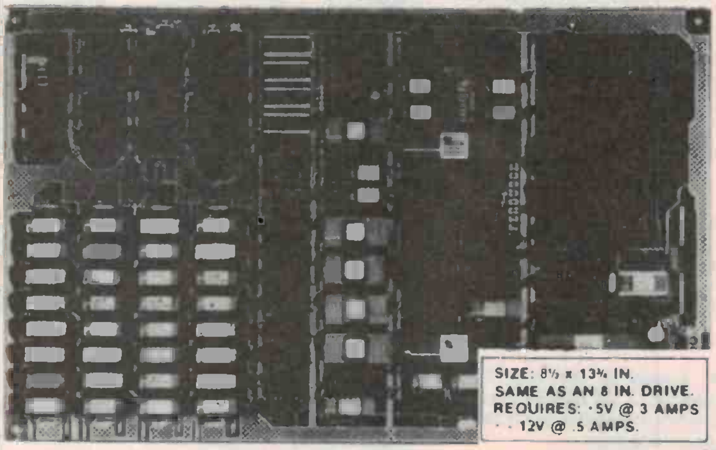

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Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 Int. Price for all parts and connectors: $65

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Consists of a separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

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6/82-4

SPACE DOGFIGHT

Luke Skywalker rides again! Shoot the evil X-wing fighter and see it disintegrate before your very eyes. But watch it! The X-wing fighter will sneak up behind and clobber you — unless you duck out of its way!

In this game, you control a Y-wing fighter that first appears in the middle of the screen, immediately you run the program. LOOK OUT! The huge X-wing fighter appears over your port rear quadrant — press key 9 to drop out of its way and, as it cruises past, hit key 5 to fire your missile before the X-wing craft disappears off the screen to the right.

- To move your Y-wing fighter UP — press key 1.
- To move it DOWN — press key 9.
- To move LEFT — press key 6.
- To move RIGHT — press key 7.
- To FIRE — press key 5.

A one-second tone is heard whenever the X-wing craft runs into the Y-wing craft — and you lose points from your score. When you score a hit, you'll hear a 'pip-pip-pip-pip-pip', 'bits' will disappear from the X-wing craft and it will change shape — making it much harder to hit, especially as you score more hits.

The game lasts about 80 seconds and your score appears on screen at the end. Press 'RESET 8' to get a new game. We'll let all you keen CHIP-8 hackers have fun annotating the listing to find out how it works on this one.

This program has been modified and rewritten for the '660 from an original program submitted by J.L. Elkhorne of Chigwell, Tasmania, called 'COSMAC Asteroids', written for a 4K VP-111 reproduced elsewhere in this issue).

PROGRAM NOTES

There are eight basic 'modules' in this program:

0600 — 0607	PLACE Y-WING MID SCREEN
0608 — 0641	CALL AND EXECUTE ROUTINES
0642 — 065B	MOVE Y-WING FIGHTER
065C — 067F	MISSILE DYNAMICS
0680 — 06B5	HIT X-WING FIGHTER
06B6 — 06CE	MOVE X-WING FIGHTER
06D0 — 06F8	SCORING
0700 — 0711	FIGHTER & MISSILE PATTERNS

Scanning of the keyboard and executing the commands entered is done within the second module, from 061A to 0635. The Y-wing fighter pattern resides at 0700-0702, the missile at 0703. The X-wing pattern is entered in two places (as it is called twice) at 0704-0709 and 070C-0711.

For left-handers, the keyboard positions can be exchanged by changing 061A to 63 02, 0620 to 63 01, 0626 to 63 07, 062C to 63 0F and 0632 to 63 03.

If you want to put the SHOOT key between the MOVE LEFT and MOVE RIGHT keys, change the original (right-handed) program by altering 0620 to 63 05 and 0632 to 63 06. Left-handers change 061A to 63 03 and 0632 to 63 02.

You can also muck about with the fighter patterns (completely changing the 'look' of the game, without altering its operation). You can change the Y-wing fighter to a miniature X-wing craft by altering addresses 0700-0702 to 28 18 28; or a 'reverse' of that by entering 10 28 10 instead. Note that your missile is at address 0703. You can make the larger craft harder to hit by changing address 0704-0709 to 00 66 18 18 66 00; do likewise at addresses 070C-0711. Or you could try something like 00 D8 20 D8 00 in those addresses. The 'reverse' of that pattern is 00 20 D8 20 00. You can really decrease the size of your Y-wing craft by entering 20 10 20 at addresses 0700-0702. Have fun!

X-WING DOGFIGHT

0600	A7	00
0602	6A	1F
0604	6B	10
0606	DA	B3
0608	69	00
060A	6D	14
060C	6C	00
060E	A7	04
0610	61	00
0612	62	00
0614	D1	26
0616	67	18
0618	A7	00
061A	63	07
061C	E3	A1
061E	26	42
0620	63	06
0622	E3	A1
0624	26	48
0626	63	01
0628	E3	A1
062A	26	4E
062C	63	09
062E	E3	A1
0630	26	54
0632	63	05
0634	E3	A1
0636	26	5C
0638	26	B6
063A	47	18
063C	16	D0
063E	16	36
0640	16	42
0642	DA	B3
0644	7A	02
0646	16	58
0648	DA	B3
064A	7A	FE
064C	16	58
064E	DA	B3
0650	7B	FE
0652	16	58
0654	DA	B3
0656	7B	02
0658	DA	B3
065A	00	EE
065C	A7	03
065E	47	18
0660	26	76
0662	D5	61
0664	77	FE
0666	4F	01
0668	26	80
066A	D5	61
066C	75	03
066E	37	00
0670	00	EE
0672	67	18
0674	00	EE
0676	85	A0
0678	86	B0
067A	76	01
067C	7D	FF
067E	00	EE
0680	6C	06
0682	6E	02
0684	FE	18
0686	6E	03
0688	FE	15
068A	FE	07
068C	3E	00
068E	16	8A
0690	7C	FF
0692	3C	00
0694	16	82
0696	79	02
0698	67	18
069A	A7	04
069C	D1	26
069E	C3	05
06A0	89	34
06A2	F3	1E
06A4	F0	65
06A6	C3	EE
06A8	80	32
06AA	F0	55
06AC	71	08
06AE	A7	04
06B0	D1	26
06B2	A7	03
06B4	00	EE
06B6	A7	04
06B8	C3	02
06BA	C4	01
06BC	D1	26
06BE	81	34
06C0	82	44
06C2	D1	26
06C4	3F	01
06C6	00	EE
06C8	6E	0A
06CA	FE	18
06CB	7D	FF
06CE	00	EE
06D0	3D	00
06D2	16	18
06D4	A7	13
06D6	F9	33
06D8	F2	65
06DA	00	E0
06DC	6A	18
06DE	6B	0A
06E0	F0	29
06E2	DA	B5
06E4	7A	06
06E6	F1	29
06E8	DA	B5
06EA	7A	06
06EC	F2	29
06EE	DA	B5
06F0	A7	0C
06F2	F5	65
06F4	A7	04
06F6	F5	55
06F8	16	F8
06FA	00	00
06FC	00	00
06FE	C0	00
0700	C0	20
0702	C0	10
0704	C3	66
0706	18	18
0708	66	C3
070A	00	00
070C	C3	66
070E	18	18
0710	66	C3

ERRATA

VIDEO DRAWING

May issue p.117

This program has the last four lines missing! Following 06A4 (00 EE), enter:

81 04
82 74
16 32
00 00

In addition, addresses 0664 to 0672 contain a data file and do not call subroutines, as the disassembled listing indicates.

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Bare Board	$ 35.00
4Mhx kit	$174.00
4Mhz A&T	$199.00
Kit no RAM	$120.00

DYNAMIC RAM

T.I. 4116-3 16K for $16.00
Upgrade Super 80, TRS 80, and others
Expandable + 64K.
Dynamic RAM Board A&T $425.00
Guaranteed to work at 4Mhz or your money back

QT SILENCE+MOTHERBOARDS

The Silence + has become one of the most tried and proven motherboards on the market. Using a unique grounding matrix, each line is completely surrounded with ground shielding which eliminates necissity for termination and gives the unit a very high cross talk rejection. One of the OEM customers has used the Silence + as high as 14Mhz without terminations.

FEATURES:

- LED power indicator
- Eliminates necessity for termination
- Fits most industry standard mainframes
- Available in 6, 8, 12 and 18 slot configurations

QTCMB6BB	6 Slot Bare Board	$ 31.00
QTCMB6A	6 Slot A&T	$ 81.00
QTCMB8BB	8 Slot Bare Board	$ 33.00
QTCMB8A	8 Slot A&T	$104.00
QTCMB12BB	12 Slot Bare Board	$ 39.00
QTCMB12A	12 Slot A&B	$138.00
QTCMB18BB	18 Slot Bare Board	$ 61.00
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S100 Sockets	Solder Tail (Gold)	$ 630

SBC2/4 Z80 S100 SINGLE BOARD COMPUTER

The QT Computer SBC2/4 Processor Board is a versatile and powerful Z80 based design which is compatible with the proposed IEEE S-100 bus standard. Although the SBC2/4 may be used as the host CPU of a large system, it has all the necessary features to be used as a stand-alone computer system.
Unlike old designs it will work reliably with dynamic RAM boards and more importantly with soft sectored disk controllers, and hence standard versions of CP/M. This will give you access to the largest software base for microcomputers.

- Z80A 8 bit CPU
- 2 or 4 Mhz Switch selectable
- 1K RAM (which can be located at any 1K boundary
- Full 64K use of RAM allowed in shadow mode
- DMA compatability allows MWRT signal generation on CPU board or elsewhere in system under DMA logic or front panel control
- TWO programmable timers available for use by programs run with the SBC+2/4 (timer output and controls available for use on CPU board).

Shipping weight: 2lbs.

QTCSBC24B	Bare Board	$ 66.00
QTCSBC24K	Kit	$199.00
QTCSBC24A	Assembled and Tested	$269.00

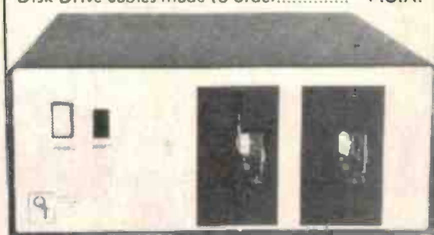
The MD+MD Mainframe offers the same quality as the MF+. It accepts two 5 1/4" disk drives with remaining space for either a 6, 8, or 12 slot Silence Plus Motherboard.

QTCMFMD	without Motherboard	$400.00
QTCMFMD6	with 6 Slot Motherboard	$480.00
QTCMFMD8	with 8 Slot Motherboard	$500.00
QTCMFMD12	with 12 Slot Motherboard	$540.00
QTCMFMDB	bare metal work	$195.00

DISK CONTROLLER

CCS2422A features ROM bootstrap loader and monitor ● CP/M 2.2 with ducumentation included ● Accepts 5 1/4" and 8" disk drives ● Double sided/single sided select ● Read, write IBM 3740 or system 34 single or double density ● Fast seek available for voice coil operation ● Automatic disk density determination ● ROM bootstrap phantom.

CCS2422A A & T Incl. CP/M 2.2	$399.95
JADE DD Bare Board	$ 85.00
QTFDC II A&T Incl. QT DOS	$379.00
Disk Drive cables made to order	P.O.A.



Also available without cutouts on front panel

MAINFRAMES

S-100 MAINFRAME FOR DUAL 8" DISK DRIVES

AT LAST! A desk top enclosure that will accommodate a S-100 bus system and two 8" disk drives. The MF+MD mainframe is the most versatile dual 8" mainframe on the market. It will accommodate 6, 8, or 12 slot card cages using the Silence + motherboards. Just add a CPU, memory board, disk controller and terminal and you have an inexpensive, high quality computer system.

FEATURES;

- Accommodates and 8" standard disk drive (801R, DT-8, etc.)
- IEEE S-100 Silence + 6, 8 or 12 slot motherboard available. (See motherboard description at left.)
- Keyed power switch.
- Reset switch on front panel.
- Anodized 6, 8 or 12 slot cages.
- Quiet fan provides cool system operation featuring filtered positive air pressure. User may add two additional fans for the 12 slot if required.
- Detachable line chord plugs directly into EMI filter for electrical noise suppression.
- 16 DB25 cut out
- 2 50 pin plug connector cut outs.
- 2 DD55 cut outs.
- Dimensions 9 5/8" x 17" x 21" (HxWxD)
- Power supply +8V@25A/+- 16V @ 5A/ +5@2.5A/-5@5A/+24V@3A
- Input Voltage 110-113VAC/220-240VAC 50-60 Hz 48 lbs.

QTCMFDD	without Motherboard	$575.00
QTCMFDD6	with 6 Slot Motherboard	$625.00
QTCMFDD8	with 8 Slot Motherboard	$650.00
QTZMFDD12	with 12 slot Motherboard	$700.00
QTCB	Bare Metalwork	$175.00

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We have fantastic specials on printers, terminals, plotters and disk drives. Call or write for details and pricing. Here are some examples:

YD-174 8" DS/DD Drives .... @ $625.00
2 for $1200.00
VIEWPIONT Terminal 80x24 detachable keyboard $995.00
Hazeltine Esprit 80 x 24
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Optional Graphics. Best value $975.00
WATANABE 6 colour plotter $1295.00
TEAC and MPI mini drives, 40 or 80 track.
Single or double sided. Our prices are too low to advertise!! We carry a complete range of cabinets and power supplies for 5 1/4" and 8" drives for single and dual drives.
ITOH DAISYWHEEL 25 cps (parallel) .. $1500.00
Serial or 40 cps optional.
ITOH M8510 Graphics Printer
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CR256-64 .... $795.00
CR256-256 .... $995.00

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SYSTEM + II (2MB +)

Computer system with 8" Dual Sided Drives (uses Y-E DATA YD174 Disk Drives) Terminal not included.

A&T (6 Slot) $4270.00
A&T (8 slot) $4370.00

MINI-SYSTEM + (½MB +)

Computer System with 5 1/4" Single Sided Drives (uses TEAC FD-50A Disk Drives) Terminal not included.

A&T (6 slot) $2745.00
A&T (8 slot) $2845.00

QT Systems are designed for both businessmen and engineers in accordance with the latest IEEE standards. Among other functions, they can be used for accounting and word processing as well as a variety of scientific applications. The systems are available with MP/M or QT DOS operating systems to allow multi-user, multi-tasking operations. QT also offers a full line of business and applications software, ranging from a business package to word processing.

Technical specifications: 4 MHz Z-80 CPU ● Dbl-sided, dbl-den 5 1/4" or 8" floppy disk controller (handles both drives simultaneously) ● CP/M 2.2 included ● 64K RAM, expandable per your requirements ● Comes complete in single mainframe ● RS232C serial port ● Parallel port ● Hard disk compatible ● Monitor program & disk routines included on EPROM ● Power-on/reset jump to monitor program ● Documentation included ● Extensive software available.

SOFTWARE +

Word processing ● System utilities and diagnostics ● Games ● CP/M users group diskettes $10.00 each, catalogue $4.50 ● Pascall, Forth, Tarbell Basic, Fortran and most other compilers and utilities are available ● Complete range of business software ● Custom programming can be arranged on a fixed price or hourly basis.

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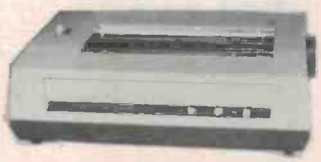

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CS-1559A	130mm	DC-10MHz	10MV/DIV	1uS/DIV .5S/DIV	Single	$ 448.00
CS-156AMKII	130mm	DC-15MHz	10MV/DIV	.5uS/DIV .5S/DIV	Dual	$ 498.00
CS-1562A	130mm	DC-10MHz	10MV-DIV	1uS/Div .5uS/Div	Dual	$ 528.00
CS-1566	130mm	DC-20MHz	5MV/DIV	.5uS/DIV .5uS/DIV	Dual	$ 645.00
CS-1572	130mm	DC-30MHz	5MV/DIV	.2uS/DIV. 5S/DIV	Dual	$ 929.00
CS-1575	130mm	DC- 5MHz	1MV/DIV	.5uS/DIV 2MS/DIV	Dual	$ 537.00
CS-1577	130mm	DC-35MHz	2MV/DIV	1uS/DIV .5S/DIV	Dual	$ 983.00
CS-1830	130mm	DC-35MHz	2MV/DIV	.2uS/DIV .5S/DIV	Dual	$1163.00

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J.H. Parkes

A giant 'Detail' for UK101 and Superboard II owners, revealing their system's subtleties.

AMONG THE more popular single-board machines equipped with graphics are the Superboard II and its UK competitor, the UK101. The two systems are basically very similar but they do have differences, both in their graphics sets and the layout of the screen memory.

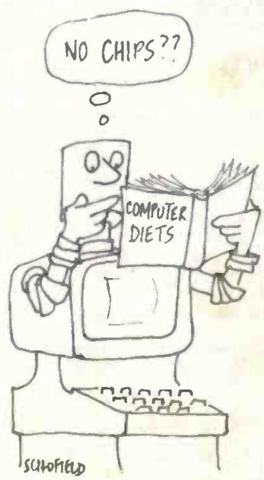
This Graphic Detail is intended to reveal these differences and make program conversion between them simpler. It should also be of use to those converting to or from totally different systems.

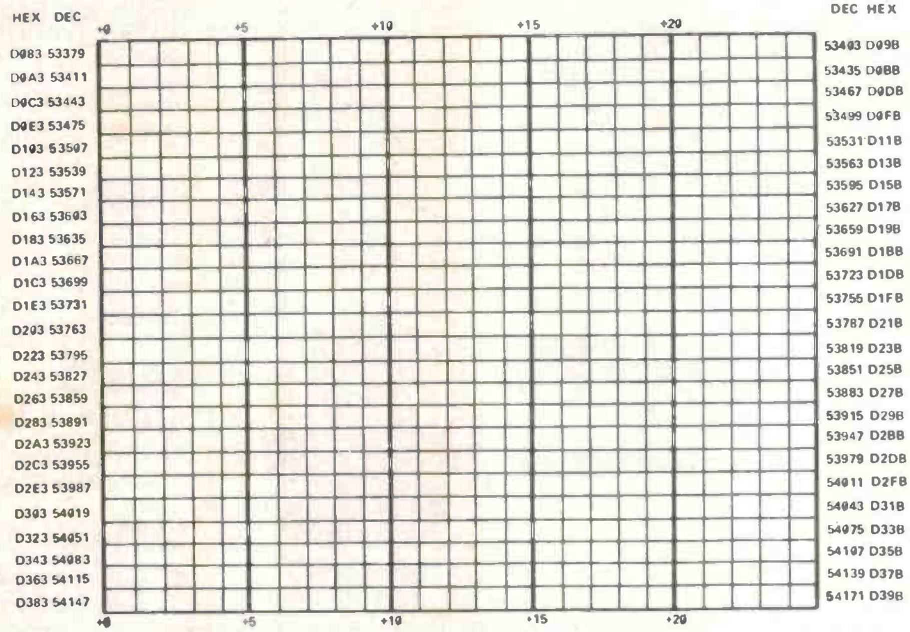
Controlling Codes

There are a number of monitors around for the two computers and Table 1 is intended to show the various cursor and other 'non-printing' functions. The numbers shown are those associated with the CHR$() function.

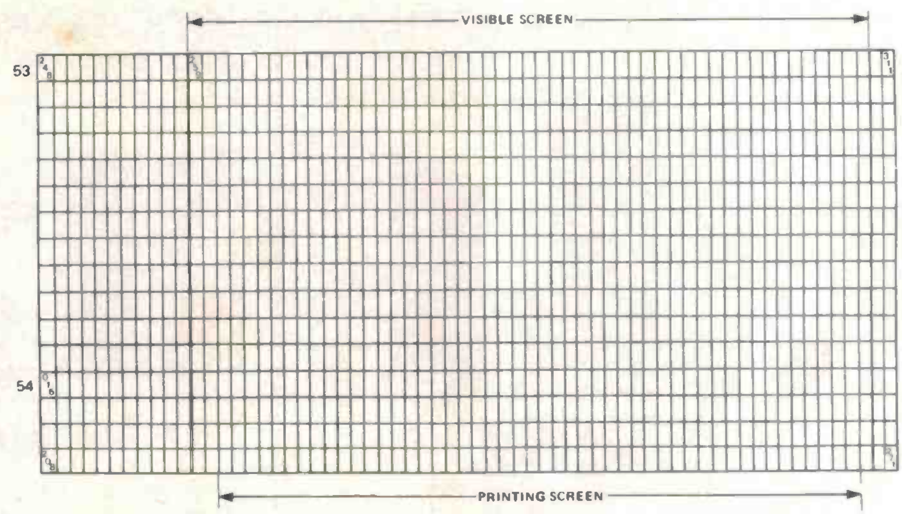
FUNCTION	MON 01	MON 02	CEGMON
Carriage Return	13	13	13
Cursor Left	—	08	—
Cursor Right	—	09	11
Cursor Up	—	11	—
Cursor Down	10	10	10
Home	—	—	12
Clear Screen	—	12	26
Clear Window	—	—	30

Table 1. The 'non-printing' functions for the various monitors.



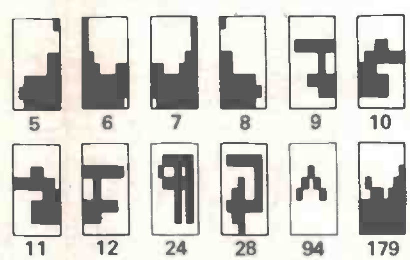


The Superboard II's screen memory map.



The UK101 has a slightly more convoluted arrangement as can be seen from its screen map.

The following 36 characters are from the Superboard II and should be inserted in the table when using that system.



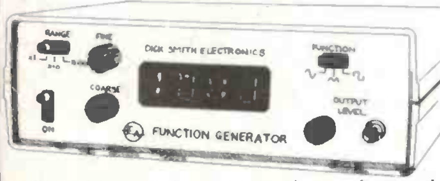
GRAPHIC DETAILS

CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL
0		32		64	@	96		128	—	160		192	(	224	(
1		33	!	65	A	97	a	129	—	161		193	^	225	)
2		34	"	66	B	98	b	130	—	162		194	>	226	O
3		35	#	67	C	99	c	131	—	163		195	/	227	(
4		36	$	68	D	100	d	132	—	164		196	<	228	)
5		37	%	69	E	101	e	133	—	165		197	\	229	♥
6		38	&	70	F	102	f	134	—	166		198	\	230	♣
7		39	'	71	G	103	g	135	—	167		199	\	231	♠
8		40	(	72	H	104	h	136	|	168		200	\	232	♦
9		41	)	73	I	105	i	137	|	169		201	/	233	
10		42	*	74	J	106	j	138	|	170		202	/	234	◀
11	^	43	+	75	K	107	k	139	|	171		203	L	235	▶
12	≡	44	,	76	L	108	l	140	|	172		204	r	236	
13		45	-	77	M	109	m	141	|	173		205		237	
14		46	.	78	N	110	n	142	|	174		206		238	
15		47	/	79	O	111	o	143	|	175		207		239	
16		48	0	80	P	112	p	144	=	176		208		240	↑
17		49	1	81	Q	113	q	145		177		209		241	α
18		50	2	82	R	114	r	146		178		210		242	β
19		51	3	83	S	115	s	147		179	⇒	211		243	ω
20		52	4	84	T	116	t	148		180	⇐	212		244	δ
21		53	5	85	U	117	u	149		181		213	.	245	ψ
22		54	6	86	V	118	v	150		182	△	214		246	Ω
23		55	7	87	W	119	w	151		183		215		247	
24	£	56	8	88	X	120	x	152		184		216		248	π
25		57	9	89	Y	121	y	153		185		217		249	Σ
26		58	:	90	Z	122	z	154		186		218		250	λ
27		59	;	91	[	123	{	155		187		219		251	φ
28		60	<	92	\	124	¦	156		188	X	220		252	θ
29		61	=	93	]	125	}	157		189	/	221	(	253	ξ
30		62	>	94	↑	126	÷	158		190	\	222	)	254	ν
31		63	?	95	_	127		159		191	V	223		255	γ

All these characters make up the UK101's graphic repertoire.

DICK SMITH KITS

NEW FUNCTION GENERATOR



This kit produces sine/triangle and square waves over a frequency range from below 20Hz to over 160KHz! it has four digit LED readout enabling accurate frequency setting. This kit makes an ideal companion for our frequency counter kit (Cat K-3439). The case shown above is optional at extra cost (Cat H-2505 $19.95).
Cat K-3520
SEE EA APRIL 82

$59.50

EASY TO BUILD

We supply everything you will need to assemble the kits, right down to the last nut and bolt. We even include full instructions rewritten by our technical specialists to make construction easy.

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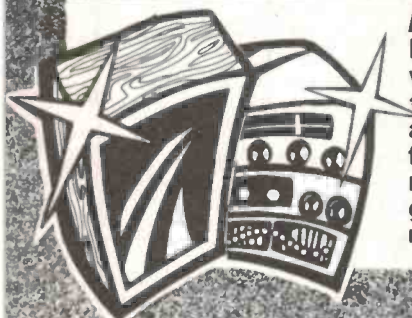


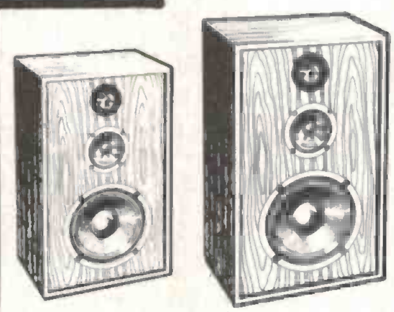
Imagine how proud you will be when you are able to show a fully assembled kit to your friends and say 'I built it myself!' They look so good your friends will never believe you.

QUALITY COMPONENTS

We only use brand new, prime spec components in our kits. If we do have to make parts substitutions we check these out with the designer of the project first before we make the change.

SAVE A FORTUNE ON THESE QUALITY SPEAKER KITS!

Famous Playmaster



Now Dick Smith offers you these superb speaker kits just right for your needs. All are manufactured to exacting standards of E.A. specifications. All kits include 3 magnificent speakers (woofer, mid-range and tweeter), superbly re-designed cabinets to suit any decor, full instructions, wiring harness with clip on connections (no soldering required). All kit prices are per pair.

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Cat K-3476

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NEW

PERCUSSION SYNTHESIZER

Now we've got rhythm with this percussion synthesizer. Produces the sounds of drums, cymbals, snares and bongos. You can play manually or by total electronic control. By the simple connection of a sequencer you can have automatic rhythm, just right for learning the basics of timing in music.
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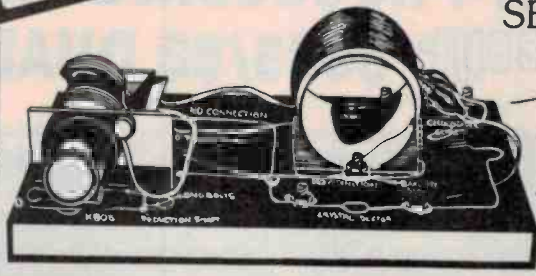
FOR FAMILY FUN REDISCOVER THE CRYSTAL SET WITH THE

DICK SMITH CRYSTAL SET



- ★ No batteries
- ★ Surprisingly good sound
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NEW

Cat K-3518

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Comes complete with pre-amp PCB and special Hitachi mosfets 2SJ49 and 2SK134. Also includes on board power supply, just add transformer (PF4361/1 Cat M-0153).

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PROTECT YOUR LIFE & EQUIPMENT
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Use as a stopwatch, countdown timer or event timer! Selectable timing rates between 0.01 and 1.0 seconds make this ideal for sporting events, darkrooms etc. Wiring for the unit for any of seven different functions is possible.
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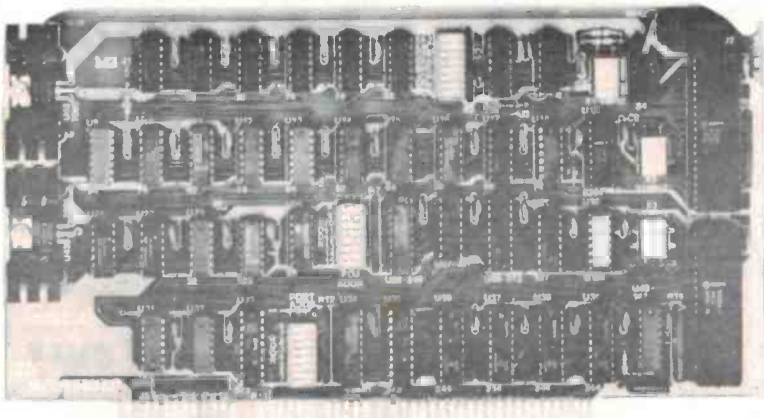

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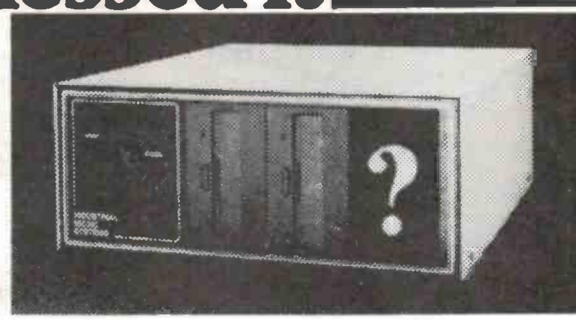

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Hard copy from your Sinclair

Peter Freeby

Sooner or later, every computer owner wants hard copy from his or her machine. If you have a low-cost machine, printout need not be high-cost — thought Clive Sinclair. So he produced the ZX printer, and at a price to suit the ZX owner.

THE ZX PRINTER, while announced some time ago, has only recently been released in Australia, at a retail price of $190. As befits the machine it is designed to team with, the ZX printer is compact, functional and simple to operate. It plugs directly into the ZX81 or the ZX80 with 8K BASIC ROM. It provides metallised paper, obtainable from the suppliers at $25 for a five-roll pack. You can print nine lines to the vertical inch (25.4 mm) at a speed quoted as 50 characters per second. The 20 m roll allows you to print over 250 screens-worth of text (about 6500 lines)!

Putting it to use

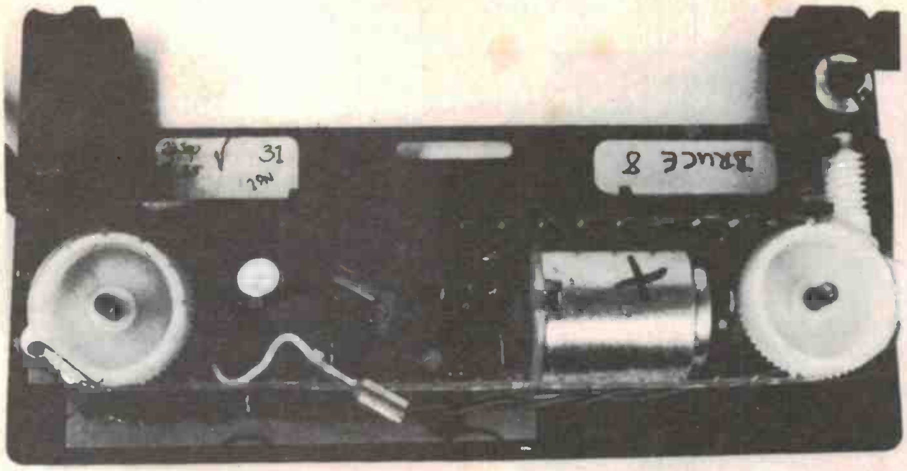
The ZX printer is extremely simple and quick to put into operation. It takes longer to put a mains plug on the power supply lead than it takes to plug in the printer and learn the use of the one control available — the paper feed. The plug on the printer lead has an integral socket to accept the add-on 16K RAM pack. The 17-page instruction book gives a clear description of how to load a fresh roll of paper, use the feed button, tear the paper neatly off the roll (!), clean the printer and, of course, the general principle of operation. There is also a selection of programs aimed at giving you the pleasure of seeing your new acquisition work, while at the same time showing the use of those BASIC statements associated with the ZX printer. Strange as it may seem, these BASIC statements are neither explained nor described in the text; instead we are directed to read chapter 20 of the ZX81 instruction book.

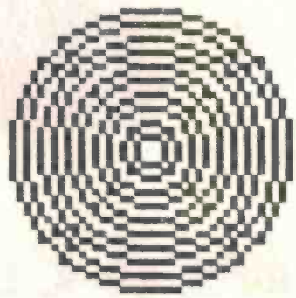
It would amuse me to report that the ZX81 instruction book then referred you to the ZX printer instructions; however, although it does tell you that the printer will have instructions with it, it has a short chapter to quite clearly explain the function of the three relevant BASIC statements. These are LLIST, LPRINT and COPY. The first two are just like LIST and PRINT except that they direct the display to the printer instead of to the television screen or monitor. The third statement, COPY, enables you to print out a copy of whatever is displayed on the screen at the time.

General theory of operation

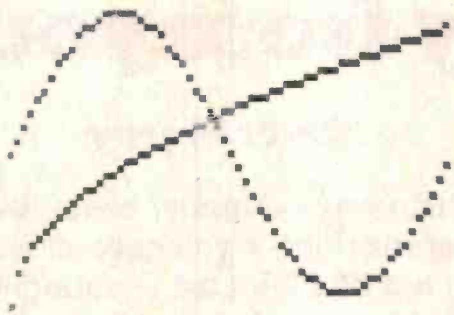
Normally when reviewing equipment or books it is not the 'done thing' to quote more than a sentence or two from any supplied text, but in this instance the ZX printer instruction book gives us a very simple and concise description of the basic workings of the printer:

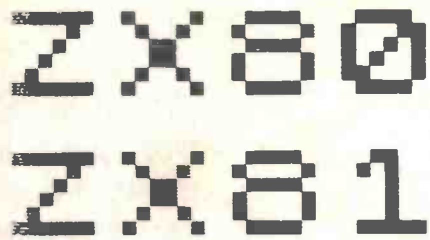
> 'the printer functions in rather the same way as a TV picture, i.e: by scanning from left to right. A conductive stylus is pulled across the paper at high speed, and where a black dot is wanted a pulse of current is passed through the stylus. This evaporates the aluminium coating on the paper, and allows the black backing to show through. To avoid the need to return the stylus quickly to the left-hand edge of the paper, there are in fact two styli, mounted on a moving belt, which follow each other in quick succession. The belt and the paper feed roller are both driven continuously whilst printing, so that when the next stylus comes round, the paper has been moved up ready for the next line.' ▶





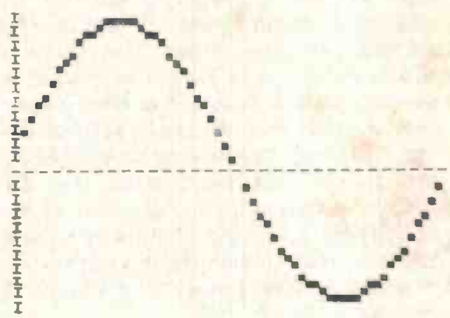
The internal workings of the printer. The belt carrying the two styli runs between the two white pulleys. Some examples of the printout are shown on this page.





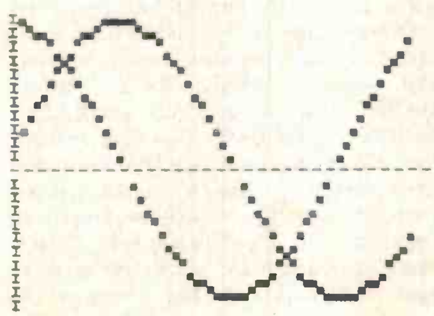
Having only three major print statements to consider, the ZX printer is very easy to use. Formatting the display to the printer can be carried out using the TAB and AT (@) statements, albeit when using the AT statement line commands are ignored and only column commands in the range ±21 actioned. Although unlikely to cause much confusion, it must be remembered that the output from LPRINT is not printed immediately but stored in a buffer one line long. The computer will only print:

1) when the buffer is full
2) after an LPRINT statement that does not end in a comma or semicolon
3) when a comma or TAB item requires a new line
4) at the end of a program if there is anything left unprinted.



In conclusion

The printout presented by the ZX printer was clear and readable with no disturbing fuzziness which occasionally has been seen with other systems. Graphic symbols can 'join up' from line to line, giving a clear, continuous picture. Keeping the printer clean is probably very important, and although the review model has been tested to some extent, long term reliability cannot be commented upon. As with the ZX81 and the ZX80 before it, the ZX printer offers something that, for the initial outlay, is quite remarkable, and can only add to the effectiveness of your ZX system. ●



```
ZX81 [illegible] ZX81 [illegible]

5530 CLS
5540 PRINT "AND FINALLY, THE PRI
NTER CAN BE USED TO PRINT TEXT"
5550 FOR N=1 TO 100
5560 NEXT N
5570 LPRINT "ZX81 [illegible] ZX81 [illegible]
"
5571 LPRINT
5572 LPRINT
5573 FOR N=0 TO 50
5577 NEXT N
5580 PRINT ,,"AND LIST PROGRAMS"
5590 FOR N=0 TO 40
5600 NEXT N
5610 LLIST 5530
5620 LPRINT
5630 LPRINT
5640 LPRINT
5650 LPRINT
5660 PRINT "FOR ANOTHER CYCLE"
5670 GOTO 1142
```

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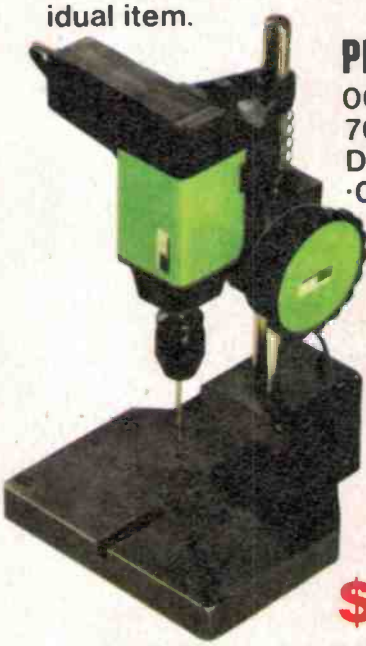

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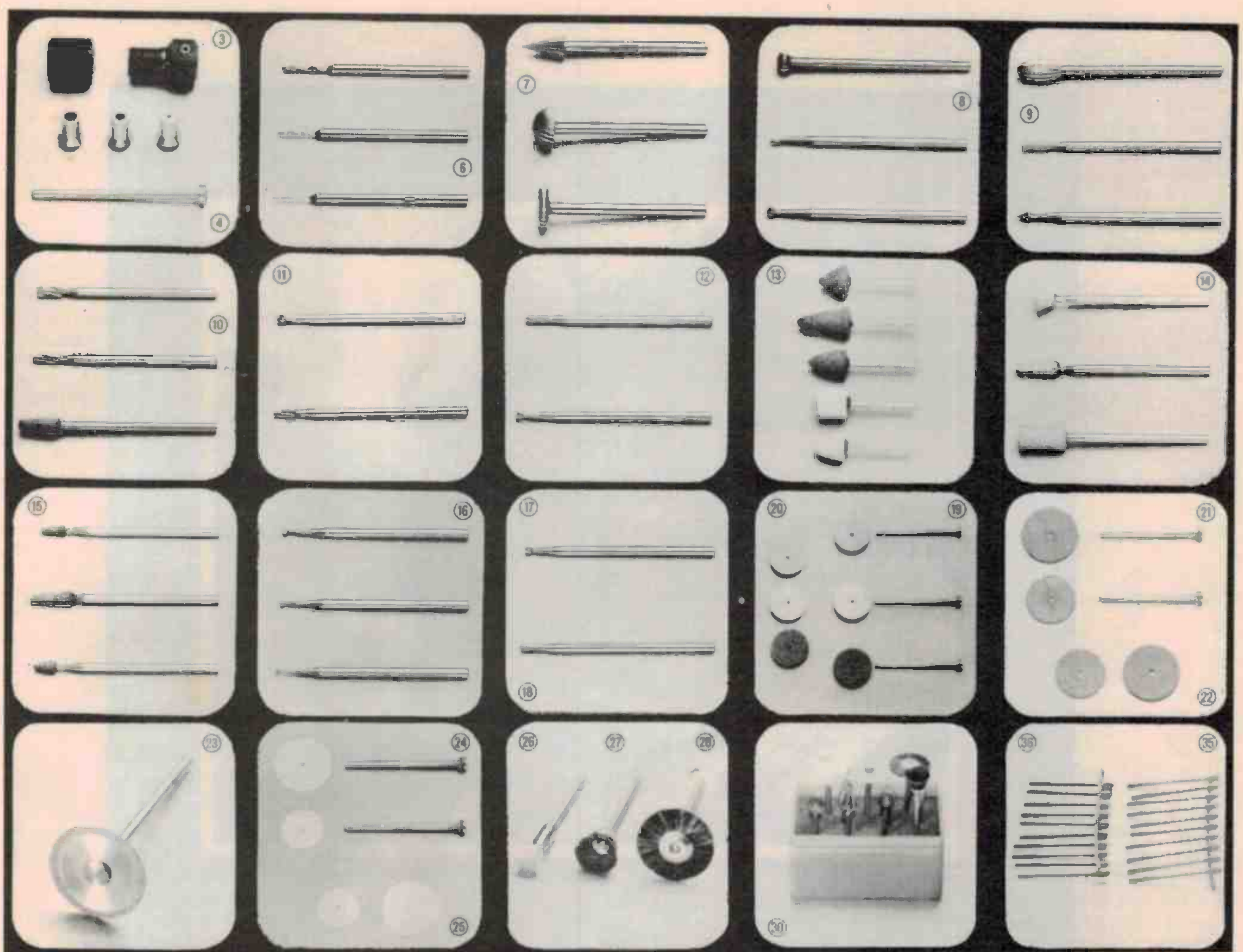

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Illustration at next page.

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- head Ø 6.4 mm, head length 12.1 mm

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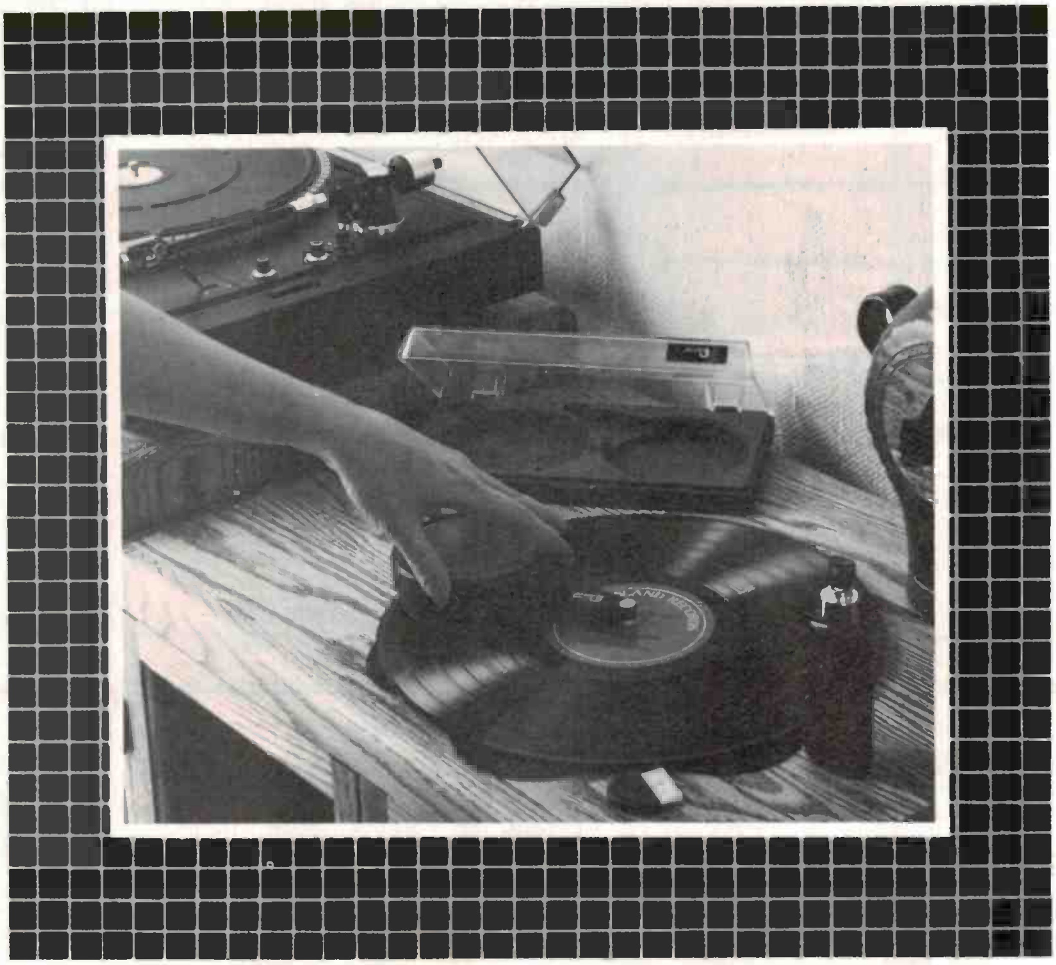

SIGHT & SOUND

Stereo TV sound proposed by US and Japan

The US Electronic Industries Association (EIA) has spent the past three years or so discussing future television sound standards for use in that country, and it is expected to recommend a multi-channel television sound standard to the FCC very soon.

Not only will the new standard provide for stereo sound, but it will also involve a secondary audio programme system which can be used for the transmission of sound in a second language.

In addition, two proprietary signals for broadcasting station use are proposed for inclusion in the transmitted signal at a lower level.

One of these low-level signals will be used for electronic news gathering (ENG) purposes so that reporters in the field can carry receivers which will monitor this narrow band, over which programme directors in broadcasting studios can issue instructions.

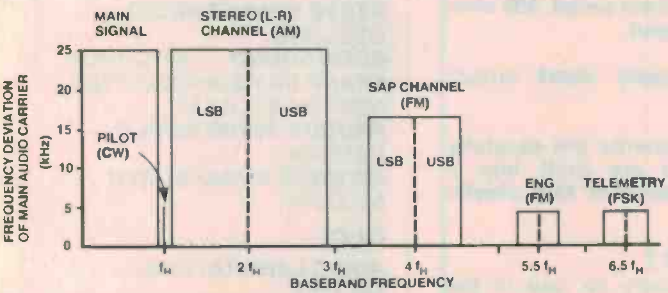

Figure 1. **The Zenith multichannel system.**

The second low-level sub-channel will carry an FSK signal which can be remotely monitored so that unmanned broadcasting stations can satisfy FCC requirements.

Current Japanese proposals for stereo television sound standards do not include any proposals for the inclusion of the ENG or remote signal monitoring channels.

The American proposals take into account the fact that compatibility with existing television receivers is to be regarded as essential. The additional audio transmissions must not be allowed to degrade the picture or sound quality of the huge numbers of receivers now in use, although the reception of stereo sound and possibly of the second sound channel will require the purchase of a suitable decoder, additional audio amplifier and a second loudspeaker.

In order that users shall be able to upgrade their systems when they so wish, the new stereo television system must employ some multiplexing scheme similar to that employed in FM stereo broadcasts.

Thus there will be a (left + right) signal channel and a (left − right) channel covering the full 5 kHz audio bandwidth, the left − right signal being modulated onto a suitable subcarrier. The secondary audio programme for other languages will probably offer a 10 kHz to 12 kHz audio bandwidth and will be modulated onto a subcarrier of higher frequency.

The two proprietary channels will be modulated onto still higher frequency subcarriers, but their bandwidth can be quite low — probably about 3.5 kHz. Thus the audio spectrum of the transmitted signal may be like that proposed by the Zenith Company (Figure 1) or by the Telesonic Company (Figure 2).

A constraint imposed by the US National Television System Committee (NTSC — often humourously remembered as 'Never Twice the Same Colour') is that the 6 MHz interchannel frequency spacing is unalterable and therefore the total bandwidth required by the improved radio transmissions cannot exceed that of the conventional transmissions.

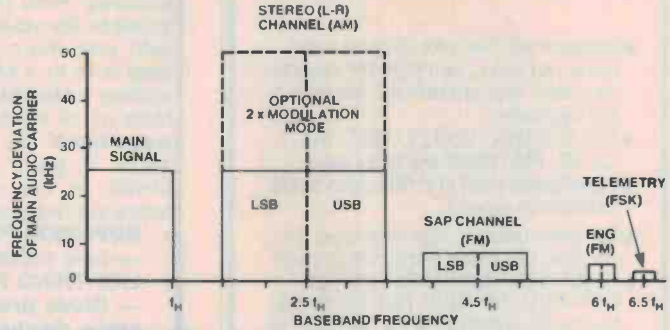

Figure 2. **The Telesonic system.**

When one remembers that the television signal already has a chroma subcarrier, the number of subcarriers required becomes quite large. As the frequency of the ultrasonic subcarrier is increased, the signal-to-noise ratio in that channel becomes smaller. Thus a decoded stereo signal will have a signal-to-noise ratio some 16 to 20 dB lower than that of the monaural left-plus-right signal, whereas the secondary audio signal, where the highest possible fidelity is not so vital, will contribute perhaps 10 dB more noise than the stereo signals. The least critical ENG and telemetry signals will operate at still higher noise levels, but this is acceptable.

The US systems prefer to employ AM for the stereo subcarrier, since this technique appears to provide less distortion than in systems using FM for both the main signal and for the subcarrier. The two systems (Figures 1 and 2) employ different subcarrier frequencies, each claiming specific reasons for the choice of these frequencies.

The Japanese-proposed system for stereo television sound has an audio spectrum similar to that of Figure 3. The control tone at 3.5 f_H indicates whether the subcarrier contains stereo difference signals or whether it contains a second language soundtrack. If desired, the left-minus-right signal could be transmitted on the 2 f_H subcarrier and a further channel could be added on a subcarrier of 5 f_H (for example, for a second language).

Although these systems are, at the moment, only proposals, it seems likely that it will be only a matter of time before television sound becomes available at least in stereo, if not also in multilingual sound, especially with satellite television covering areas such as Europe.

Brian Dance

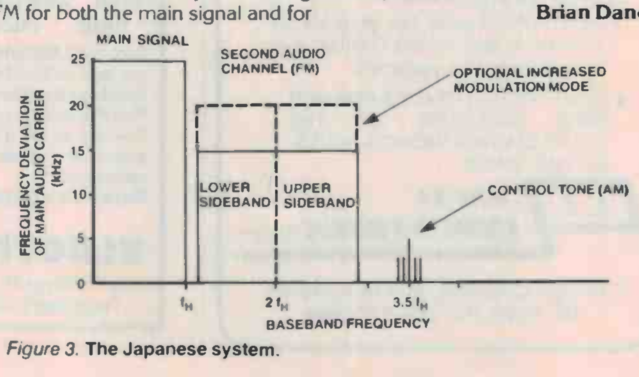

Figure 3. **The Japanese system.**

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Design and specifications subject to change without notice.

New shape for Ortofon

Ortofon's new moving-coil cartridge, the MC200, breaks with in-house tradition with new styling, a new transducer technique and attractive pricing!

The MC200 features a new 'selective', wide range damping system, a boron cantiliver and an asymmetric nude diamond stylus held in a 'fork' at the end of the cantilever.

The transducer employs a newly developed ring magnet (toroid) of samarium cobalt. All this has allowed Ortofon to fit a high performance cartridge in a very slim headshell with a total weight of only 16.5 grams.

A design feature is the ability to plug the MC200 into standard tonearm sockets! The MC200 incorporates overhang and vertical adjustment facilities.

Recommended retail price is \$320. Enquiries to Harmon Australia, LMB 12, North Ryde NSW 2113. (02)887-3233.

16 pounds, and what do you get?

Bob Carver, designer of the 'magnetic field' amplifier, has come up with a 600 W/channel amp that weighs only 16 lb (7.25 kg) and is said to give a super-high headroom for life-like dynamic range.

Dubbed the M1.5, Carver Corporation's blurb claims the new amp employs "... dramatically new Demand Responsive Magnetic Field circuitry ...". It also features a "... unique acceleration stress monitoring and protection circuit which constantly evaluates stress, thermal input and other vital factors to render the loudspeakers immune from amplifier damage."

The Carver M1.5 went on sale in America in March for around US\$800. Convoy International, who have the Carver agency here, will have them in Australia in due course.

Sony's new top tapes

Following a move spearheaded by BASF late last year, Sony have introduced a 'Type II' CrO_2 cassette, dubbed UCX-S, and said to take hi-fi musical recording "a step closer to perfection".

Available in C60 and C90 tapes for \$5 and \$6.70 respectively, the new UCX-S tapes came on sale recently. Sony say they have improved retentivity and the tapes deliver a 3 dB increase in MOL and sensitivity over their previous Type II tapes, at the high frequency end. In addition, Sony say they have improved sensitivity by 1 dB at the low frequency end and MOL by 1.5 dB at that end of the spectrum.

The UCX-S tapes feature cleaning tape leaders and Sony's 'Super Performance' (SP) mechanism, said to prevent uneven winding of the tape.

SIGHTS

Noise reduction developments

All recording enthusiasts are familiar with the well-known Dolby B noise reduction technique, which currently dominates the audio tape cassette market — although it will be replaced by the Dolby C system for an improved performance.

However, these Dolby systems are used only for tape recording and, to a very limited extent, for FM broadcasting, whereas noise improvement is also highly desirable in many other fields.

The Dolby system can be employed only when the signal is processed before the recording or transmission and again during the replaying or reception.

National Semiconductor has developed a Dynamic Noise Reduction (DNR) system using a single chip which, it is claimed, does not require the signal to be processed before recording or transmission and which can be used with all the types of signal shown in Table 1. Natsemi claim it is complementary to the Dolby systems and can actually be employed together with a Dolby system to enhance the noise reduction obtained by the Dolby circuit.

National Semiconductor's DNR system is based on the LM1894 device and is claimed to be the most universal and cost-effective noise reduction technique available. In addition to its use in the domestic market, it will be employed in certain radio receivers designed for incorporation in General Motors' cars.

Many other companies will also be using the DNR system in audio-visual products to be introduced early in 1982.

Market research studies by National Semiconductor indicated that only some 20% of the available audio material had been encoded for special processing, so they consider the demand for the DNR system will be high.

Recently the Columbia Broadcasting System (CBS) has developed an audio compression system for use with disc recordings. This CX noise reduction technique can be used in addition to the DNR and Dolby systems and applies a 2:1 compression to the audio being recorded on discs. Warner, RCA and DiscoVision have agreed with CBS that they will produce disc recordings encoded in this way.

National Semiconductor's LM13700 operational transconductance amplifier is used as the basis of the decoder used with CX recordings, and it is claimed that this system enables an effective signal-to-noise ratio of 80 dB to be obtained on playback.

A substantial growth is expected in the supply of CX encoded discs, but there will be a delay of something like six months to a year before CX compatible equipment becomes readily available in the USA.

National Semiconductor consider that by 1985 the Dolby, DNR and CX will have approximately equal shares of the noise reduction market and that combinations of these systems will develop to cover the wide variety of encoded and non-encoded material that has been in production and which is already present in most libraries.

A single type of noise reduction system will not meet all requirements and with trends towards 'home entertainment centres' combining video and audio, the ability to reproduce a wide variety of material becomes highly desirable. Will everything eventually be replaced by digital systems?

Brian Dance

	Dolby Systems	DNR System	CX System
Audio tape recording	Yes	Yes	No
FM broadcasts	Limited Use	Yes	No
AM broadcasts	No	Yes	No
Video cassette recorders	No	Yes	No
Television (high market)	No	Yes	No
Videodisc	No	Yes	Yes
Disc recording	No	Limited Use	Yes

Table 1. Primary current noise reduction systems

sound

Super-compact stereo microcassette recorder

Joining Sanyo's range of 'personal audio' products is a new sophisticated microcassette recorder, model M-X55.

Features include full stereo record and playback facilities, a two-speed (12 and 24 mm/sec) recording system for extended record and playback use and a built-in one-point stereo condenser microphone.

A control is provided for balance, a switch for 'dictation' or 'conference' in the record mode, and a high/low tone control for playback mode. Input sockets are also conveniently located for external microphone and auxiliary. A set of lightweight stereo headphones is also included.

The unit is powered from two AA batteries and sells at a recommended retail price of $209. For further information contact Mr. W. Fabiszewski, Sanyo Australia Pty Ltd, 225 Miller Street, North Sydney NSW 2060. (02)436-1122

Pioneer tunes in to car sound

Pioneer has emerged as the world's leading manufacturer of car stereo products, according to worldwide sales figures recently released in Tokyo.

The statistics clearly show that Pioneer has steadily drawn away from its nearest competitor over the last two years. Pioneer sold some $A294 million worth of car stereo units in the period from October 1979 to September 1980, nearly $A60 million ahead of its competitor, Clarion.

Pioneer's 23% lead in the first year had increased to 46.3% in the second year, based on a 30.6% increase in growth between the two years under comparison.

The Japanese-based company is confident it will further increase its lead during the current financial year and is predicting rapid growth in sales of car stereo (both regular and components), speakers and accessories.

The dbx dynamic range expansion system: challenge to digital?

Live musical performance can have a dynamic range as great as 90 dB, though 80 dB is probably a more 'usual' figure. The very best discs achieve about 65 to 70 dB, as do the best open reel tape decks, whilst top cassette decks get only 55 dB or so. Hence signal compression is used on recording, followed by expansion on playback. The dbx system of companding claims to be able to achieve 90 dB, a figure being claimed by digital recorder makers — and without companding. Brian Dance explains.

Brian Dance

PERHAPS the most difficult of all the problems one meets in both disc and tape recording systems is that of preventing unwanted noise from appearing in the output. Such noise is, for example, generated by microscopic non-homogeneities in the groove of a disc, while tape hiss arises as each particle of the magnetic material on a tape passes across the replay head gap. The best known noise reduction technique is the Dolby system, but the more recently developed dbx system discussed here operates on different principles. Both have their own advantages.

The dbx system

In equipment using the dbx system, all the incoming signals are compressed by a 2:1 ratio (as measured in dB). For example, if the difference between the loudest and quietest passages to be recorded is 60 dB, the dbx recording circuitry will compress the dynamic range so that there is only 30 dB between the maximum and minimum signal levels.

When the recording is replayed, the circuitry 'restores' the signal to the original 60 dB dynamic range by providing greater amplification for the higher-level signals than for the lower-level signals. Any tape noise will, hopefully, be at a level below that of the smallest signal and will thus be amplified very little. This is illustrated in Figure 1.

In the case of disc recordings, the disc must have been recorded using a dbx compression circuit, in which case it can be replayed with no appreciable playback hiss. Ordinary recorded discs cannot benefit from dbx.

Unlike the Dolby system, the dbx system operates at all frequencies with a compression and subsequent expansion dependent only on the signal level. (Obviously this is a simplification, since there will be certain 'attack' and 'decay' times during which the gain change takes place.)

Dynamic range

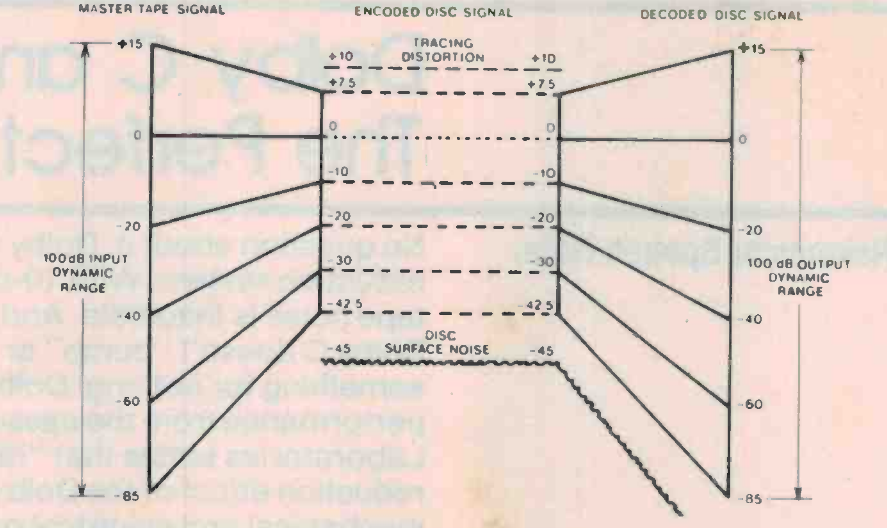
A good human ear can perceive sound levels from the threshold of audibility (0 dB) up to a level of the order of 120 dB, which produces severe discomfort or even pain. Occasional transient peak levels of 120 dB occur during live musical performances. However, the background noise level due to movements of the audience, etc, can reach levels of 30 dB (Figure 2) or even more. Thus the dynamic range which a perfect system should be able to handle should not be less than some 80 dB, although some experts regard 90 dB as being a more desirable figure.

When one is recording music on either a magnetic tape or on a disc, the signal must be suitably compressed so that the loudest passages do not overload the equipment and thus cause distortion, yet the quiet passages must be well above the level of the tape hiss or record noise. The maximum dynamic range which can be accommodated on a vinyl recording disc is normally about 55 dB, although 65 dB to 70 dB is said to be obtainable from the very best pressings. Clearly this is well below the desirable dynamic range.

Similarly, the dynamic ranges of professional studio tape recorders are limited to around 60 dB to 70 dB or so for the open reel models, while that of a good cassette recorder may be only about 55 dB (weighted, sans noise reduction figures).

If circuitry is not employed to increase the dynamic range of the recorded signal where necessary, the music as reproduced from the disc or tape sounds uninterestingly flat, and the contrast between the loud and quiet instruments is considerably blurred. Thus the excitement and realism of the performance is largely lost.

The dbx system can compress the signal for the recording process and expand it again so that a dynamic range of the order of 90 dB can be obtained. The noise from the dbx system is claimed to be appreciably below the ambient room noise, as shown in Figure 3.



Signal compression and expansion during the encoding and decoding stages for dbx discs.

Comparison with Dolby

One of the advantages of the dbx system over the various Dolby systems is that the expansion is provided uniformly over the whole frequency range and therefore one does not need to carry out the adjustment procedures which are required for setting up a Dolby circuit. A badly adjusted Dolby circuit can produce an appreciably inferior performance.

Although Dolby does its work well at high frequencies, where the hiss is generally the most obtrusive noise, the dbx equipment will also reduce any low frequency noise such as mains hum or turntable rumble that may be added to the signal by the circuitry.

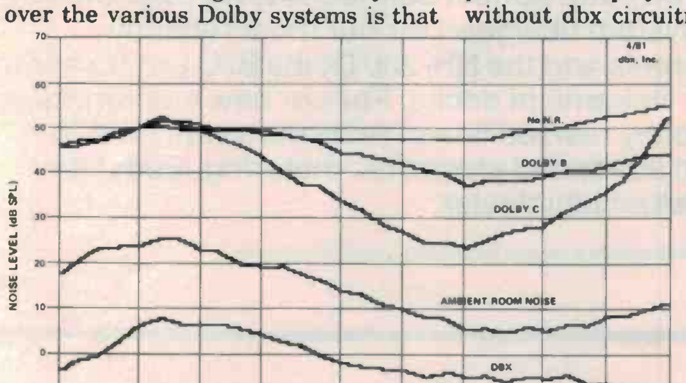
Figure 3 indicates that the noise reduction obtainable using the dbx tape system is, at least in theory, somewhat better than that provided by a Dolby system. In practice the dynamic range obtainable is greater than that with Dolby B, but it may not be quite so high as the values suggested in the graphs of Figure 3 owing to the need to prevent any possible tape or disc overloading in certain frequency regions.

Any tape recorded for playback through dbx equipment will sound quite peculiar if replayed through a recorder without dbx circuitry; so will any dbx disc. On the other hand a dbx-encoded tape replayed through a Dolby B circuit will provide a reasonable signal if one reduces the treble response somewhat.

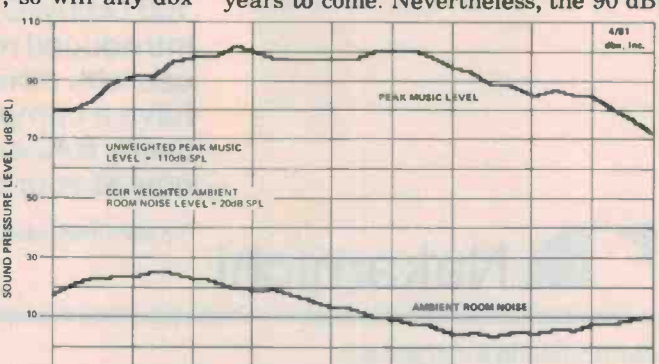
Although the number of dbx discs is greatly increasing at the present time, it may be some time before the selection is considered reasonably adequate by most potential users. At present the number of pre-recorded Dolby tapes available is much greater, giving Dolby an advantage there.

Performance

It is quite uncanny to place the tonearm over a dbx disc and start playing it, since one hears virtually nothing until the first notes of the music are reached! 'Digital' dbx discs provide even quiter backgrounds, since the hiss from the master tape, together with its saturation distortion, wow and flutter, are claimed to be eliminated. However, any digital tape equipment likely to be available in the foreseeable future may be quite expensive, whilst the usual problem of lack of standards in digital equipment is likely to cause considerable difficulties, perhaps for some years to come. Nevertheless, the 90 dB ▶



Noise from biased chromium dioxide cassette tape compared with typical ambient room noise. One-third octave analysis. Tape noise level referred to 200 nWb/m = 110 dB SPL.



Peak music and ambient noise levels measured in typical living room environments. One-third octave analysis.

approximate dynamic range of the current dbx discs enables them to achieve a very impressive performance.

Equipment

For home recording, the series II equipment manufactured by dbx Inc, Chapel St, Newton, Massachusetts 02195, USA, includes a Model 224 (with monitoring facility) and a Model 222 (without a monitoring facility). When used as an addition to one's existng equipment, they claim to provide an 85 dB range on open reel recorders and an 80 dB range even with cassette recorders. This includes a noise reduction of some 30 dB across the entire audio range together with an extra 10 dB 'headroom' at the upper level of the dynamic response.

The peak signal to the weighted background noise ratio is quoted as some 110 dB. The frequency response is quoted flat to within ±0.5 dB over the range 40 Hz to 20 kHz and about −1 dB at 30 Hz. Total harmonic distortion is quoted as being less than 0.5% from 30 Hz to 100 Hz and less that 0.1% from 100 Hz to 20 kHz, while intermodulation distortion is less than 0.2%.

The Model 222 and 224 units incorporate circuitry for the recording and the replaying of tapes and for playback of discs. However, a smaller Model 21 unit is available for the playback of dbx discs and of dbx-encoded pre-recorded tapes when the latter become available. The performance of this Model 21 unit, which cannot be used for recording tapes, is fairly similar to that of the 222 and 224 equipment, but the frequency response is quoted as being matched to the decoding curve to within ±0.5 dB between 30 Hz and 15 kHz, and the total harmonic distortion is given as being less than 0.2% at 1 kHz at up to 4 V RMS output.

The units mentioned are the domestic Series II units, but a Type I series is available for professional use where tape speeds are generally higher; it is not compatible with the Series II units, owing to minor signal processing differences.

When using dbx equipment, one often tends to turn up the volume before the start of the programme simply because one expects to hear some background hiss or noise and may even wonder if the system is working! However, this problem is soon overcome after the equipment has been used for some time. The dbx system can be very demanding on programme material; for example, wideband noise in the presence of high-level programme signals will be considerably amplified, but the programme material will usually mask the noise.

The dbx Model 21 decoder shown with a range of the currently available dbx-encoded discs.

Expanders

The dbx company also produces a range of volume expanding equipment. Most records, tapes and radio programmes have their dynamic range compressed somewhat, and the expanders have been designed with the object of restoring the original wider dynamic range. They can be set to provide any dynamic range expansion from 1:1 (no expansion) up to 1:1.5 measured on the dB scale; the latter is usually far too great and 1:1.2 to 1:1.3 is normally as much as is needed for any programme material.

There are currently three of these expanders available. The simplest is the 1BX, which treats the whole of the audio frequency band together. The next unit in the range is the 2BX, in which the bass and treble are treated separately by splitting the audio frequency band into two parts. The most expensive unit is the 3BX, in which the audio frequencies are divided into three parts, each of which is separately processed. The advantage of splitting the frequencies for separate processing is that a high-level signal in one part of the frequency band will not cause a lower-level signal in another part of the band to be affected. (See also our review of the 3BX, Sept. '80 ETI.)

By making loud passages louder relative to quiet passages, it is claimed that these expanders restore much of the realism of recorded or broadcast music and make it more like what one hears in a live performance. In each unit the frequency response is claimed to be flat to within ±0.5 dB from 20 Hz to 20 kHz at the 1:1 setting, total harmonic distortion typically 0.1% under the same conditions and intermodulation distortion 0.15% typical.

A further unit, the dbx 118, provides continuously variable expansion from 1:1 to 1:2 and continuously variable compression from 1:1 to infinity. The compression mode is said to be useful when making tapes for playback in moving vehicles, where the ambient noise may be too high for the quieter passages to be heard without volume compression. A peak limiter is also incorporated in the unit.

Equaliser

The dbx 20/20 unit combines a microprocessor-controlled ten-band graphic equaliser, real-time analyser, pink noise generator, sound pressure level meter, and includes a calibrated microphone; it is designed to automatically adjust for the effects of furniture, drapings and other factors which alter the acoustics of the listening room. When the microphone is placed in the desired position for listening, the precise equalisation characteristic is computed within 15 seconds. This characteristic can then be stored for later use at the touch of a memory button. The best average characteristic can also be computed for a number of listening positions.

Bargraph LED readouts are provided on all ten bands in this instrument.

Conclusion

The dbx equipment can certainly provide some rather amazing dynamic range expansion and noise reducing effects, but like all such equipment, it must be used intelligently. ●

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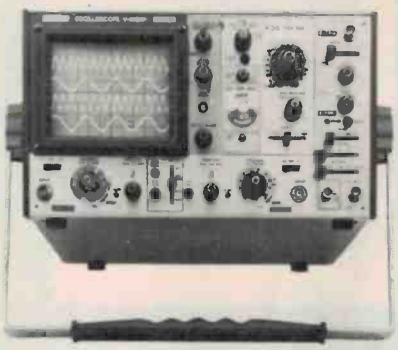

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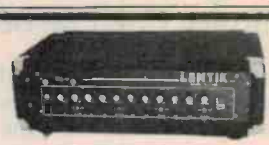

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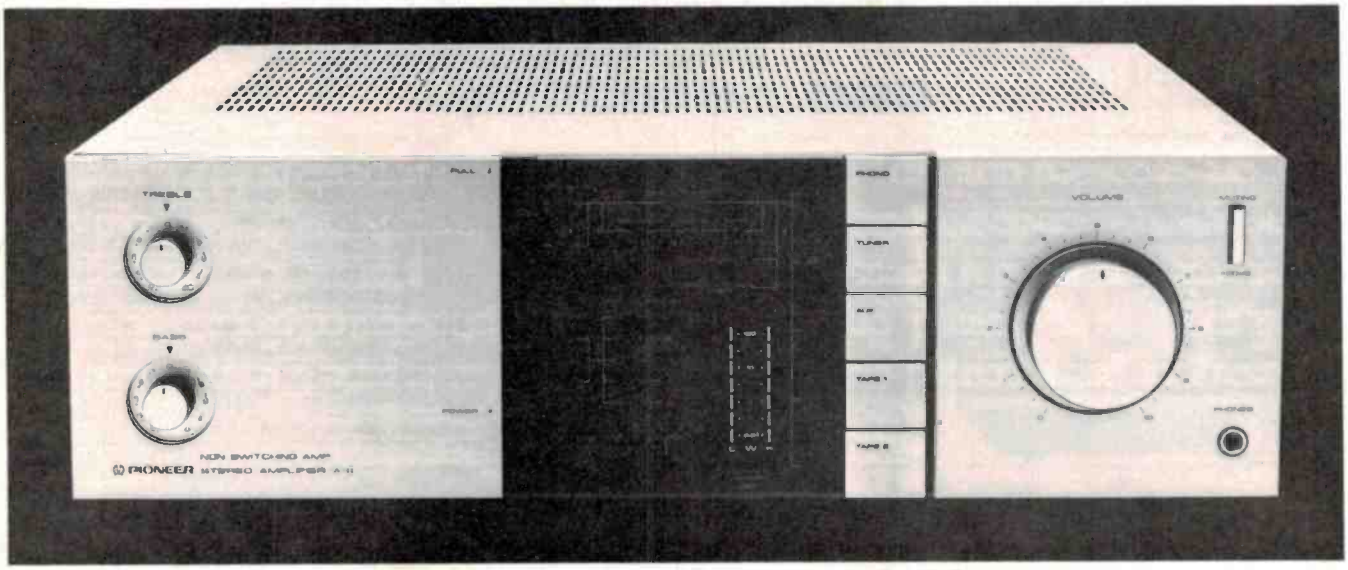


Pioneer A-8 amplifier

Words like 'superlative . . . exemplary' don't come often from Louis Challis, but after reviewing the Pioneer A-8 amp he was using them quite a few times. Can't be bad!

Louis Challis

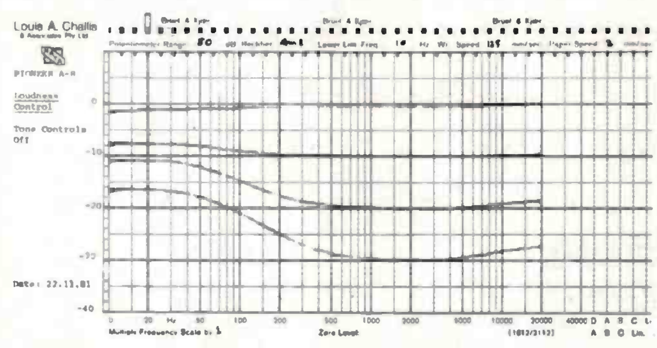
IT IS A LITTLE more than 25 years ago that two of my friends purchased their first Japanese receiver and main amplifier. Both were manufactured by Pioneer and were purchased because of the reputation they had already earned for both price and performance. In the intervening period I have purchased Pioneer equipment and at least one Pioneer amplifier is still providing sterling service in my office. Pioneer have recently acquired a number of other firms, like Phase Linear in America, and have released a number of new and unquestionably exciting pieces of equipment.

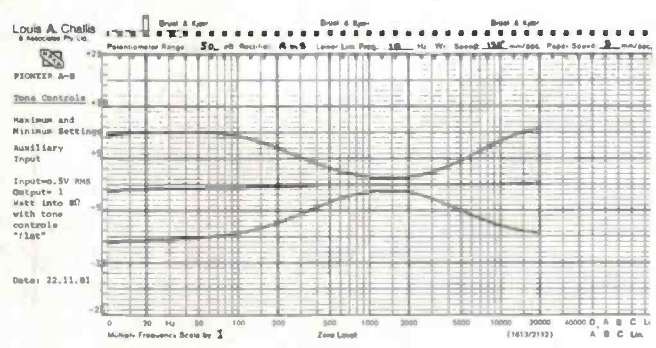
The A-8 amplifier and its bigger brother the A-9 (which is not reviewed here) are the new top-of-the-line amplifiers from Pioneer. They provide a radical departure in both appearance and ergonomic design from their predecessors, and the A-8 amplifier also incorporates a number of technical features which come unheralded in this country. The most important of these features is the development of the 'non-switching amplifier' which is a new form of dynamic bias to minimise crossover distortion. Crossover distortion in transistorised amplifiers has constituted the major source of complaints that transistorised amplifiers "will never sound as good as the best valve amplifiers did, or could."

The A-8 amplifier competes with an extremely large number of other amps, all of which also claim to have a wide array of new features. The difference is that this amplifier 'delivers the goods'.

Features

The visual impact of the front panel is bold and striking. The right hand third of the panel contains a very large volume control, which is centrally





positioned. The only other controls on that section of panel are a 20 dB muting switch, located above and to the right and a headphone socket immediately to the right and below. To the left and separating this panel from the middle panel are a vertical array of rectangular push-buttons for the selection of phono, tuner, auxiliary, tape 1 or tape 2, in the primary input signal path.

The central panel incorporates a series of rear-illuminated block schematics of the sections connected or switched on, called by Pioneer a 'pictograph'. These are really miniature mimic diagrams with yellow, green and red illumination which tell you which speaker system has been chosen, whether the tone controls are switched in or out, if the loudness or subsonic filter have been activated as well as which of the five possible input signals is being fed to either of your two possible tape recorders. The lights also provide warning as to whether your muting or protection circuits are operating. The power circuit protection indicator conveniently changes from the normal green to red on the operation of the protection circuitry, when either an overload or short circuit is applied to the output speaker leads.

This panel also incorporates a small LED peak power display, with settings ranging between one milliwatt and 100 watts to indicate the power of each channel output into 8 ohms. With only seven LEDs in a vertical array these can only provide indication in rather large 10 dB steps. The step from one milliwatt to 0.3 watts may be regarded as rather big, but this should not really be a problem when you are listening to real music.

Whilst at first sight the left hand end of the panel consists of just two controls for treble and bass recessed into a panel, on closer examination the panel is found to hinge down. Behind it, like the proverbial Pandora's Box, are a whole host of other controls. These include the channel controls for balance, and a selector for copying from tape 1 to tape 2 or tape 2 to tape 1, as well as from other possible sources.

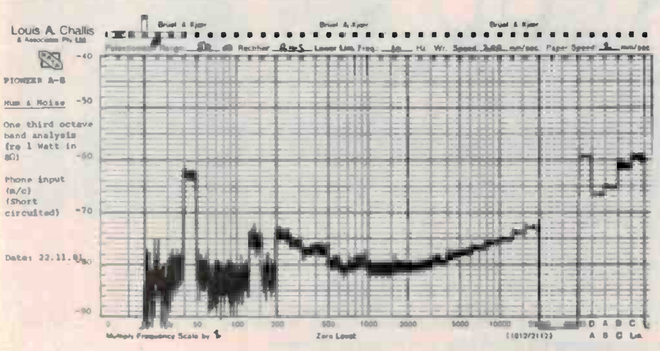
The switches include a tone control defeat button, described as a 'straight line', a selector for moving magnet or moving coil cartridges, two switches for adjusting the loading on the moving coil to provide impedances of 100 ohms and 33 ohms respectively, and two capacitor loadings for the moving magnet of 200 pF or 400 pF. This last switch takes into account the expected 100 to 200 pF capacitance of the record player leads. Other switches include a stereo/mono switch, a loudness switch, a subsonic filter switch and two small buttons for selecting A and/or B speaker systems. The treble and bass controls each have detents with five positive and negative steps, which provide a total ±10 dB of boost or cut at 50 Hz and 20 kHz.

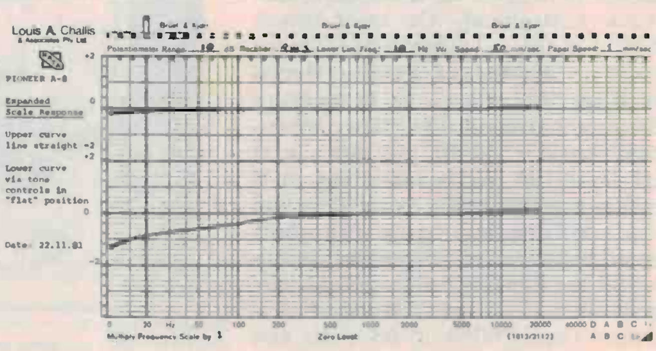
The amplifier's top cover is fabricated from steel and incorporates a very large area of perforated slots to ensure adequate ventilation, whilst the bottom is also very well perforated. The back of the cabinet features only one pair of sockets for phono, as well as the normal tuner, auxiliary, and four sockets for each of the tape recorders. Eight unusual but very effective colour-coded universal terminals are provided for speaker connection. A large decal, however, warns that with either A or B system in use the impedance should be 6 ohms to 16 ohms per speaker, while with A plus B systems each speaker should have 12-32 ohms impedance. You therefore cannot use 2 x 8 ohms speaker systems. The terminals are better designed than the normal 'universal' terminals intended to take banana leads, for they also incorporate a sensible shrouded base so that the bare wires will not be likely to short to the metal chassis immediately adjacent.

Inside

The inside of the amplifier will be more impressive to engineers and the technically minded than it will be to the average hi-fi buff, and typifies the extent to which consumer electronics has developed, displaying innovation in both design and construction. The highlight of this innovation is not visible with the naked eye as it is embodied in the variable bias system developed by Pioneer. This is a high-speed feedback circuit which continuously monitors the amplitude of the incoming signals and automatically elevates or lowers the bias current fed to the output transistors.

The transistors are never allowed to be completely cut off, so in theory there is no switching distortion, which plagues other amplifiers almost irrespective of type. The output power transistors used in this circuit are very large rectangular monolithic modules, each of which is mounted below one of the newly developed multi-finned heatsinks. The efficiency and heat dissipation of these cleverly designed units is obviously an order of magnitude better than previous types of heatsink, with which we have all been familiar. Each of the heatsinks also incorporates a thermal feedback ▶





element screwed in at the top to detect overload or runaway conditions.

The layout is conventional yet very sensible. On one side of the rear is a very large, exceedingly well-shielded power transformer, which is fully encapsulated and features a copper shorting strap to reduce the stray leakage flux. Behind this is the power supply module, with protection fuses and both high and low-level voltage regulators. On the right hand side connected to the rear panel are the preamplifier circuits, which are directly connected by very short leads to the input terminals for each of the inputs. These circuits are then connected by means of ribbon cable to the adjacent card, which is similarly connected to tape recorder inputs and outputs. This card and its board-mounted changeover switches are controlled by means of a Bowden cable from the front panel.

The switching circuit and the amplifier's protection circuit are located at the rear. In the front the power amplifier printed circuit is mounted on its side. Behind the front panels are the similarly mounted vertical printed circuits for the tone control feedback assembly, the volume control assembly, and the moving coil and moving magnet equaliser assemblies. The display module printed circuits are connected to a motherboard with plug-in sockets, whilst the switching and logic card incorporates unusual printed circuit-mounted slide switches.

Apart from the obvious use of consumer electronic components, this amplifier looks more like a professional piece of test equipment than a piece of consumer electronics.

Measurement

Four times during the last six years, in advance of the impending release of amplifiers with what have been described as 'state of the art' improvements, we have been forced to select new equipment to allow us to measure distortion. Fortuitously the most recent time was at the end of last year when we decided to design and build a special new filter that allows us to measure individual harmonic distortion components down to −120 dB, (i.e: down to at least 0.0001%). As it turns out, that decision was fortunate, as we have had at least two amplifiers since then which warranted this improvement in capability, and the Pioneer A-8 is one of them. Pioneer only claim that the distortion is no more than 0.005% at 98 watts and that the continuous power rating for two channels driven is 90 watts.

We performed our distortion measurements at 90 watts and found that the Pioneer publicity personnel are rather modest. At 100 Hz we measured 0.0038%, at 1 kHz 0.0018% and at 6.3 kHz 0.0013%. At the 1 W level these figures were only slightly higher, being 0.008% at 100 Hz, 0.0036% at 1 kHz and 0.006% at 6.3 kHz. Any improvements in performance beyond this point would be, in my opinion, of purely academic interest. The transient intermodulation distortion is also extremely low, being way below 0.1%.

The sensitivity of the phono inputs for one watt output are 300 microvolts for moving magnet and 41 microvolts for moving coil, which are excellent figures. Equally important, the overload characteristics of these two inputs are 220 millivolts for the moving magnet and 35 millivolts for the moving coil input. This means that you have a very wide margin left in hand before you approach the overload limits on either type of cartridge. *Both of these sets of figures are significantly better than claimed in the handbook.* The output impedance of each of the two main amplifiers is 75 milliohms, which is a particularly low figure and obviously would benefit greatly from very low impedance cables to follow.

The dynamic headroom of the amplifier is 1.3 dB relative to the 90 watts power rating, so the manufacturer's rating is realistic and not overstated. The signal-to-noise ratios with the volume set for one watt output are −73 dB unweighted and −79 dB A-weighted for the auxiliary, −79 dB(A) for the moving magnet input and −66.5 dB(A) for the moving coil input. Some of these figures are slightly lower than quoted by the manufacturer, but overall are still good.

The transient overload recovery test performed in accordance with IHF-A-202 shows that the amplifier has *impeccable* recovery performance. It recovers within the first quarter cycle from an overload without any trace of jitter or instability. The excellent linearity of the frequency response shows up particularly well in the expanded scale response (level recording 8). There is no real droop in the 10 Hz to 20 kHz range and it can be seen to be impeccably flat, within 0.2 dB at 10 Hz and within 0.1 dB at 20 kHz with the tone controls defeated. It is still ▶

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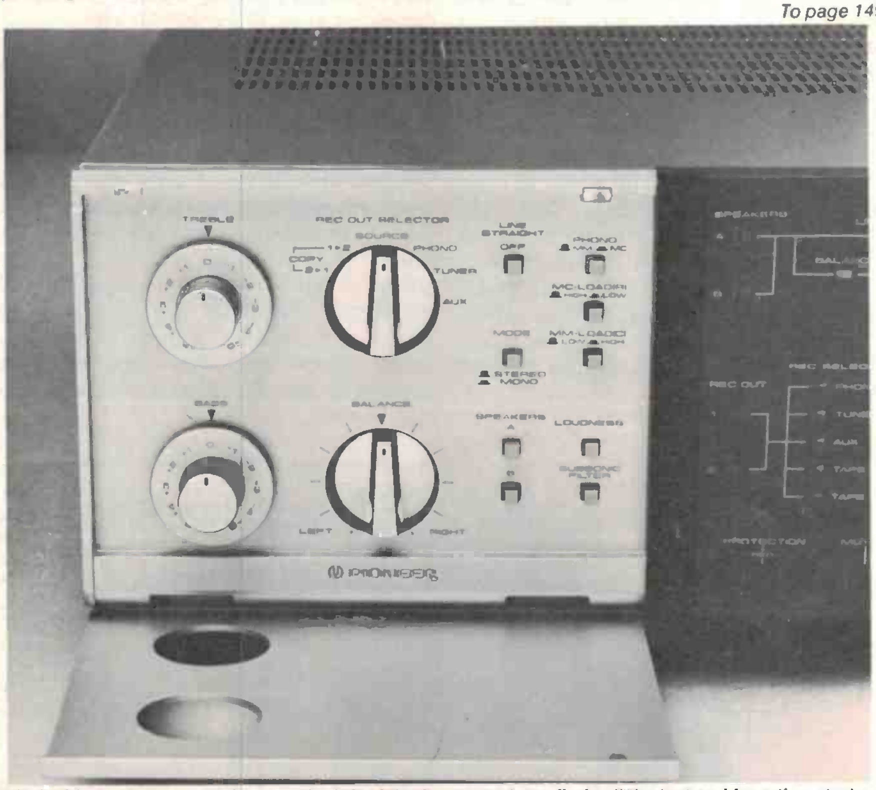


Behind a hinge-down escutcheon at the left of the front panel one finds all the 'set and forget' controls. Only the treble and bass are accessible through holes in this escutcheon.

MODEL PETERSON SIX STUDIO MONITOR

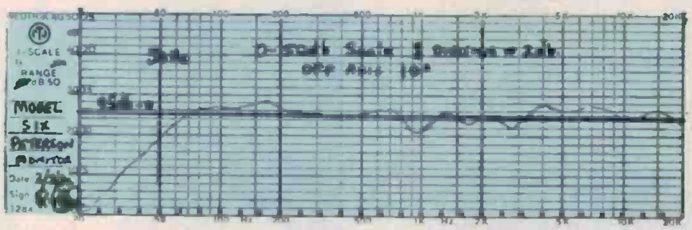
GENERAL DESCRIPTION:

The model six 'Studio Monitor' is probably one of the best 'value for money' monitors available in Australia today. In comparing other speakers to this unit subjectively, not only did we have to use imports at twice the price to compare but, surprisingly, found in many instances it out-performed units three times the price.

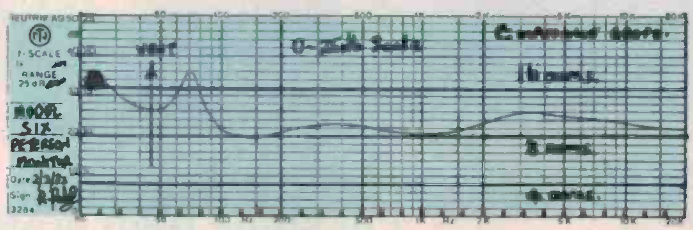
CABINET MATCHING:

790 (79) de luxe or standard.
SOUND PRESSURE LEVEL: 1 watt, 1 meter. 95 db
SHIPPING: 1 speaker per carton. (Matched pairs.)

	IN CARTON	OUT OF CARTON
WEIGHT	29.5 kg	28.00 kg
DIMENSIONS: Height	860mm	790mm
Width	465mm	395mm
Depth	480mm	430mm



FREQUENCY GRAPH: CALIBRATED. 0-50 db Scale



IMPEDANCE GRAPH (Z) CALIBRATED. 0-25 db Scale

SPECIFICATIONS:
TYPE: Tuned reflex dual ports
SYSTEM: 30cm (12") 3 way (8 ohm)
MAXIMUM RATING: 120 watts R.M.S.
MINIMUM PREF. DRIVE: 15 watts R.M.S.
DRIVER SIZE: 30cm (12")
CAPACITY: 76 litre
BAFFLE: 19mm braced
COLOURS AVAIL.: Royal Grove Walnut
ATTENUATION: Dual variable ± 6 db
CROSSOVER TYPE: 3rd generation
CROSSOVER *frequ.* 400 Hz and 5kHz
MIDRANGE ROLLDOWN: 6db
MIDRANGE ROLLOFF: 6db
DRIVER ROLLOFF: 6db
TWEETER ROLLDOWN: 18db
TWEETER ROLLOFF: N/A
FREQUENCY RANGE: 20 Hz to 20 kHz
EFFECTIVE RANGE: 40 Hz to 20 kHz

All graphs are live environmental.
All S.P.L. levels are calculated from a pink noise source. 1 watt, 1 meter.
(This is, we feel, a more accurate indication of musical listening levels, than random spot frequency methods.)

PETERSON SPEAKER LABORATORIES P/L

Peterson

VICTORIA: Clive Peters, all stores; Frankston Sound; Brash's, all stores; Reliance Hi-Fi, Footscray; Mildura Audio, Mildura; Gleeson and Tonta, Dandenong; Maryvale Electronics, Morwell; John Thomas, Ballarat; Roy Vincents Audio, Echuca; Denman Audio, St. Kilda; Sounds Alive, Shepparton. NEW SOUTH WALES: Orange Audio, Orange, Car Radio & Hi-Fi, Wagga Wagga; The Record Centre, Griffith; Brian Bambach, Newcastle; Kent Hi-Fi, Canberra; Nitronics, Coffs Harbour. WESTERN AUSTRALIA: High-Fidelity Stereo, Perth. QUEENSLAND: Queensland Entertainment Co. P/L, Eight Mile Plains; Downtown Hi-Fi, 64 Charlotte St., Brisbane. SOUTH AUSTRALIA: Track Hi-Fi, City; Ern Smith, Norwood; Astra Hi-Fi, Woodville South; O'Connells, Country.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M-G10 Compact Personal Tape Player – □ normal and metal tape facility □ Hi-Lo tone switch □ lightweight headphones □ convenient thumbwheel volume control □ Auto-Stop tape system □ cue and review □ carry case with shoulder strap.
STEREO
METAL TAPE
SANYO
SANYO


whenever you want it!
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Clean, compact styling and every feature you need for your listening pleasure – All this, plus the rugged reliability you expect from Sanyo – one of the world's most respected brands in audio equipment.
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STEREO
SANYO

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within 1.4 dB at 10 Hz and within 0.15 dB at 20 kHz with the tone controls switched on and centred. This amplifier achieves its frequency linearity primarily as a result of the lack of coupling capacitors between the various stages from front end to output. The result is an amplifier with superlative transient performance, which is enhanced by particularly low distortion characteristics.

The subsonic filter features the same lazy roll-off that we have complained about recently with other amplifiers. It is a shame Pioneer have not made that attenuation steeper, providing a sharp roll-off either at or below 10 Hz to control wow from records and low frequency transients that can so easily destroy your speakers.

The crosstalk characteristics drop from a figure of 55 dB at 1 kHz to 31 dB at 20 kHz. This drooping characteristic is not perfect but is quite acceptable. The tone control circuits provide modest but acceptable characteristics in terms of cut and boost, whilst the loudness control provides an excellent approximation of the Fletcher-Munsen curve over the mid-band to low frequency region. The RIAA linearity lies within 0.3 dB right across the range, and the majority of the manufacturer's important performance figures were confirmed or found to be very close to the stated figures.

At home

I kept the amplifier at home for a little longer than I normally do, because it offered so many useful features. The one I liked best was the 'pictograph system' or what I would prefer to call a 'mimic diagram'. This makes it easy to see what you are doing, and more directly than the majority of other indication systems currently being offered to the consumer.

Ignoring the frills, however, the A-8 has one major virtue — the *quality of the sound it can produce*. Its lack of non-linear harmonic distortion and its complete lack of colouration make it an attractive option when selecting an amplifier with 80-120 watt-plus capability. In use, driving either a set of B&W 801s or a set of Fisher ST 550 speakers, it is quite happy pushing out 100 watts of peak signal almost continuously. Moreover, its performance is equally good at very low signal levels, where the quality is exemplary. In use with a set of Pioneer electrostatic headphones *the quality of sound at low levels is superlative*, and so this is an amplifier 'for all seasons'. At a recommended retail price of $769 this is one amplifier whose technical performance would be very hard to beat. ●

PIONEER A-8 STEREO AMPLIFIER

Dimensions:	*Width: 420 mm; height: 132 mm; depth: 423 mm.*
Weight:	*13.8 kg*
Price:	*$769*
Manufactured:	*In Japan by Pioneer Electronics Corporation*
Distributor:	*Pioneer Electronics Australia, 178 Boundary Rd, Braeside Vic. 3195.*

MEASURED PERFORMANCE OF PIONEER A-8

S.N. 95008025

FREQUENCY RESPONSE:

(-3dB re 1 Watt, 0.5V Input to Aux)

	Tone Controls Defeated
Left	<3Hz to 117kHz
Right	<3Hz to 117kHz

	Tone Controls Centred
Left	5Hz to 65kHz
Right	4.4Hz to 76kHz

SENSITIVITY: (for 1 Watt in 8Ω)

	Left	Right
AUX	15mV	15mV
TUNER	15mV	15mV
TAPE	15mV	15mV
PHONO 1	300 uV	300 uV
PHONO 2	41 uV	41 uV
OVERLOAD M/M	220 mV	220 mV
OVERLOAD M/M	35 mV	35 mV

INPUT IMPEDANCE:

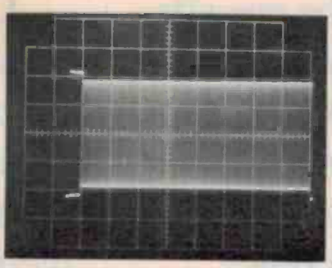
	Left	Right
AUX	47 kΩ	47 kΩ
TUNER	47 kΩ	47 kΩ
TAPE	47 kΩ	47 kΩ
PHONO M/M	47 kΩ	47 kΩ
PHONO M/C	100 Ω	100 Ω

OUTPUT IMPEDANCE: 75 milliohms @ 1kHz.

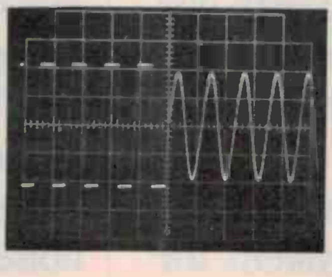
TRANSIENT OVERLOAD RECOVERY TEST

(IHF-A-202)

1mS/div.



50mS/div.



10dB overload re rated power into 8 Ω- both channels driven.

Overload duration: 20mS; Repetition rate: 512mS.

MEASURED PERFORMANCE OF PIONEER A-8

HARMONIC DISTORTION:

(A) (At Rated power of 90 Watts into 8 = 26.8 Volts)

	100Hz	1kHz	6.3kHz
2nd	-89.6	-95.1	-99.9dB
3rd	-95.9	-107.0	-106.5dB
4th	-101.4	-119.0	-103.1dB
5th	-	-	-dB
THD.	.0038	.0018	.0013%

(B) (At 1 Watt into 8)

	100Hz	1kHz	6.3kHz
2nd	-83.4	-89.1	-83.6dB
3rd	-88.9	-101.0	-92.0dB
4th	-97.0	-117.0	-97.0dB
5th	-113.5	-	-dB
THD	.008	.0036	.006%

TRANSIENT INTERMODULATION DISTORTION: Very low, less than 0.1%

(3.15kHz square wave and 15kHz sine wave mixed 4:1)

NOISE & HUM LEVELS:

re 1 Watt into 8) AUX -73dB (Lin) -79dB(A)

(with volume control set for 1 Watt output with. PHONO M/C -59.5dB(Lin) -66.5dB(A)

PHONO M/M -73dB (Lin) -79db(A)

0.5V input (Aux)
5mV input (Phono M/M)
0.5mV input (Phono M/C)

MAXIMUM OUTPUT POWER AT CLIPPING POINT:

(IHF-A-202)
(20mS burst repeated at 500mS intervals)

88 V P-P

= 121 Watts

Dynamic Headroom = 1.3 dB (re 90 Watts)

Why Technics their dbx

You can't fit a quart in a pint pot. Dynamic range is what brings music truly 'alive'. It's the difference in sound level between the proverbial 'drop of a pin' and the cannons' roar in a digital recording of the 1812. This difference represents more than 100 decibels of dynamic range – a figure regularly exceeded by a full orchestra or live rock band in full flight.

However, even with modern tape formulations, this full dynamic range cannot be captured on a cassette recording due to the inherent limitations of the tape itself. The quietest passages become submerged in tape hiss, whilst the louder parts suffer distortion through tape saturation. Clearly, the capabilities of the cassette tape have been stretched to their limits. How, then, can further performance increases be achieved?

Technics proves 2 into 1 does go! The new generation of Technics cassette decks are equipped with dbx encoding/decoding equipment — a system already well established in professional recording studios.

When a recording is made through the Technics dbx system, the input signal is compressed (encoded) to half its 'sound level', electronically,

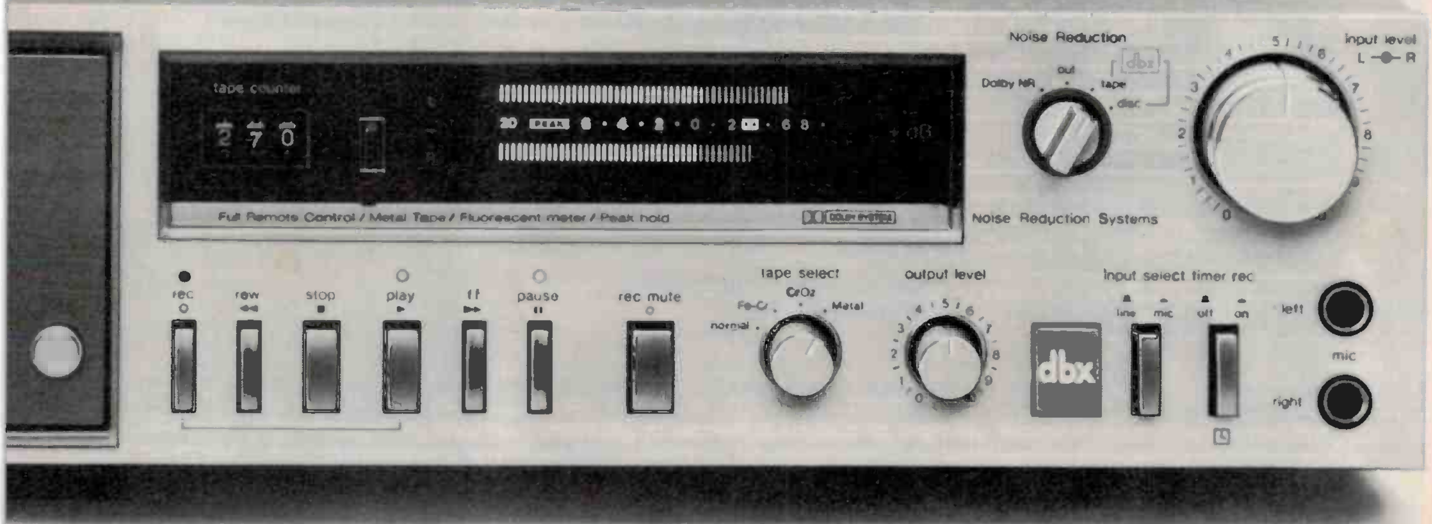
so a performance with a wide dynamic range can be stored within the narrower dynamic capabilities of a cassette.

On playback, a 'mirror image' expansion (decoding) takes place and the original full dynamic range is released. The results are dramatic. Simply compare the performance of a Technics dbx deck with an ordinary machine and the difference will stagger you.

And, as an interesting by-product of the process, your recordings will benefit from around 30 decibels of noise reduction, too.

With Technics, you're ready for dbx recordings, too. In hi-fi terms,

have developed cassette decks.



the quality of pre-recorded cassettes has left much to be desired. But when dbx recorded material is released in Australia, you'll notice a big difference. Play a pre-recorded dbx tape through your Technics dbx cassette deck and you may well think you're listening to a good quality disc.

And whilst on the subject of discs, there are dbx albums being made, too. Naturally, Technics have taken this into consideration. And you'll find a DISC position on the dbx selector, so you can play dbx-encoded albums through your existing system.

Technics RS-M270X dbx cassette deck. A typically advanced Technics component that combines stable, reliable tape transport with highly sophisticated electronics. Direct drive motors for both capstan and reel drive; IC logic solenoid controls; 2- colour, peak-hold FL meters; 20–20,000 hz frequency response with metal tape; 110 dbs dynamic range.

Let Technics expand your music experience to new horizons.

Listen to a Technics dbx cassette deck and hear the amazing difference for yourself.

Of course, all Technics components carry a two-year warranty.

Technics

Expanding the music experience.

Dailey/NPA126

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Few palates could tell that McWilliam's Chablis didn't come from this small French village.

This little village in Burgundy has been making an attractive dry white wine for quite a while now. The wine has long been called after the name of the village... Chablis.

They make it primarily from the Chardonnay grape, so do we. Their soil is ideal for Chardonnay, so is ours. Their wine has a delicate bouquet, pleasing fruit on the palate with a clean, crisp, dry finish, and so has ours.

Their prices are astonishingly high, McWilliam's prices are astonishingly affordable... vive la Australie! **McWILLIAM'S**

'URBAN LEGENDS' are the stuff from which many jokes originate. You know — like the one about the cuckolded husband who drove a truck for a certain cement crowd who filled his wife's lover's expensive Mercedes sports car with cement!

Well, Dregs is about to create (or is it resurrect?) another urban legend — albeit an electronic one (after all, this is ETI, isn't it?)

Barry Wilkinson, who was ETI's famed project engineer in 'the early days', now owns Nebula Electronics, which specialises in one-off design and small production runs of electronic equipment. Barry's work lately has become more and more involved with microcomputers — even micro-microcomputers (i.e: small enough to fit in your pocket!). Yes folks, he's right into the micro revolution — no more rack cabinets, or even big boxes — if it doesn't fit in your hand or your pocket, he's not interested. So successful has this new line of work been for Barry that he's seriously considering moving into smaller premises!

Toots, mon!

True or not, the Scots are universally renowned for their pennypin . . . er, thriftyness, so what better place to pilot a new electronic 'debit card' scheme than Scotland?

To be launched in Aberdeen, the scheme will allow motorists to buy petrol and have the cost debited directly from their account at the point of sale. All they need do is proffer a card, similar to the 'Handybank' or 'Autobank' cards, instead of cash or a credit card — no waiting for change, vouchers, etc. (Save time, not money?) BP Oil and the Clydesdale Bank have teamed up to pilot the scheme, no doubt thinking that if they can get it working on the world's 'toughest' customers, the rest of the world will be a pushover!

Guid luck tae ye, laddies!